

## MANAGEMENT OF THE ENVIRONMENTAL RISKS IDENTIFIED IN AN ORGANIZATION

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### ABSTRACT

*Response to risk is a process that is directly involved in risk management and is governed by the organization's security strategy, environmental characteristics and security mechanisms. The management identifies the options available to respond to the risk and analyzes the effects of these options on the likelihood and impact of a risk, in close connection with the availability for the risk and cost-benefit ratio, and then conceives and implements actions of response to risk. These steps are integral parts of risk management and contribute to bringing the level of risk within agreed tolerance limits. The paper presents the evaluation of risk management options and the way of environmental risk management decision making. The multi-criteria analysis of risk management options and the use of the precautionary principle are also presented.*

**KEYWORDS:** risk management, options, decision making, multi-criteria analysis

### 1. Introduction

Environmental Risk Management (ERM), applied at the level of an organization with a significant environmental impact, ensures the organizational structure, responsibilities and efficient allocation of resources so as to manage all the environmental risks associated with the main activities and related activities performed by the organization. In this context, ERM has the role of ensuring a systematic review of the organization's exposure to environmental risks and developing well-targeted risk management programs based on this analysis. This systematic approach provides specific risk management benefits, including improved environmental performance, and responsible risk-response decisions with an effective cost / benefit ratio. A structured and systematic approach to risk management allows for adequate and properly targeted environmental protection measures while avoiding excessive or inadequate measures [1]. Developing structured and documented risk assessment and management was essentially determined by the recognition that the possibility of negative and undesired results of an activity cannot always be eliminated [2]. Therefore, there is a need for a way to evaluate the following issues:

- the severity and probability of these negative results;
- applying appropriate control measures with an effective cost-benefit ratio;
- acceptance or tolerance of remaining risk after the available control measures have been implemented.

The risk management is a particular type of management considering the main objective, namely making decisions to address risk or establishing a response to risk [2]. For this reason, the main steps are not only those proposed by the Deming cycle (planning, executing, verifying, improving), and all specialists in the field agree to go through the following specific steps for a good risk management:

- systematically applying policies, procedures and practices to identify hazards;
- analyzing the likelihood and consequences of these hazards;
- estimating (quantitative or qualitative) risk levels;
- assessing these risk levels based on relevant criteria and objectives;
- making decisions about the identified risks.

Response to risk is a process that is directly involved in the risk management and is governed by the organization's security strategy, with its environmental characteristics and security

mechanisms. The top management or environmental manager identifies the options available to respond to the risk and analyzes the effects of these options on the likelihood and impact of a risk, in close connection with the availability of risk and the cost-benefit ratio, and then conceives and implements risk response actions. These steps are integral parts of risk management and contribute to bringing the level of risk within the agreed tolerance limits.

## 2. Evaluating the options for environmental risk management

In the process of assessing environmental risk management options, consideration should be given to the relationship between environmental protection and improvement so as to allow for sustainable and long-term economic growth [3].

Environmental security aims at achieving a better quality of life globally, both now and for future generations [4]. The overall objective is to make sure that the economic and environmental benefits are available to everyone. It has been recognized that achieving environmental security requires a collective partnership in the decision-making process for environmental protection. Therefore, environmental management strategies must take into account economic requirements, social needs and the ability of the environment to deal with spills, pollution and other disturbances, in order to support humankind and all other forms of life. Continued efforts are being made to develop specific methods for assessing environmental risks and choosing their management options such as they are, for instance those that support land-contamination risk management decisions [5-9].

Unacceptable environmental risks require appropriate management to bring them to a tolerable residual risk. The zero risk is a target usually not achievable or demonstrated. Evaluating options for reducing environmental risks is the process of identifying and selecting the most appropriate risk management strategy taking into account the constraints imposed by the decision-maker [10]. The systematic methods that can be used to compare and evaluate risk management options cannot be universally valid for all circumstances. There is usually the possibility of selecting or adapting an existing methodology, but there will always be cases that will require the development of new methodologies.

Risk mitigation opportunities can be found along the whole risk analysis approach. In identifying opportunities for risk reduction, the following aspects will be considered:

- eliminating the hazard (such as replacing a hazardous chemical with a non-hazardous one in the technological process);
- reducing potential consequences (e.g. reducing stocks of hazardous substances or increasing security measures);
- reducing frequency / probability (e.g. increasing the frequency of maintenance and repairs or monitoring or taking additional measures).

Risk reduction will concern both the whole system and:

- possible changes to some operational phases;
- changes to protective measures;
- essential changes, for example: relocation of installations, revision or replacement of technology, revision of the mode of transport.

It is important that risk management facilitates risk mitigation so as to adopt the management option that results in the lowest risk levels whenever they are affordable to an affordable price. Identifying risk mitigation opportunities will focus on their likely impact on risk levels. It is important to identify risk management options as a distinct preliminary step because inappropriate risk management strategies can lead to unnecessary efforts and expenses [10].

The available risk management options can be [4, 11-13]:

- eliminating the source of risk wherever possible;
- mitigating the effects of hazards by improving environmental management techniques or engineering systems;
- minimizing risk through new technologies, procedures or investments;
- exploiting the beneficial potential of risk by accepting new opportunities;
- accepting the risk of not intervening in new or existing situations;
- transferring the risk to a third party.

To select the appropriate risk management options, the potential positive and negative effects associated with each option will be assessed by analyzing at least the following factors [14]:

- technical factors: for example, the degree of research and development needed;
- economic factors: the cost of implementing the option;
- environmental security: the potential impact of options on health and sustainability of environmental resources, including impacts on existing habitats;
- social issues (social impact of risk) such as: potential costs or another loss to the community, jobs or housing prices, life expectancy, etc.;
- organizational capabilities - the ability to manage risks within the organization, other bodies, or the ability of the exposed society or groups.

Combining these elements allows for a systematic comparison of risk management options.

### ***2.1. Economic considerations in choosing risk management options***

Risk reduction can often be carried out at a low cost, and in some cases leads to substantial savings in operating or capital costs. Economic factors can have a significant influence on the decision-making process and may affect the acceptance of a given option. The best option will probably be the one that provides the greatest benefit achieved at the lowest cost. Benefits can come from reducing damage (avoiding damage or loss of property, material or cultural damage, damage to human health and environment). Benefits can also be achieved by reducing costs such as:

- social costs;
- regulatory costs and private costs;
- control costs, including construction and maintenance;
- the costs of remedying environmental damage.

Economic considerations should include both those benefits and costs that can be measured in money as well as those that cannot be measured as such, or for which accurate monetary assessments are not available. The latter must be evaluated physically and qualitatively. We need to make sure that the decision-making process pays same attention to all elements, without the non-valued ones being considered significant in relation to the elements that do not allow for such assessments. Applying a multi-criteria decision analysis can help to discern the benefits associated with various risk management options [4].

### ***2.2. The role of criteria and objectives in choosing management options***

Once the hazards have been identified and analyzed, the risk objectives or criteria set up at the beginning of the risk analysis can provide a rational and consistent basis for identifying risk mitigation options / options for assessing risk responses.

When risk analysis only aims at comparing cases and identifying options for the lowest risk, the analysis may be simple and no other criteria are required. When a risk analysis has the purpose of determining the level / rank of the risk and identifying the factors that can contribute most to risk, the need for criteria may be limited [15, 16]. For most analyses, however, the defined objectives and / or criteria are important. While the criteria are largely used towards the end of the analysis, identifying,

selecting or developing relevant criteria should be made earlier than the end of the risk analysis and eventually improved over time. In this way, the criteria can be taken into account throughout the risk management process. This approach will help determine when a hazard can be removed from a more in-depth examination on the grounds that it has a low consequence or probability. Therefore, the results can be developed in an appropriate form for the assessment of management options according to specific criteria. In spite of this, economic considerations on benefits and cost effectiveness may become de facto criteria [17].

Even if criteria are important, it should be underlined that it is just as important that the risk analysis and management process do not become a criterion verification exercise, missing the main purpose of achieving a real improvement in safety and environmental protection.

### **3. Making decisions on environmental risk management**

The best decisions on environmental risks require both the best scientific approach and the best decision-making processes. Decision-making will be based on information, knowledge, experience, concerns, research and understanding as well as support by the people who may be directly affected by them. Risk management involves all categories of staff, never being solely the responsibility of the top management or risk advisory organizations. Running the risk management process requires both commitment and decision-making power of the top management along with employee involvement, because the latter can first identify an incident, a potential hazard or an opportunity for improvement. In this approach, it is important for the decision maker to be fully informed about the objectives and the way to decide, especially when the choice is between the benefits of risk mitigation and the cost of introducing appropriate measures.

Appropriate decisions will be based on an effective and accurate assessment of alternative risk management options. A systematic assessment of the options will be a process of identifying and quantifying the costs and benefits of the measures to implement the environmental management. This process should include all possible options and implications, not just those that can be quantified. A framework for decision-making can include the following steps:

- well-defined identification of the target and the desired result;
- identifying the options for achieving the objective or the result sought;

- clarifying the decision criteria and the implications of applying an economic, social and environmental option;
- identifying the tools needed to implement options such as policy instruments, measures or economic regulations;
- identifying the impact of the options (in this respect it will be necessary to collect data from the stakeholders that will be affected by the potential measures);
- comparing the advantages and disadvantages of each option, including the compromise between quantified and qualitative data.

### 3.1. Multi-Criteria Analysis

The analysis of decision options, taking into account several criteria (also called multi-criteria analysis) such as economic, social and environmental criteria, is a complex approach, largely due to inherent compromises between these risk-affected areas.

Selecting an appropriate risk management strategy often involves additional criteria, such as environmental impact distribution or costs and benefits [18]. Decision-making research based on a multi-criteria analysis [19-21] has allowed for the development of practical ways to compare decision-making options when there are several criteria for assessing these options [22]. The main advantage of multi-criteria analysis is its ability to draw attention to areas of divergence between stakeholders and decision-makers. However, the need to reach a consensus with stakeholders on the main criteria in question may lead to limitations in the use of the method. Participants may initially be unprepared to give up their own opinions, but they may better understand an alternative option presented through a multicriterial analysis [23]. Multi-criteria decision analysis typically meets criteria and performance levels in the form of matrices to provide a basis for integrating risk levels and uncertainty. In this way, it is possible to carry out an assessment of alternative risk management options. Table 1 presents a multi-criteria analysis matrix of the decision on a risk management option.

The efficiency of the criteria according to the options being evaluated can be a two-step approach:

- First, how each option will affect the issue is presented in terms of positive and negative effects on the three main elements: environment, society and economy;
- Next, for the option considered optimal, the potential risks of applying that option (e.g. organizational capacity, complexity of implementation) will be considered.

For example, the decision matrix presented in Table 1 shows that decision 3 is the most effective in terms of risk reduction, but it is costly. Depending on the opinion of the decision-makers and the available budget, they can select decision 3 or a cheaper option, decision 2, which can still lead to an adequate level of risk reduction [22]. If the risk response becomes clear, the effectiveness of the action chosen by the risk management is then verified during the monitoring and risk assessment phases.

**Table 1. Multi-Criteria Analysis of Risk Management Options [22]**

Criterion	Decision 1	Decision 2	Decision 3
Economic	?	↑	↑
Environment	↑	↓	↓
Social	↑	↔	↓

↓ - decrease in risk level  
 ↑ - increase in risk level;  
 ↔ - insignificant impact on risk;  
 ? - insufficient information or too many uncertainties to analyze the option impact.

### 3.2. Involvement of the interested parties/stakeholders and the public in decision-making

In some cases, it may be necessary to involve stakeholders and the public in the decision-making process on the choice of environmental risk management options. It is possible that those who were involved in defining the risk area or planning the risk assessment would like to be involved in the post-evaluation phases as well. This can be beneficial because good decisions are often based on the information, knowledge and concerns of stakeholders and the public and are understood and supported by people who may be directly affected by them (e.g. studies on genetically modified vegetables, designing a new food control system, granting license for land use, remediating a contaminated site). The involvement of stakeholders and the public in assessing risk management options can lead to positive results such as conflict resolution, social education [24], wider knowledge integration and community support [25]. In practice, the too late consultation of stakeholder decision-making [26] is no longer appropriate so as to actually influence the decision. The result may be public frustration, opposition to decisions made and requirements for more information, resulting in delays in decision-making. These difficulties have led to the adoption of analytical and deliberative decision-making processes in many countries that enable public involvement through analyses and debates on risk assessment and

risk analysis (known as participatory risk assessment). Participatory risk assessment has been recognized as a valuable way to support public commitment.

In planning a risk assessment, public commitment should be ensured for:

- stakeholders and public opinion who can be considered in decision-making;
- the situation where there is, it is likely to be, or has been concern about the risk issue;
- support for stakeholders and the public for decision-making.

A participatory risk assessment process is joined by a bottom-up approach. This process aims at involving stakeholders and the public in: formulating the problem, assessing preferred management options, and proposing solutions to specific risk issues.

There may be several decision-makers (environmental authorities and agencies, NGOs, etc.) that need to be involved in the assessment of risk management options. In this case, it is important to clearly show to those involved the goals and limits of what can be achieved. For example, it may not be possible to change the land use decision, but it is possible to introduce conditions for construction and activities [1].

### ***3.3. Relevance and use of the precautionary principle in decision-making***

The precautionary principle may be invoked if a preliminary scientific assessment shows that there are reasonable grounds for concern that a particular activity could lead to harmful effects on the environment or on the health of plants, humans, animals or would be in conflict with the protection normally provided to them within the European Community. The precautionary principle states that "In order to protect the environment, a cautious approach is widely applied by states according to their capabilities. If there are threats of serious or irreversible damage, the lack of full scientific certainty will not be used as a reason for postponing measures to prevent environmental degradation "(Principle 15 of Agenda 21). If the precautionary principle is adopted, decision-makers establish:

- what action is necessary in view of the potential consequences if no action is taken;
- the uncertainties inherent in scientific evaluations;
- consultation of stakeholders on possible ways of risk management

The measures adopted must be proportionate to the level of risk and the desired level of security. They should be provisional, pending the availability of more reliable scientific data. Research into the use of

the precautionary principle [27] has already identified the following issues to be considered:

- admitting the lack of information;
- the need for long-term monitoring of the actual field conditions;
- taking into account the benefits;
- the use of local knowledge and expertise;
- avoiding lack of analysis and action to reduce potential injury when there are good reasons for concern.

## **4. Conclusions**

The environmental risk management applied at an organization is intended to evaluate options for addressing the identified environmental risks and to make the best decisions to eliminate and minimize these risks.

Assessing the risk response options will be based on economic considerations, the best option will be the one that ensures the highest benefit achieved with the lowest cost.

The risk management involves all categories of staff and is never the sole responsibility of top management or risk advisory organizations.

Making appropriate decisions on ERM will be based on an effective and accurate assessment of alternative options.

The analysis of decision options, taking into account several criteria (also called multi-criteria analysis) such as economic, social and environmental ones, is an appropriate method of assessing decisions.

The involvement of stakeholders and the public in making decisions is important. This can be beneficial because good decisions are often based on the information, knowledge and concerns of stakeholders and the public.

The precautionary principle in management decision-making may be invoked if a preliminary scientific assessment shows there are reasonable grounds for concern that a particular activity of the organization could lead to harmful effects on the environment.

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