

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK OF TECHNOGENIC NATURE – AN ELEMENT OF THE ENVIRONMENTAL POLLUTION LIABILITY INSURANCE OF THE INDUSTRIAL ENTERPRISES

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Abstract: The article deals with the issues of insuring the environmental pollution risk in economic enterprises. In addition, the research outlines the structure of the environment with reference to the operations of enterprises with hazardous waste production; it also analyses the elements of the environment and the risk factors, which determine the risk situations in the industrial enterprises. Finally, the article discusses the primary role of environmental pollution liability insurance within the concept of risk management in the industrial enterprises.

Key words: environmental pollution liability insurance, corporate environmental responsibility, technogenic risk, environment, risk management.

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Introduction

Over the last decade, there have been profound qualitative changes in both the organisation and management of the natural resources use and in the protection of the natural environment throughout the world. New normative requirements and legal acts have been applied to regulate the operations of the enterprises with hazardous waste production. New promising research findings on the issues of ecological management of the industrial enterprises have been published in the specialized literature. The requirements to the process of risk management and the organisation of insurance coverage of enterprises have become more stringent. With reference to this, the **purpose** of the article is to raise and discuss the following important *issues*:

First, to analyse the risk factors which determine the risk situation in the enterprises with hazardous waste production;

Second, to outline the relationship between the elements of the natural environment in which the industrial enterprises operate;

Third, to determine the importance of expert risk assessment in the context of environmental liability insurance of enterprises;

Fourth, to define the role of environmental liability insurance for the corporate risk management of industrial enterprises.

The present research defends the **thesis** that environmental insurance is a significant component of the risk management process of enterprises with hazardous waste production. In the context of the main thesis, the study puts forward the following **hypotheses**:

- first, the importance of environmental liability insurance as an instrument of the corporate risk management of enterprises with hazardous waste production increases;
- second, the environmental liability policies have specific advantages and their purpose is to satisfy the insurance protection needs of the industrial enterprises operating in the different sectors of the economy;
- third, the expert assessment in the field of ecological liability insurance is used to determine adequately the insurance liability and calculate the insurance premium.

1. Analysis of the risk situation in the enterprises with hazardous waste production

The factors of the environment are determined as parameters (elements), which characterize its state and properties and provide information about its risk situation. These factors are of direct or indirect importance for the existence of living organisms and are called *environmental factors*. An ecological factor is “any element of the environment, which influences the living organisms during their entire life cycle or during some of the phases of their individual development” (Velev, 2015, p.23-24).

The environmental factors affect organisms directly or indirectly and are necessary for their existence by forming the conditions for this existence. Their impact varies depending on whether it is exerted individually or in combination with other factors. This influence is constantly creating beneficial or unfavorable conditions for the existence of organisms. The nature of the interrelationship and interaction of organisms with the environment can be described by the following characteristics (Velev, 2015, p.20-21):

1. it is specific – these relationships are individual or unique for every organism;
2. it is permanent – the organisms spend their entire life in the environment in which they live;
3. it is reciprocal – the interaction between the organisms and their environment is a two – way one;
4. it is necessary – if the organisms are taken out of their environment they can die.

The environment in which organisms live is part of the natural environment and represents their entire surrounding environment. Any change in the environment parameters results in changes in the quality of life of individuals.

The conditions of existence are part of the living environment and constitute a set of elements of the surrounding reality with which the organisms are in a dialectical unity and to which the individuals adapt. In other words, they adapt to specific living conditions according to their living

requirements and respectively find their “ecological niche”. The ecological niche is “the place that each species occupies in the biocoenosis, in other words this is the functional role it plays in the other relationships including the nutritional ones. It also characterizes the chemical, physical and biotic elements of the environment that determine the existence and the vital activities of the organisms”(Velev, 2015, p.21).

There are two types of conditions needed for the existence of individuals, namely:

- organic – they refer to the physical and chemical properties of their habitats such as climate, i.e. light, heat, humidity, water, soil, etc.
- inorganic – these conditions involve the general relationships of an organism with all the other organisms with which it comes into contact.

Searching methods for overcoming the negative consequences of the impact of environmental risks is related to the manifestation of one more form of interaction between the society and the natural environment, namely the protection of the environment.

Monitoring and studying the elements of the environment, in which the industrial enterprises operate, is a prerequisite for making effective management decisions for its protection and restoration. In the context of the **risk management concept**, the business entities apply a number of measures related to environmental safety and corporate social responsibility.

The specialized literature provides the following groups of risk factors (risk indicators) in the industrial enterprises according to the “source of danger” criterion (Bagrov, & Murtazov, 2010, p.79):

- environmental factors;
- socio – economic factors;
- technogenic and /or anthropogenic factors;
- military factors (determined by the operations of the military industry).

According to another opinion in the specialized literature, the level of the ecological risk posed by the manufacturing activities in the enterprises is formed under the influence of four groups of factors (Mun, 2004):

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

- factors of the natural environment – they involve the influences of natural phenomena and processes such as floods, erosion, corrosion, thermal karst processes, landslides, etc. as well as natural climatic and meteorological conditions;

- factors of the technogenic environment – they have a significant technogenic impact on the environment and involve a higher degree of wear of the used fixed assets; these factors also concern the lack of sufficient preventive actions such as poor protection against thunders and the possibility of spontaneous fires;

- factors of the anthropogenic environment – they refer to violations of the manufacturing process safety techniques, unintentional errors and intentional misconduct of employees and third parties;

- factors of the socio – economic environment – they refer to any changes in the regulatory and legal framework controlling the operation of enterprises; pressure from public, non-governmental organizations and trade unions, etc.

2. Interrelationship between the elements in the environment of industrial enterprises

In the theory and practice in the field, there is almost no disagreement about the interpretation of the risk factors affecting the activities of the business entities. These risk factors and their consequences have to be studied by taking into account not only their mutual influence but also their interdependencies of hierarchical nature. Based on this, the requirements related to the environmental safety of business entities with hazardous production call for the establishment of “a system for detailed analysis of the impact of environmental risks throughout all phases of the entire production cycle, namely the pre-investment, investment and exploitation phase of development” (Petrova, Lobanova, p.2).

The complex impact of the environmental risk factors of the industrial enterprises are presented in Figure 1.

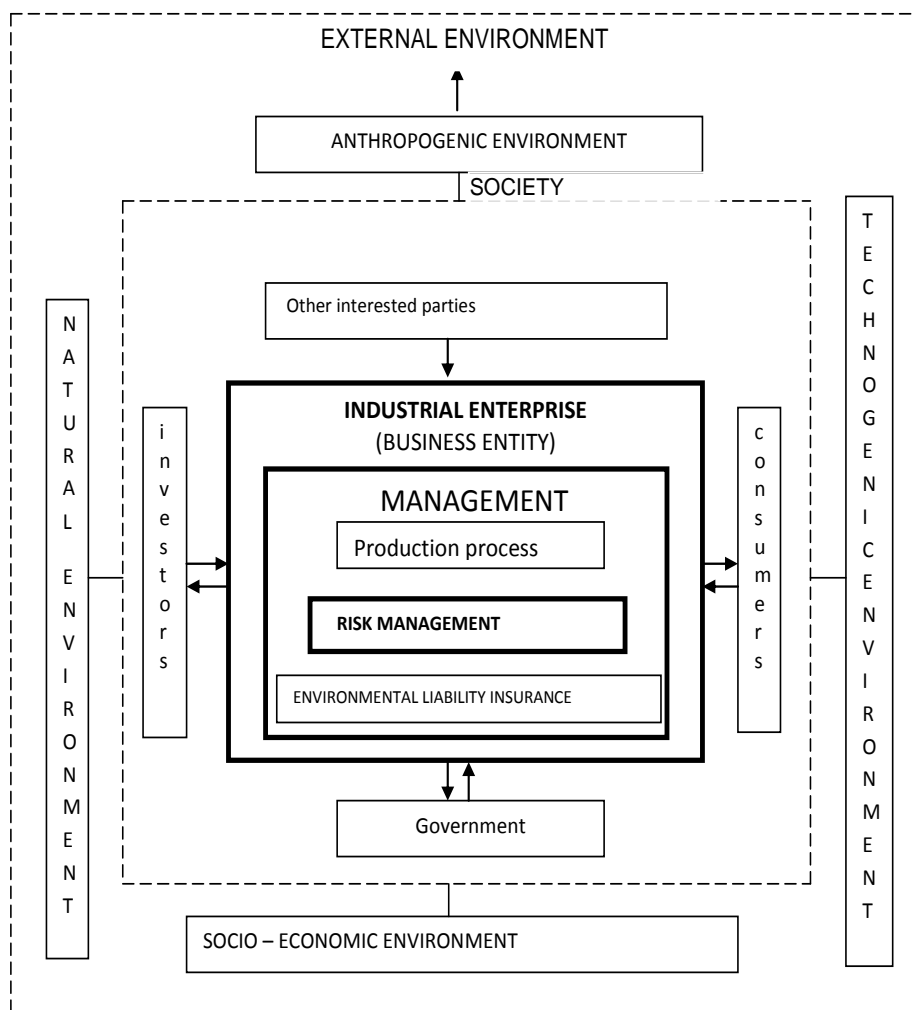


Figure 1. Structure of the environment in which enterprises with hazardous waste production operate

In the operation of enterprises, the participants in the market environment, i.e. consumers, competitors, investors, the government and other interested parties, also affect the realisation of the manufacturing

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

process. All these economic players are interested in reducing the negative impact of the production activities on the elements of the environment. In their efforts to meet the increased requirements for protecting the environment that are imposed by the society, the industrial enterprises increase their environmental responsibility. This trend is manifested through improving the process of managing environmental risks and implementing effective security measures.

With reference to this, there are two groups of risks connected to the environment (Monti, 2002, p.2):

- Risks related to the environmental liability, i.e. the financial risk taken by the enterprises concerning the pollution of the environment;
- Risks related to natural disasters, i.e. the risk of occurrence of natural disasters such as earthquakes, floods or other extreme environmental conditions.

Active risk management has, by rule, a systematic character and is viewed as a continuous, circular and developing process. It is an inseparable element of the strategic management of the business entities.

The assessment of environmental risks in the context of risk management involves the following key steps or stages (Environmental Risk Assessment, 2013, p.2):

1. Identification of the hazards.
2. Assessment of the consequences in the event of hazardous situations.
3. Assessment of the magnitude of consequences. This stage includes considering the spatial and temporal scale of the consequences and the time to their onset. When chemicals are involved in the process, this step can sometimes be called assessment of chemical releases.
4. Assessment of the likelihood of consequences. This stage involves three elements – hazard analysis, hazard probability assessment and assessment of the likelihood of damage resulting from exposure. This stage is also called an exposure assessment or an impact assessment.
5. Assessment of the significance of risks. This stage is often called risk characterization or risk assessment. It involves assessing the likelihood of arising of hazardous situations and the severity of their consequences. At this stage, uncertainty about hazards and risk can also be considered.

The purpose of risk management is “consistent research of the risks associated with the activities of organizations over their past, present and, most importantly, their future”. Risk management increases the likelihood of success and at the same time reduces the likelihood of failure and uncertainties with reference to achieving the set corporate goals (A Risk Management Standard, 2011, p.3).

The main *strategic goal* of enterprises is to achieve *sustainable development*, which is revealed in increasing the overall well - being of the population. This economic welfare guarantees the satisfying of various needs that are based on a new value orientation. This objective implies “not only reaching a state of material well – being but also protecting the quality of the environment and its recovery”. In order to achieve this strategic goal, enterprises should strive towards the realization of several sub – goals, namely (Neverov, Moroz & Martsul, 2005, p. 28):

- Maintaining both the quality of life and the environment;
- Ensuring economic growth that is acceptable from a social and environmental point of view;
- Preserving the natural ability of the ecosystems to reproduce themselves;
- Guaranteeing the environmental safety of the population.

Measuring the environmental risk of technogenic nature poses a number of difficulties to the risk managers in the industrial enterprises. This makes it necessary to use **expert assessments in the industrial enterprises** to predict the likelihood of occurrence of environmental risk of technogenic nature as well as the magnitude of the consequences of the probable occurrence.

Over the recent years, risk assessment has become a frequently used approach to addressing environmental issues caused mainly by human activities. The definitions of risk assessment differ significantly from source to source. This is mainly due to the wide range of approaches and meanings of the terms used by different groups of experts and practitioners (Manuilova, 2003, p.4).

3. Importance of expert risk assessment in the context of environmental pollution liability insurance of industrial enterprises

Expert assessments are used to analyze, control and insure risks in the context of risk management of the business entities. They have a number of specific features and can be characterized in the following manner:

First. The expert assessments are based on particular **indicators**, which are connected with the achievement of the company's goals, i.e. quality of life, quality of the environment, level of economic development, social and environmental well – being. These indicators are as follows (Neverov, Moroz & Martsul, 2005, p. 28-29):

- indicators for quality of life: life expectancy, health status of individuals, incomes of the population, GDP per capita, employment rate, level of education, etc.;

- indicators for quality of the environment: implementation of new technologies in the production process, decreasing the energy intensity of the production sector, use of non-waste technologies, use and disposal of waste, etc.;

- indicators for economic, social and environmental development: adoption of appropriate legislation, urban greening, zoning of the inhabited places, reduction of traffic volume, implementation of modern technologies in the chemical and oil processing industries, etc..

Second. With the help of expert assessments related to the risk situation of the enterprises with hazardous waste production it is possible to complete particular **tasks** leading to the achievement of sustainable development, namely (Neverov, Moroz & Martsul, 2005, p. 29-30):

- guaranteeing the radiation safety of the population;
- increasing the rates of economic growth;
- achieving a degree of greening of the manufacturing industries;
- reducing the natural resource and material intensity of production;
- implementing energy and resource – saving and science-intensive technologies;

- preserving and maintaining stability in the social and political life of the society;
- improving the demographic situation in the countries;
- develop ecological awareness and environmental ethics;
- increasing the effectiveness of international cooperation in addressing various environmental issues.

Third. Using expert assessments in environmental pollution liability insurance plays an important **role** in the *risk management* of industrial enterprises.

US EPA defines the environmental risk assessment as “a process that assesses the potential adverse environmental effects that might arise or have already arisen as a result of the impact of one or more stressors”. The assessment may include chemical, physical or biological stressors, which can be studied separately or in combination (U.S. Environmental Protection Agency).

Fourth. The European Center for Ecotoxicology and Toxicology of Chemicals (ECETOC) poses the question of applying an **instrument** that can be used for the first screening of the product portfolio in order to determine the substances that need to be assessed further. The ECETOC screening assessment of risks is a software project based on the EUSES principles. This is a simplified instrument, which requires limited amount of data.² For example, there are six variables used in the assessment process, i.e. 1. an emissions scenario; 2. tonnage; 3. hydrophobicity; 4. volatility; 5. biodegradability; 6. Ecotoxicity (Svensson, 2003).

Fifth. When enterprises with hazardous waste production obtain environmental pollution liability insurance, they should rely on highly – qualified specialists, such as the underwriters, who have very specific knowledge to carry out the expert assessments (Misheva, 2015b, p. 34-46). To assess the environmental risks the underwriters need reliable **information** about:

First, the external and internal **factors of the environment** in which the industrial enterprises operate. The information can be gathered and

² European Center for Ecotoxicology and Toxicology of Chemicals. <http://www.ecetoc.org/entry.htm>

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

exchanged through various sources. With reference to this, the experts should summarize two main types of data, namely:

- External information – it could be obtained from websites; similar enterprises from the same industrial sector; government standards, environmental legislation, normative documents, requirements and indicators for environmental safety and labor protection; established rules for environmentally safe storage, moving, transportation and use of chemicals, materials and waste that contain harmful substances, etc. The information obtained from the following sources is also of great importance (Association Française des Entreprises pour l'Environnement, p. 19): correspondence with the government institution, tools for mapping the risks causing environmental pollution, ISO 14001 documents, reports on various environmental issues from previous years, documents connected with the relationships with all interested parties concerning the protection of the environment, etc.;

- Internal information – it refers to any changes in the environmental policy of the enterprises, changes in the objectives and tasks of the economic entities with respect to the environmental protection, prevention measures taken by the enterprises, results from environmental audits (Misheva, 2015a), the enterprise's standards, technological instructions and job descriptions, orders of structural unit managers, environmental records such as minutes of meetings and discussions, results of analyses and inspections, information from different kinds of reports, accounting statements.

Second, the specific **risk factors of the enterprises** that are taken into account by the underwriters when assessing the risk situation of the business entities. The main risk indicators of the researched entities are *the enterprise's risk class* and *the type of harmful substances* that are used and disposed of as a result of the enterprises' manufacturing processes.

In order to prevent major accidents with hazardous substances and to limit their consequences for the life and health of people and the environment, the industrial enterprises should be classified according to the severity of hazard in accordance with the regulatory provisions of the particular country. The enterprises should declare the presence of hazardous substances in their production processes, including the activities

of their storage and transportation. In addition, the performed classification has to be documented. There is little difference in the legal frameworks of different countries with regard to the classification of high-risk industrial enterprises.

In accordance with the Federal Law on Industrial Safety of Dangerous Production Sites of Russia, all hazardous production sites, depending on the extent of danger to humans and the environment they involve, are divided into *four classes*.³

- I class hazards – production sites that are extremely hazardous;
- II class hazards – production sites that are highly hazardous;
- III class hazards – production sites that involve medium hazard;
- IV class hazards – production sites that involve low hazard.

According to the legal framework of Bulgaria, the enterprises with hazardous waste production are classified in *two groups* (Environmental Protection Act, 2015):

- Enterprise / facilities with low risk potential – this is an enterprise (facilities) in which there are hazardous substances whose amounts are equal to or do not exceed the amounts indicated in the Environmental Protection Act (EPA);

- Enterprise / facilities with high risk potential – this is an enterprise (facilities) in which there are hazardous substances whose amounts are equal to or exceed the amounts indicated in the Environmental Protection Act (EPA).

The concept of “hazardous substances” usually involves substances that are “hazardous” for the environment and are a threat to the population, the infrastructure and the natural environment. They are also labelled “toxic” or “poisonous” substances.

The risk of incidents in enterprises is caused by the harmful effects of chemicals, including their compounds and mixtures that can directly or indirectly damage people, tangible assets and the environment due to their distinct reactivity, toxicity or other physical and chemical properties (Velev, 2015, p.224).

³ <http://technoconsgroup.ru/promyshlennyy-konsalting/157-klassifikaciya-opasnyh-proizvodstvennyh-obektov.html>.

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

According to the Law on Protection from the Harmful Impact of the Chemical Substances and Mixtures in Bulgaria, the chemicals and mixtures that are labelled as hazardous are classified in one or more of the following fifteen categories: 1. explosive; 2. oxidizing; 3. extremely flammable; 4. highly flammable; 5. flammable; 6. very toxic; 7. toxic; 8. harmful; 9. Corrosive; 10. irritating; 11. sensitizing; 12. carcinogenic; 13. toxic for reproduction; 14. mutagenic; 15. dangerous for the environment (Law on protection from the harmful impact of the chemical substances and mixtures, 2010, Art.2).

The Environmental Protection Act in Bulgaria, for example, provides in a separate appendix a detailed list of the hazardous substances in the form of “raw materials, products, by-products, sludge or intermediate products, including ones obtained as a result of side reactions or accidents”(Environmental Protection Act, 2015).

The expert assessments in the insurance of enterprises with hazardous waste production should be based on forecasts of the *extent of environmental pollution* in the event of risks of technogenic nature. By applying the “Scenario Method”, experts should study the causes and consequences of the “environmental pollution risks”.

According to the criterion of “type of pollutant”, pollution can be classified as *anthropogenic* (caused by the life and production activities of people); *physical* (caused by the physical processes and phenomena that threaten the life of organisms; it can be mechanical, thermal, noise and radioactive); *chemical* (it refers to changes in the chemical properties of the environment due to various elements, which enter the environment and which cannot be usually found there or whose concentration exceeds the established norms; these substances include gases; *heavy metals* – the chemical elements in a metal form and/or the compounds of antimony, arsenic, cadmium, chromium, copper, mercury, lead, nickel, selenium, tellurium, thallium and potassium as far as they are classified as hazardous; petroleum products, mineral fertilizers, household products) and *biological* (caused by increase in the number of organisms, new species entering the ecosystem, spreading of biogenic substances,

increase in the number of microorganisms and the products of their life functions or acquiring pathogenic properties in a non-pathogenic microbial population) (Velev, 2015, p.102) .

According to the “environmental component” criterion, the pollution affects the *air (atmosphere)*, *water (hydrosphere)* and *soil (lithosphere)*.

The specialized literature in the field provides the following classification of chemical substances of anthropogenic origin. It is based on the extent of danger and the impact on the environment of these chemicals (see Table 1) (Reiter, Kovalev & Borisova, 2013, p.6).

Table 1
Classification of the hazardous chemicals

Classes of hazardous chemicals	
(for the soil, plants, animals and people)	(for people and the environment)
1 – highly hazardous chemicals	1 – extremely hazardous chemicals
2 – moderately hazardous chemicals	2 – highly hazardous chemicals
3 – less hazardous chemicals	3 – moderately hazardous chemicals
	4 – less hazardous chemicals

The “level of soil contamination” is an objective criterion for the systematization of chemical substances. With reference to this criterion, both from theoretical and practical studies, researchers have come up with two classifications. According to them, the chemicals are grouped in 4 and 5 categories respectively depending on the degree of pollution (see Table 2).

Table 2
Classification of soil contamination levels

Categories of soil contamination	
I classification	II classification
Very high	Without contamination
High	Permitted contamination
Medium	Moderately hazardous contamination
Low	Hazardous contamination
	Extremely hazardous contamination

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

The expert assessments of environmental risks in the enterprises with hazardous waste production should take into account the main types of chemical substances that act as environmental pollutants. They are outlined in two classifications known from the specialized literature and are presented in Table. 3 (Reiter, Kovalev & Borisova, 2013, p.7).

Table 3
Classification of soil contaminating chemicals

№	Chemical substance	Classification 1	Classification 2
1	Strontium	Moderately hazardous	Less hazardous
2	Copper	Highly hazardous	Moderately hazardous
3	Nickel	Highly hazardous	Moderately hazardous
4	Chromium	Highly hazardous	Moderately hazardous
5	Manganese	Highly hazardous	Less hazardous

The water pollutants are classified into three main groups, i.e. chemical, physical, and biological. They are shown in Table 4 (Bardukova, p. 125-126).

Sixth. In assessing the risk situation of the industrial plant, the experts should take into account the applied **preventive measures** that reduce the probability of occurrence of environmental risk of technogenic nature. The expert assessments report the results of the controls on the classification, labeling and packaging of chemicals, mixtures and specific products in accordance with Regulation (EC) № 1272/2008 (CLP).

Table 4
Classification of the chemicals causing water pollution

№	Type	Characteristics
1	Chemical pollution	<ul style="list-style-type: none"> - is the most widely spread and persistent type of pollution when compared to the other types; it spreads over the longest distances; - is further divided into the following subclasses: organic, non – organic, toxic, and non – toxic; - <i>Organic pollution</i> concerns the household, agricultural, or industrial water (the organic substances are decomposed by the microorganisms and the process is accompanied by the consumption of oxygen that is decomposed in the water; the pollution caused by oil and oil products is very serious; other organic substances which pollute the water include excrements and waste from the leather, paper, dairy and pulp industry); - <i>Non – organic pollution</i> refers to the chemical compounds mineral and toxic substances that enter the water. The most serious non – organic pollution is caused by the metallurgy, machine building, mining and coal industry enterprises; the factories producing acids, building materials and mineral fertilizers; the logging and timber industry, water transport, etc.
2	Physical pollution	<ul style="list-style-type: none"> - refers to the radioactive substances, heat, etc. present in the water; - the presence of radionuclides is one of the most dangerous problems (the radioactive substances are disposed of by Nuclear Power Plants, hospitals, enterprises working with radioactive substances, the Armed Forces, etc.); - thermal pollution refers to heated water used as a coolant in various industrial manufacturing processes which after that becomes waste water; the second cause of physical pollution is the contact of water with heated surfaces; - thermal pollution can be caused by nature related factors (very high temperatures) or industry related factors – industrial manufactures or energy production (Nuclear Power Plans or Thermal Power Plants).
3	Biological pollution	<ul style="list-style-type: none"> - refers to pathogenic bacteria, viruses, parasitic worms and others in the water (the pathogenic microorganisms and viruses are contained in poorly cleaned or untreated sewage waters in the populated areas and livestock farms); - when infected with pathogenic microbes and viruses, drinking water causes different epidemics.

Seventh. When applying the expert method of environmental risk assessment, specialists should use certain basic ***principles of risk characterization*** to define “the framework of the assessment, present clearly the results, state the main assumptions, ambiguities and alternatives and separate the scientific research conclusions from the political evaluations”. These principles and their importance for the environmental pollution liability insurance of the industrial enterprises are outlined in Table 5 (Velev, 2015, p.153).

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

Table 5
Principles of characterizing the environmental risk of technogenic nature

Principles	Definition
Transparency	The characterization should outline the used methods of risk assessment, underlying assumptions, logic, justifications, applied technical extrapolations, ambiguities and the overall weight (importance) of each step of the assessment process.
Clarity	The risk assessment results must be understandable to everyone within and beyond the framework of the assessment process. The text and graphics in the documents should be clear to all users.
Consistency	The risk assessment must be carried out and presented in a manner, which is consistent with the enterprise policy and is in accordance with other assessments of similar risks.
Reasonability	The risk assessment should be based on objective judgment. It should be carried out by using methods and assumptions that comply with the used methodology. It should also be done in a conventional and completed manner.

Eighth. Risk analysis is based on the use of a number of *methods for identifying and studying probable hazards*. The results of the application of these specific methods should be used for the purposes of expert assessments, which in turn facilitate the underwriting of the industrial enterprises. Some of the most widely used methods, known to the specialist from both theory and practice, are as follows:

- The Safety Risk Model (SRM) – it is used to present the logic of dangerous incidents which occur as a result of events of technical and organizational nature or are caused by human actions;
- The Event Tree Analysis – it is an inductive method that is used to describe the causes and consequences of risks and it is shaped as a tree of causal links. The method makes it possible to make the most appropriate management decisions to reduce the likelihood of risk occurrences and to limit the consequences of these events.
- The Fault Tree Analysis (FTA) - it is a top – down, deduction method, which focuses on a particular event to determine the causes for its manifestation. The method uses the so called logic diagram that explains the logical relationship between an output event and the other input events – basic and intermediate ones – leading to its occurrence. The output event is usually associated with an unwanted, dangerous event and the probability of this hazard is taken into account when the “tree” is being designed.

Figure 2 presents an exemplary version of the Fault Tree Analysis in an industrial enterprise.

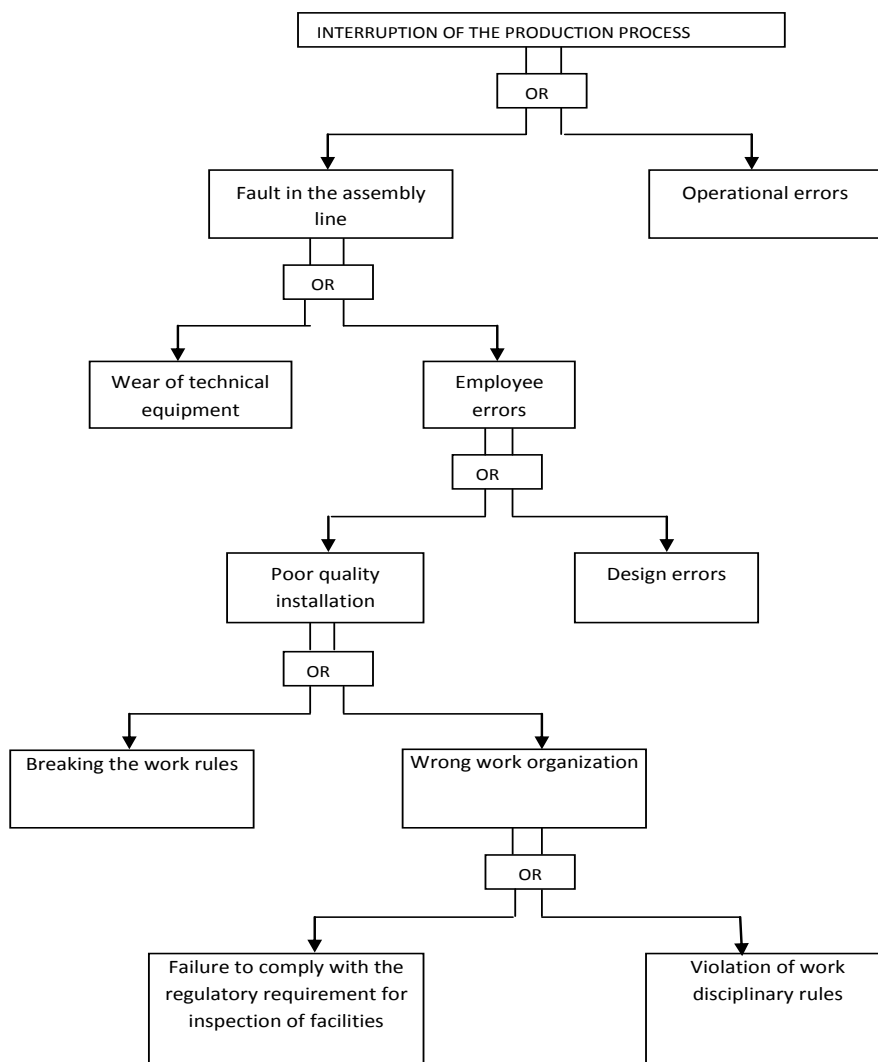


Figure 2. Application of the Fault Tree Analysis method in an industrial enterprise

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

The method determines the ways in which hazards can lead to industrial accidents with negative effects on the environment. It has been applied most widely in the nuclear power sector and the chemical industry.

- The “Bow tie” method is a graphical combination of the following methods: „The fault Tree Analysis”, “Event Tree Analysis” и the Barriers Diagrams (representing the safety measures). It provides the most detailed illustration of the accident from the moment the critical event occurs, through its development to the arising of the consequences and the undertaking of the appropriate measure for dealing with the accident in the enterprise. The method permits the study of the human errors that might cause industrial disasters. It also allows for a quantitative assessment of risks, respectively forecasts of the probability of accident occurrences.

- The Hazard and Operability Analysis (HAZOP) – this is a structures and systematized technique for identifying potential hazards in systems and their operations which lead to the occurrence of unwanted situations. The method is based on a theory, which assumes that risks are events causing deviations in the prescribed rules for designing, constructing and operating a particular system.

- other methods - environmental expertise, analysis of expert opinions, the method of expert assessments, etc. (Orlov, 2002).

Ninth. When enterprises with hazardous waste production insure their environmental pollution liabilities, they have to solve a number of problems by developing **systems for expert assessments** of risk situations. These systems can possess a different degree of expertise and can provide high efficiency of the systems’ automated realization. The system for expert assessment of environmental risk of technogenic nature in industrial enterprises should follow a particular algorithm. Developing such a system in the enterprises with increased risk of polluting the environment should be based on studying and analyzing all types of risk indicators and their overall impact on the risk situation of the assessed enterprise. The systems for expert assessment in insurance involve a complex of expert knowledge, work methodology and specialized algorithm implemented in a computer software application. The results obtained after

using the system depend on the value of the indicators entered by the users of the software. With reference to this, the expert assessment system is “an intelligent programming tool, which expands and complements the abilities of the underwriters by rationalizing and making their activities easier while the results of applying the expert assessment system could be used successfully for making diagnoses, giving advice and consulting” (Shishmanov, Krastev, 2007).

3. The role of environmental pollution liability insurance in the corporate risk management of industrial enterprises

A survey of the demand for environmental pollution liability insurances by the industrial enterprises on the Bulgarian market was carried out through a questionnaire administered among the insurance companies in the Non – life insurance sector. Some of the questions asked to the underwriters and their answers reveal the role of environmental pollution liability insurance for the risk management of the enterprises with increased risk of polluting the environment.⁴

75% of the surveyed insurers responded positively to the question “How do you evaluate the role of environmental pollution liability insurance as a tool of corporate risk management of enterprises with hazardous waste production?” while only 5% expressed a negative opinion. 20% of the respondents had neutral attitude towards the role of environmental pollution liability insurance in the activity of industrial enterprises. (see Table 6).

The main users of the environmental pollution liability insurance are business entities, which pollute the environment, from economic sectors such as the extractive, energy and processing industries and (see Table 7).

⁴ The marketing survey was conducted during the period July 2016 – March 2017 with the institutional support of the “Professor V. Gavriiski, PhD” Foundation and in cooperation with the Financial Supervision Commission and The Association of Bulgarian Insurers.

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK ...

Table 6

Role of environmental pollution liability insurance for the risk management of industrial enterprises

	Positive	Negative	Neutral
Assessment (evaluation) of the role of environmental pollution liability insurance as a tool of corporate risk management of enterprises with hazardous waste production	15	1	4
Overall: 20	15	1	4

Table 7

Economic sector where the insured legal entities using Environmental Pollution Liability Insurance operate

	The Extractive Industry	The Energy Sector	The Processing Industry
Economic sector where the insured legal entities under the Environmental Protection Act operate	6	2	5
Overall: 13	6	2	5

According to the answers of the surveyed underwriters who insure against environmental pollution liability risks, approximately 46% of the users of these insurances operate in the extractive industry, 15% in the energy sector and over 38% in the processing industry.

With reference to determining the liabilities of the underwriters who cover the risks of environmental pollution, the majority of the experts in the field think that there should be differentiation of the limits based on the sectors in which the industrial enterprises operate (see Table 8).

Table 8

The need to limit the insurance liability for the "environmental pollution" risk

	Definitely yes	Definitely no	Can't say
Need of differentiating the insurance liability limits for the "environmental pollution" risk according to the different economic sectors	14	6	0
Overall: 20	14	6	0

The data from the questionnaires show that 70% of the participating insurers are convinced that there should be differentiation of the insurance liability limits in transferring the “environmental pollution” risk from the enterprises with hazardous waste production. 30% of the respondents, however, do not think that the differentiation of the insurance liability limits is of considerable importance for the environmental pollution liability insurance.

Based on the summarized and analyzed information from the conducted market research, several *main conclusion* can be made:

- The enterprises from the chemical industry are still not very much interested in the environmental pollution liability insurances;
- Not all insurers in the country have experience and traditions in the field of environmental pollution liability insurance. For example, in 2016 the insurers specializing in the field of Non – life/general insurance were 29. In 2015, only 16 insurance companies had a license to offer Environmental Pollution Liability insurances and only 7 of the survey participants performed any insurance operations concerning this type of insurance in 2016.⁵
- The Environmental pollution liability insurance is still not well positioned on the national insurance market;
- It is necessary to popularize the advantages of the environmental pollution liability insurances with the help of appropriate promotion activities in order to increase the customer demand in the country;
- The importance of the issue calls for the development of an algorithm for environmental risk assessment for the purposes of insurance coverage in the context of corporate risk management.

⁵ The data was obtained from the Financial Supervision Commission and after conduction the questionnaire – based survey of the articles’s author.

Conclusion

The expert assessments of environmental risks of enterprises with hazardous waste production are based on a combination of specific knowledge about the economic sectors in which these enterprises operate, their type of production and the possible consequences in the event of damages. According to the theory and practice in the field of insurance, the expert systems are implemented on the basis of informatics and the information technologies by simultaneously increasing the expert knowledge with the purpose of “using the human potential in the most rational and effective way” in the process of making the expert assessments.

The application of expert systems in environmental insurance will lead to improvement in the insurance coverage against risks. This means that the actuary calculations should become more accurate, respectively the insurance premiums should be determined more precisely with clearly differentiating the liability limits according to the particular economic sectors. In this way, the insurance companies will be able to rely on an increase in their competitiveness and in the demand for insurance products among the industrial enterprises.

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CONTENTS

MANAGEMENT theory

BRAND VALUE CO-CREATION VIA THE PLATFORM ENTERPRISE

Boryana V. Dimitrova, PhD

Brent Smith, PhD

Trina Larsen Andras, PhD..... 5

MANAGEMENT practice

DETERMINANTS OF THE DEVELOPMENT OF INTER-ORGANIZATIONAL RELATIONS

Prof. nadzw. UEP, dr hab. Dariusz Nowak 25

THE EFFECT OF HABITS ON THE MANAGEMENT PROCESS

Assist. Prof. Stanimir Slavov, PhD 46

ACCOUNTING and audit

COMPLETENESS AND TIMELINESS OF THE ANNUAL FINANCIAL STATEMENTS PUBLISHED BY BULGARIAN ENTERPRISES

Chief Assist. Prof. Reni Petrova, PhD 63

INSURANCE and Social Security

EXPERT ASSESSMENT OF THE ENVIRONMENTAL RISK OF TECHNOGENIC NATURE – AN ELEMENT OF THE ENVIRONMENTAL POLLUTION LIABILITY INSURANCE OF THE INDUSTRIAL ENTERPRISES

Assoc. Prof. Irena Misheva, PhD 83

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