

## **RISK ASSESSMENT AND RISK MANAGEMENT STRATEGIES**

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**ABSTRACT.** – **Evaluarea și strategiile de gestionare a riscurilor.** Evaluarea și gestionarea riscurilor reprezintă un demers complex și anevoios. Poate că și din această cauză este preferată abordarea lor numai după producerea unui dezastru. Ar fi de dorit ca aceste procese să fie inițiate înainte în scopul pregătirii populației și oficialităților pentru a face față acestor evenimente. Evaluarea riscurilor este acel proces obiectiv care trebuie să fie piatra de temelie a gestionării riscurilor.

### **Introduction**

We always have to choose between some alternatives, either we want or not. We must choose between alternative courses of action which have some degrees of uncertainty. No matter what decision we may take there is a chance to be wrong, so we are aware of the fact that it may be risky to us. We informally assess risks when we make choices in our everyday life.

Formal, the risk analysis is used when the likelihood magnitude of the potential risks are perceived to be very high or very uncertain (Jones et al, 2001).

The outcome of the natural or man-made hazards is complex and it is rarely well known with high certainty. The risk include squandering limited resources, incapability to reduce the most significant impacts and creating more significant problems than those already existing.

Although the resources we may benefit of are very limited, and at the same time very diversified, all risks cannot be eliminated. We have to decide what risks are to be evaluated in order to be reduced and how much of reduction is enough. The most notable risk is human carelessness regarding the occurrence of natural and man-made hazards.

Risk assessment and risk management may be done both before and after the occurrence of the hazard. Unfortunately, only when a disaster appears people think of mitigation. It is desirable for these processes to be performed before the occurrence of the disaster in order to prepare the population and the local administration to cope with the crisis. From this point of view some simulations may be useful for the local people but also to the decision-makers to prepare them to better react when they are faced with emergency situations.

Risk assessment is important for the decisions to be made (risk management) from an objective point of view. It represents the starting point for further planning or decision making.

## 1. Terminology: Basic terms used in risk assessment and risk management

There are key-words that are essential in risk assessment and risk management. Some of them, such as hazard, risk, sensitivity, resilience, vulnerability were already defined (Mac, Petrea, 2003, Cheval) in Romanian literature, so we will focus upon others.

*Acceptable risk* represents “the level of loss a society or community considers acceptable given social, economic, political, cultural, technical and environmental conditions” (UNISDR, 2001). In engineering terms acceptable risk may refer to describe structural (improving the design and the building of new facilities, adapting of the existing ones, building protection facilities) and non-structural (limiting land-uses, tax incentives and insurance programs) measures in order to reduce possible damage at a level that does not harm people and their properties.

*Assessment endpoints* “are an explicit expression of the value that is to be protected; they consist of an entity, a property of that entity that can be measured or estimated and, whenever possible, a level of effect on that property that constitutes an acceptable risk” (Jones et al., 2001).

*Capacities* are those positive factors that increase people’s ability to cope with hazards.

*Integrated risk assessment* is the process of bringing different disciplines together to create an extended view over the problem in question. More information and different points of view make the analysis more comprehensive.

*Measures of effects* are those measurable changes in an attribute that are given by the action of a stressor upon an assessment endpoint.

*Measures of exposure* represent the measures of stressor existence that influence the distribution of a receptor or of a stressor that, in turn, influences exposure and responses to it.

*Mitigation* represents “structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards” (UNISDR, 2001).

*Preparedness* is expressed by the “activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary removal of people and property from a threatened location”(UNISDR, 2001).

*Public awareness* is “the process of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards” (UNISDR, 2001).

It is the responsibility of public officials to inform people about potential risks in order to save their lives and properties. It should be developed a “culture of

risk” among people by public information, dissemination, education, radio or television broadcast, printed materials, conferences, seminars, public meetings etc. The more informed the people are the less the damages will be.

*Receptor* is considered any entity (human or non human) that is exposed to the action of one or more stressors.

*Risk analysis* is the second step in risk assessment in which the exposure and the effects are analysed.

*Risk assessment* is “a process to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, properties, livelihoods and the environment on which they depend” (UNISDR, 2001).

*Risk management* is “the subjective process of deciding which actions to take in response to a potential risk” (Jones et al., 2001).

*Stressor* is any entity that actions upon a receptor and produces an adverse response in it.

## **2. Risk assessment**

As defined above, risk assessment implies potential hazards identification and evaluation of vulnerability, on the basis of physical, human elements and the socio-cultural dimensions.

The basic characteristic of risk assessment is that it offers transparency and objectivity to the decision-making process. This is the result of implementing a standard structure in order to facilitate interactions between experts and decision makers.

There should be a distinction between risk assessment (quantitative and objective) and risk management (qualitative and subjective).

*Risk assessment* implies the identification of the likelihood and the magnitude of adverse effects (also identifying the effects that occur, either direct or indirect) while *risk management* is the decision making process regarding what actions to take in response to a risk. Risk evaluation is an objective process and risk management is a subjective one. The difference between the two does not mean that the assessors and the managers should not conlucrate but that they should interact. The endpoints of evaluation are the tools for managers’ work. In the same time the assessor has to ensure that his estimations are not influenced negatively by these interactions.

### **2.1. Principles of risk assessment**

The principles should be considered as criteria for selecting the endpoints of assessment. They are very important and if one or more of them is not implemented in the analysis this cannot be considered a reliable tool in risk assessment.

a) *the principle of relevance* – the assessment should focus on the value that is to be protected. For instance, if the value is a community then the endpoints should be relevant from the social point of view.

b) *the susceptibility to specific risk factors* is a function of exposure and sensitivity. An entity of the endpoints of assessment should be exposed, or potentially exposed, to a specific factor of interest. When selecting an entity to be evaluated we should consider the characteristics of the stress factors.

c) *the sensitivity* is a function of the action of the stress factor and of the characteristics of the receptor. We should focus on the way in which the functioning of the affected systems is disturbed.

d) *relevance for public policy and management* – the endpoints should respond to the necessities of decision makers. These are meant to be implemented in practice, so they are supposed to be applicable.

## **2.2. Types of risk assessment**

There are three types of risk assessment: comparative assessment, discipline specific assessment and integrative risk assessment (Jones et al., 2001).

*Comparative assessment* is used to choose between several alternatives. The positive and negatives aspects are underlined, compared and valued.

*Discipline specific risk assessment* can be applied to a very narrowly topic as it is concerned to problems regarding a single field. For example the risks of a disfunctioning system (e.g. a landslide affecting a road) can be estimated as part of an engineering evaluation project, without taking into account human or ecological disturbances.

*Integrative risk assessment* is more complex and more used than the other ones. It puts together different types of information in a cohesive and comprehensive way. It is designed to bring together more disciplines in order to prepare a competent project (geography, engineering, economics, ecology, sociology etc). This high-level framework is meant to sustain the integrated risk assessment.

Integrative risk assessment also includes: space, time, sources of risk (other activities in that area that may be regarded as risky), results (direct effects cause indirect effects), multiple endpoints (for instance engineering costs and social impacts).

## **2.3. Steps in risk assessment**

Risk assessment is a process of application of a methodology for evaluating risk as defined by probability and frequency of occurrence of a hazard event, exposure of people and properties to the hazard and consequences to that exposure.

There are three major steps related to risk assessment. These include risk identification, risk analysis and vulnerability evaluation (risk exposure).

**a. Risk identification** represents the most important step in this process. It consists of defining and describing the type, the magnitude, the severity of the hazard. Potential exposures (hazards) may be classified as natural, technical or human.

In order to identify risks we should identify hazards first. For this purpose it is useful to complete a form. This way we will understand better which are the threats and how powerful they are (a potential model of this form is presented in Table 1).

**Table 1.** Risk identification form

Hazard	Location	Probability of occurrence	Rate of impact	Risk factor
Landslide				
Flooding				
Terrorism				
.....				

There are many methodologies of identifying and rating risk. Each of them takes into consideration some parameters such as duration, frequency, severity, long or short term impact, damages etc.

In 1993, *Long and John* (quoted by FEMA, [www.fema.gov](http://www.fema.gov)), proposed a risk matrix that considers the frequency and the severity of the event. They are given a qualitative measure that permit the prioritization of risk. Frequency varies from *very low* (events that occur less frequently than once in 1,000 years) – *low* (events that occur from once in 100 years to once in 1,000 years) – *moderate* (events that occur from once in 10 years to once in 100 years) – *high* (events that occur more frequently than once in 10 years). Severity is rated as *minor*, *serious*, *extensive and catastrophic*. According to these parameters four classes of classification arised:

- class A – high-risk condition with highest priority for mitigation and contingency planing (immediate action). Exemple of losses: death or fatal injury, activity is interrupted for more than one month, more than 50 percent of the properties are severely damaged.
- class B – moderate-to-high-risk condition with risk addressed by mitigation and contingency planning. Exemples of losses: severe injury or illness, activity is intrerrupted for more than two weeks, more than 25 percent of the properties are severely damaged.
- class C – risk condition sufficiently high to give consideration for further mitigation and planning. Exemples of losses: injury or illness not resulting in disability, activity is interrupted for more than one week, more than 10 percent of the properties is severely damaged.

- class D – low-risk condition with additional mitigation contingency planning (advisory). Examples of losses: treatable first aid injury, activity is interrupted for more than 24 hours and no more than 1 percent of the properties are severely damaged.

This approach does not take into consideration the span of the event and the affected area (square km). These two parameters offers a real dimension to the event.

Another method used to identify the risk is the weighted point rating system (Wold, 1997). It consists of four impact rates and three classes of probability points. The impact of hazards may be rated as follows (Wold, 1997, modified):

- 0 – no impact;
- 1 – noticeable impact, interruption in activities up to 8 hours;
- 2 - damage to equipment and/or fatalities and humans, interruption in activities for 8-48 hours
- 3 – major damage to the equipment and/or facilities and humans, interruption in activities for more than 48 hours.

Each level of probability of occurrence can be assigned points as follows: high-10, medium-5, low-1.

To obtain a weighed risk rating, probability points should be multiplied by the highest impact rating for each facility. For example, if the probability of seismic activity is high (10 points) and the impact rating is 3, then the weighed risk factor is 30 (10x3). This is the rate for the highest risk a threat can pose.

Beside the fact that there are very few parameters taken into consideration, Wold does not offer a risk classification scale. It is useless to rate if we cannot assess on the basis of this rating.

Considering the weighted risk rating proposed by Wold, the risk factor may be classified as follows:

- 0-5 low
- 5-10 medium
- 10-15 medium to high
- 15-20 high
- 20-30 extremely high.

One of the well-known classifications was elaborated by *Bryant* (1992). It is a complex one because it considers nine criteria (severity, duration, affected area, total human injuries, economic losses, social effect, long term impact, speed of onset, connective phenomena). Each category was given grades from 1 to 5 (1- the most severe situation, 5- the less severe situation). According to the average values obtained he ranged the natural phenomena at risk in a decreasing order.

**b. Risk analysis** estimates the probabilities and the expected consequences for an identified risk, or the exposures and the effects. The

consequences will vary with the magnitude of the event and with the vulnerability of the affected elements.

Exposures and effects are interdependent, meaning that the type of the stressor determines the effects that will be evaluated as the time and the space in which these are found. In their turn, they will determine a certain type of exposure.

In analysing the risks there are some considerations (Wold, 1997), which should not be omitted. These include:

- investigating the frequency of particular types of disasters (often versus seldom);
- determining the degree of predictability of the disaster;
- analysing the speed of onset of the disaster (sudden versus gradual);
- determining the amount of forewarning;
- estimating the duration of the disaster
- considering the impact of a disaster based on two scenarios (vital records destroyed/not destroyed);
- identifying the consequences;
- determining the cost of the contingency planning.

**c. Vulnerability evaluation (risk exposure)** is the outcome of the risk analysis. Risk exposure represents the total amount of risk exposed by the adverse event and may be considered as the summation of all individual risks identified. It may be internal (within the system) or external (being exposed to influences from the contiguous systems). Its size is a function of the characteristics of the system, of the social, economical and political realities, of the degree of technological development, etc. (Mac, Petrea, 2003). Vulnerability (exposure) may be expressed in various units depending on the nature of the consequences (destroyed houses, injuries, lives lost or total damages etc. - estimated in currency).

### **3. Steps in risk management**

Risk management is the subjective and qualitative process of selecting and implementing mitigation measures to achieve an acceptable level of risk at an acceptable cost.

At what level should risk management be evaluated? Is it a matter of public or individual policy? Risk management is approached at local, regional, national and global scale. It would be better to exist a cooperation between individuals and the officials and between different officials in order to manage risk. Local management should be expanded at higher levels because this is the way to achieve a better solution. A good cooperation between neighboring countries is welcomed as it may be a way of improving experience and knowledge in a field that interests both parts (for example the pollution of Tisa would have been better managed if the two countries had had a common risk management programme).

Masure (2002) proposed a three level approach:

1. a *thematic approach* (at sectorial, local level);
2. an *integrative approach* (centered on risk management, at regional, national level);
3. a *global approach* (centered on sustainable development, at regional, national, global level).

### **3.1 Risk appraisal**

This step requires the establishment of the risk. On the one hand it may be considered as acceptable or tolerable. On the other it may be intolerable. A complication is the difficulty in quantifying the intangible benefits of a certain decision. These include possible political “fallouts”, injuries to personal or organizational integrity. The research is guided by the attitude of the “actors” involved (Agumya, Hunter 1997).

Acceptable risks may be considered those having dramatic consequences, but low frequency, while the unacceptable ones have less dramatic consequences but high frequency (Ozunu, 2000). This depends on the perception of the people.

Nowadays there is a line between acceptable and accepted risks that become almost routines. The society accepts the price they have to pay. Such examples are the communicative disease (AIDS, malaria, tuberculosis etc) or waterstress. Accepting or refusing the risk does not mean that there isn't any intensity involved. Risks with a low rate of amplification may be the detonator of serious social crises (Dauphiné, 2001). Such examples are the strikes.

### **3.2. Risk evaluation**

It implies the comparison of risk exposure with the results of risk appraisal. There are two possibilities (Agumya, Hunter 1997):

- 1) when risk exposure is less than or equal to the tolerable risk, then the information may be used;
- 2) when risk exposure is greater than the acceptable risk appraisal, then the following measures should be taken:
  - rejecting the information and obtaining others of superior quality;
  - retaining the information but improving its quality;
  - using the information regardless of the consequences.

### **3.3. Risk response**

This is the final step in risk management. A decision must be taken regarding the risk exposure issue. The risk has to be faced after deciding that it is tolerable and the information can be used.

The decision-makers are supposed to give a response to the issue of concern. They have few options to consider:

1) to avoid the risk – meaning to do nothing about it. The decision-maker chooses not to be exposed to risk by not taking any decision. Hardly is it a solution.

2) to retain the risk – the decision-makers are responsible for the consequences of an adverse event.

3) self-insurance – when a governmental agency establishes a refund for those communities that were affected.

4) risk transfer – the risk is transferred from one organization to another.

Nowadays a challenge is represented by “the incorporation of the perceptual values into the appropriate stage of the risk management process” (Brebbia, 2002). Perception is usually taken into consideration only when a crisis has already materialized. Perception values should be used as preventive tools starting with “the initial planning and definition stages of the action development process onwards” (Brebbia, 2002). The result will be a better understanding of the concerns of the population and an improved ability of risk managers to cope with future risks.

#### 4. Techniques of risk reduction

There are lots of techniques to reduce risk. Based on sectorial strategies governments have developed national strategies but, unfortunately, these are not as effective as they were meant to be. An example is the French PPR (Plan de prevention des risques naturels previsibles).

FEMA established six types of risk reduction techniques (Dauphiné, 2001):

- *prevention measures based on regional planning*
- *property protection measures*
- *nature protection measures*
- *creating first-aid facilities*
- *technical tools (e.g. dams, filters etc)*
- *public informing*

#### Conclusion

Risk is a composite notion that embodies hazard and vulnerability, being a function of the two.

In analysing risk one must distinguish between risk assessment and risk management. These are complementary concepts. The former supposes the existence of three major steps: risk identification, risk analysis and vulnerability evaluation (risk exposure). Based on the results of this assessment managers should conduct their own investigation focusing on: risk appraisal, risk evaluation and risk response.

Risks may be assumed or not but either way some measures have to be taken. These aim to prevention and protection of people, nature and facilities.

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