

Application of Environment Management Systems in Environmental Security and Risk Prevention

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ABSTRACT

The development of industrial production, implementation of new technologies, using of growing number of dangerous substances brings remarkable risks tightly related to health and environmental threats. In the submitted article authors present an approach of the environmental risk prevention and present the Environmental management system as effective tool of the environmental risk prevention. The identification of the environmental aspects, impacts and risks and their characteristics and assessment in the specific register is the first and key step of the environmental risk prevention. Positive experience of the environmental management system applications is a motivation for the continual development of the processes with expected synergic effects and risk reduction.

KEYWORDS

environmental risk, environmental security, environmental management system, risk register.

INTRODUCTION

The subject of environmental security, assessment and prevention of the environmental aspects, impacts and risks has dynamic character. The numbers of methods were developed and used for risk identification sources, assessment and risk prevention in the past. Today's systematic dealing with the risk management is definitively preferred. It is the subject of an interest of local and international participated organizations dealing with environmental safety and environmental engineering problems in global, with target to implement unique standardized system.

ENVIRONMENTAL SECURITY AND ENVIRONMENTAL RISK ASSESMENT

Environmental security can be defined as a relative public safety from environmental risks caused by natural or human processes due to accident, mismanagement, human ignorance or on purpose. Environmental security is the condition, when social systems interact with ecological system in sustainable ways, all individuals have the same and reasonable access to environmental sources and mechanisms exist to react environmental crisis and conflicts, e.g., to their solving. In that stage the minimalized risks and dangers related to the environment are caused by natural or anthropogenic influence [8, 14].

Environmental security includes improvement of resources shortage, environmental degradation and biological threats could lead to conflict. To the methods for reduction of the environmental damage we can include reduction of the natural resource consumption by new environmental technologies, resources usage, sustainability strategies or environmental protection and their resources such as water or minerals.

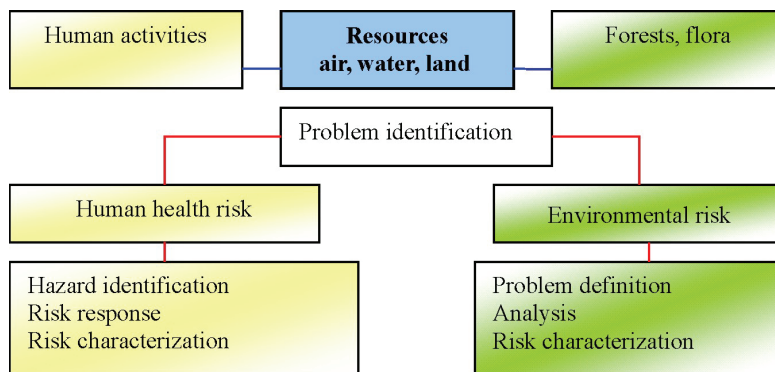


Fig. 1: The components of the environmental exposure and influence assessment.

Environmental risk assessment is applied to the consequences of natural and anthropogenic processes to ecosystems, even though the majority is affecting consequences of the anthropogenic activities. It applies and integrates the methods and processes of ecology, environmental chemistry, environmental toxicology, ecotoxicology, hydrology and other "Earth" sciences to define the probability of undesirable occurrence, e.g., industrial activities, which can have an influence to ecosystem, humans, animals and in complex can create information for decision process [15].

The human health and its ecological part are two processes that are conceptually similar because the environmental risk was developed from health (human) risk, but their historical development and political requirements were different [6].

Environmental risk assessment is the method, used to determine the probability or possibility of the negative environmental impact appearance as result of exposure one or more systems stressors, e.g., contamination level assessment of the particular environmental component. This process is based on the environmental exposure assessment and the environmental influence assessment. These two segments are the main parts during the analysis stage.

Environmental risk assessment (ERA) process helps to identify environmental problems, sets priorities and brings professional basis for regulation procedures. It also identifies already existed risks and/or forecast risk stressors, which are invisible on the environment yet. Fig. 1 shows different el-

ements (components) of human and environmental risk [14, 15].

Risk assessment as a part of the risk management, relates to risk sources and frequencies and their expected negative use. If the risk is assessed as unacceptable, certain procedures are being applied, after which risk is changed to acceptable. An output from the risk assessment process helps to protect human health and environment, and in addition optimizes the technological procedures [14].

METHODS OF ENVIRONMENTAL RISK ASSESSMENT AND PREVENTION

There are many risk analysis, methods and tools to assess significant (unwanted) negative events in changing environment (Fig. 2). Nowadays methods of ERA are established on probability basis and are the base of the environmental management. These methods are straightforward, fairly simple to apply and easy to understand. On the other hand, because there are many of them, to choose and apply right one in right situation could be a problem.

The main risk analysis methods and tools are divided in to two groups:

- inductive (ex ante) - go from fault or failure mode, through system failure, to effects safety, environment and property; consider primarily only one fault or failure mode at a time; risk analysis points to event as a fault or failure cause; are straightforward, fairly simple to apply.

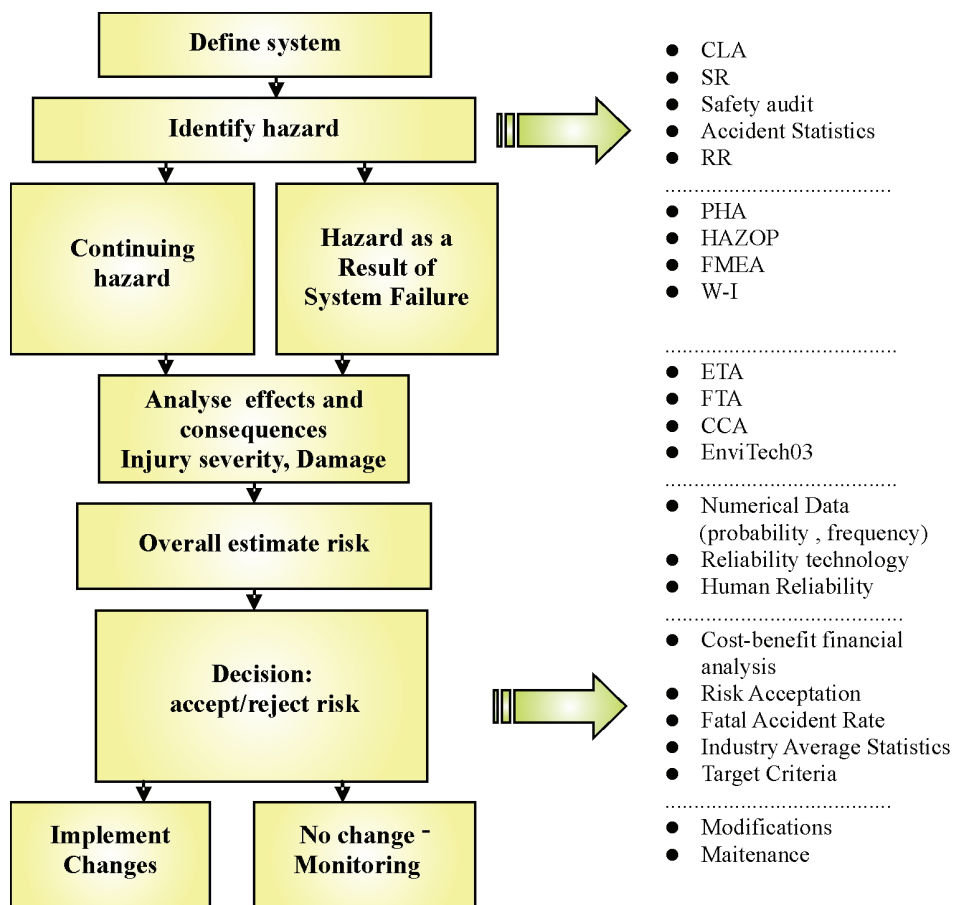


Fig. 2: Methods utilization in risk assessment process.

- deductive (ex post) - go from specified failure effects, through fault or failure modes, to failure mechanisms; consider primarily one specified failure effect at a time; use logical reasoning and pose high demands on the analyst [1, 13].

From the Fig. 2 arises, that each method can be useful in different stage of the risk assessment process. It depends on each company what type of method will chose and apply.

Not every method can be applicable and/or certain in every situation. For the higher efficiency it is appropriate to apply combination of different methods [10].

Methods as FTA, ETA, CCA, What-if analyze risk sources (Fig. 3). Methods as FMEA, HA-

ZOP analyze the component that failed in the system backward (Fig. 4) [10].

ENVIRONMENTAL MANAGEMENT SYSTEM

The prevention can be identified as an expected environmental damage, to which we are able to avoid by taking an appropriate actions or choosing less dangerous activities. In some specific cases specific correct measurement could be implemented late and it is to late avoid environmental disaster. The prevention should be a part of everyday activities for organization. The management can use available tools such as Environmental Impact As-

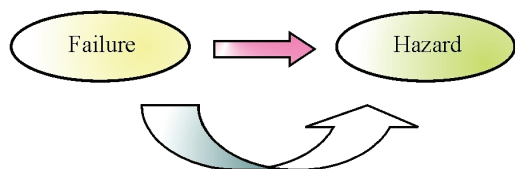


Fig. 3: *Type 1 Methods.*

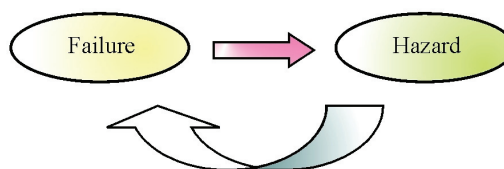


Fig. 4: *Type 2 Methods.*

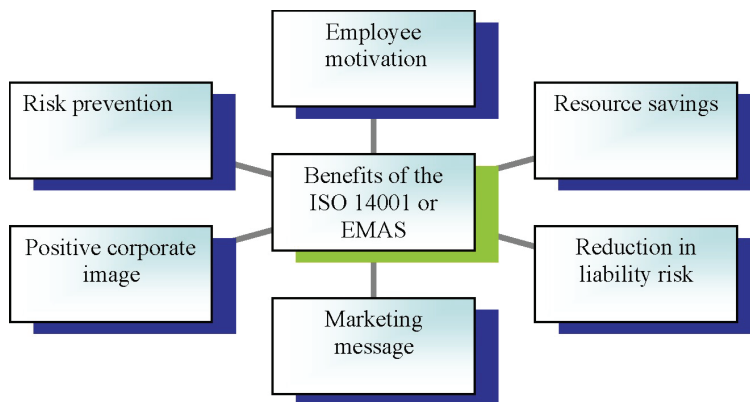


Fig. 5: *Benefits of the EMS implementation.*

assessment, Life Cycle Assessment (LCA), Environmental management system, Environmental Audit and Environmental Statement [7].

Environmental management system (EMS) is part of voluntary group preventive tools of environmental policy. The system is implemented to manage the significant environmental aspects and meet the legislation requirements. Thus, the EMS is a common used tool of the organization control management which joins the basic environmental protection approaches of the and leads to environmental achievements and business goals.

EMS includes organisational structure, planning, responsibilities, processes, procedures and resources for developing, implementing, reviewing and maintaining environmental policy [9].

EMS implementation guarantees well structured process to identify all relevant aspects, which are helping to reduce environmental risks. Monitoring of the prevention process and EMS continual improvement can help to reduce environmental risks (negative environmental impact reduction).

It is important to be fully committed to issues in environmental management. By doing that you are more likely reducing exposure of environmental risk. The implementation and performance of EMS guarantee the prosperity to organisation and its competitiveness, that decrease material and energy utilization, minimalizes waste, builds green company image, reduces fees of pressure on the environment, decreases financial penalty and increases manufacturing quality overall [2, 4, 11]. The Fig. shows the organization's benefits after EMS implementation process [12].

There are two standards of EMS implementation. The first one is applied according to ISO 14000 series, that represent worldwide transparent normative documents developed by ISO (International Organization for Standardisation). Standard norm for the implementation and EMS certification is the norm ISO 14001. The second standard is EMAS scheme (Environmental Management and Audit Scheme), which is the EMS establishment according to the Regulation of the European Parlia-

ment and the Council (ES) No. 1836/1993, and/or EMAS II No. 761/2001 after revision. Another option for the EMS implementation could be one of the numbers of informal environmental manage-

ment tools, i.e., LCA, environmental benchmarking, cleaner production, etc.

Table 1: *Register of Environmental Aspects and Impacts (P-direct, N-indirect).*

Aspect	Impact	Occurance	Situation of occurance	Significance aspect	Aspect control/management
Placement of hazardous material (P)	Soil contamination	rarely	Regular operation	Moderate	Waste separation Waste legislation
Use of electricity (P)	Depletion of natural resources	regular	Regular operation	Major	Monitoring of electricity consumption
Use of energy (P)	Depletion of natural resources	regular	Regular operation	Minor	Monitoring of energy consumption
Use of water (P)	Depletion of natural resources	regular	operation operation	Minor	Monitoring of consumption and quality water
Use of paper products (P)	Soil erosion	rarely	Regular operation	Minor	Waste separation
Sewage water (N)	Water and soil contamination	rarely	Regular operation	Minor	Water legislation
Solid waste (P)	Soil contamination	rarely	Regular operation	Moderate	Waste separation Waste legislation

RISK REGISTER

Prior to risk management process the risk, the risk identification is necessary (it is the basis for the risk management). Register of environmental aspects and impacts can be used for that purpose. It is basis for procedure recognition inadequate burden

and identification and risk assessment. That is solving the problems in environment and safety. Each organization has created its own register, because even for the same task every organization has different working conditions, sources the procedures are also different. An environmental aspect refers to

Table 2: *Environmental impact assessment.*

Level	Description
1 Never	Little or no stakeholders interest.
2 Unlikely	Small arrangements are necessary.
3 Possible	Negative aspects are visible. Management control is necessary.
4 Likely	Aspect control is necessary during processes.
5 Almost	All aspects shall be controlled during processes.

Table 3: *Severity of impact.*

Level	Description
5 Catastrophic	Significant off-site toxic release with long term environmental damage.
4 Major	Off-site release with short term or minor environmental impact.
3 Moderate	Off-site release with minimal environmental impact or on-site release requiring outside assistance.
2 Minor	On-site release contained, but the effect is minimized.
1 Insignificant	Minor fully contained release, without negative environmental change.

Table 4: *Risk Rating Matrix.*

Consequences		5 Catastrophic	4 Major	3 Moderate	2 Minor	1 Insignificant
Probability						
5	Almost certain	25	20	15	10	5
4	Likely	20	16	12	8	4
3	Possible	15	12	9	6	3
2	Unlikely	10	8	6	4	2
1	Never	5	4	3	2	1

an element of an organization, activity, product or service that can interact with the environment. An

environmental impact refers to any change which takes place in the environment as the result of the aspect. It is important to identify each negative en-

vironmental aspect whether it has direct or indirect impact [5].

The organization while assessing significant environmental aspects should consider following:

- The probability of an environmental adverse outcome,
- Vulnerability of the environment (local, regional, global),
- The amount and frequency of aspect and impact,
- Compliance with all legal and other requirements,
- Views of stakeholders.

The environmental aspect identification is very important input for organization in planning for environmental management system EMS. The organization should establish, implement and maintain a procedure [2]:

- to identify the environmental aspects of its activities, products or services, with the defined scope of its EMS that can monitor and those it can influence taking into consideration planned or new development, or new modified activities, products or services,
- to determine those aspects that have or can have significant impact on the environment (i.e., significant environmental aspects).

By means of the risk matrix, the register can be integrated by values (numbers) to make it more transparent. To do this, the input and output activities must be identified first, followed by environmental aspects (direct and indirect) derived from the activities. The category of the aspects includes emission, water pollution, waste, land contamination, usage of resources, water consumption, etc. Finally, the environmental aspects are assessed as is shown in the Tab. 2 [4].

Significance of environmental impacts is assessed according the Tab. 3.

Here we include the level of emission, probability of serious accident occurrence, pollution, the number of complaints, and aspect perception by public. Next by using Tab. 2 and Tab. 3 and taking risk matrix (Tab. 4) in to the consideration, the final values of risk are calculated. These values we

can record in to the register of aspects, impacts and risks [4].

Another form of the register of environmental aspects is its number representation (Tab. 5). The value is calculated as probability multiplied by effect (consequence) followed by the addition of particular aspects (the weight of the risk is from range 1 to 3). Effectual impact as a number representation shows column 10 (labeled as "Total") of the Tab. 5 [11].

CONCLUSION

Environmental program and its short and long term goals of each organization (company) helps understand the organization's (company's) activities to improve its environmental behavior. The organization should be able to show distinctive connection between significant environmental aspects and its improvement plans, and put its short and long term goals in to relation with significant environmental aspects and their impacts.

If environmental aspect is a source of significant environmental impact, then this environmental aspect is marked as significant environmental aspects and has to be integrated in to the environmental management system.

From the viewpoint of the planning process, the EMS as a tool of prevention helps to define and/or assess all significant environmental aspects of products and activities in relation of their significant impact on environment. The designation and follow the procedure to identify these aspects is important and is taken in to the consideration in process of organization's long term environmental goals statement.

To prefer prevention against the elimination of unacceptable consequences (events) in relation to environment, and application of principles of systematic improvement is the right direction to the sustainable development. EMS can be considered as a tool of environmental risk prevention because of its approach to the environmental protection of all involved parties.

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Table 5: *Environmental aspects and impacts register (number representation form).*

Number			1	2	3	4	5	6	7	8	9	10
		Risk										
Aspect	Probability	Impact	Product	Previous events	Uncomfortability	Exceptionability	Local/global	Time limit	Future activities	Legislation	Lack of information	Total
Air emission	3	3	9	2	2	2	2	2	1	3	0	23
Water emission	2	3	6	2	1	2	1	1	1	3	0	17
Solid waste	1	1	1	1	3	3	1	2	1	2	3	17
Energy use	1	1	1	1	1	1	1	1	1	0	0	7
Noise	1	2	2	2	1	1	1	1	1	0	0	9
Visible impact	1	1	1	1	3	2	1	1	1	1	1	12
Ecosystem	1	2	2	1	1	1	2	1	2	0	0	10
Transportation	1	1	1	1	1	1	1	1	1	1	0	8
Supplies	1	1	1	1	1	0	1	1	1	1	3	10

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