

## CONSIDERATIONS ON AN INTEGRATED APPROACH TO BEST PRACTICE IN RISKS MANAGEMENT IN THE PROCESS INDUSTRIES

**Ion DURBACĂ**

POLITEHNICA University of Bucharest, E-mail: [ion.durbaca@yahoo.com](mailto:ion.durbaca@yahoo.com)

**Abstract:** The primary objective of the paper is the integrated approach of best practices in risks management in the process industries. Also, it may be mentioned that the work is a real help in developing management strategies in order to determine a balance of interaction between the four systems (economic, human, environmental and technological) and 'drafts' a reference of integrated management of industrial risks.

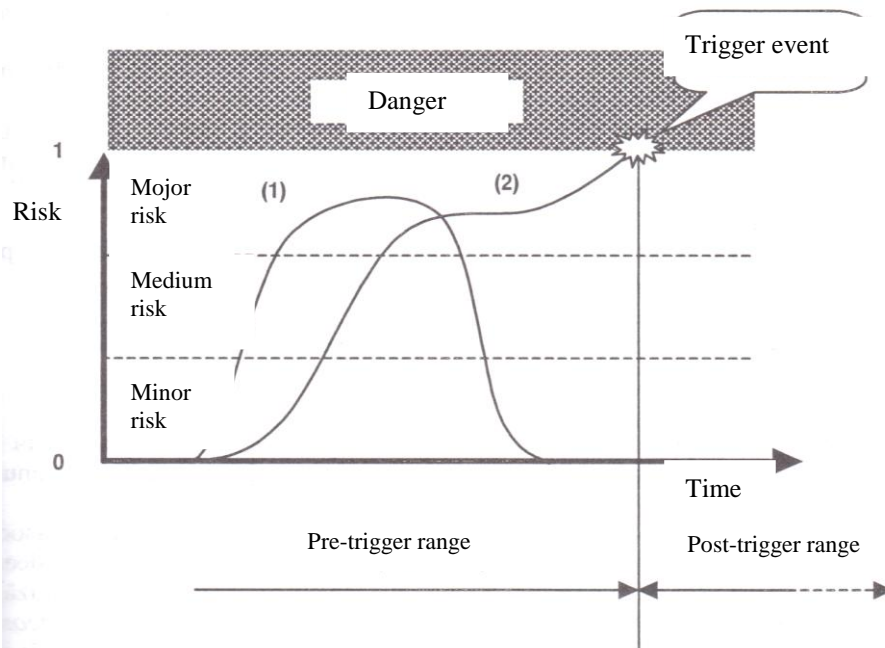
**Keywords:** emerging risk, integrated management assessment, potential, gravity.

### 1. PRELIMINARY CONSIDERATIONS ON THE RISK

The current sense, with few exceptions, the concept of 'risk' on a serious technical accident, the destructive implications of technological facilities that occurs, the service staff and the neighborhood and the environment is defined based on the correlation between two items / 1 /:

- ◆ likely trigger a technical accident (risk);
- ◆ technical severity of the consequences caused by

accident when triggered (danger). As can be seen from Figure 1, below, these two concepts - risk and danger - that make up the conventional concept of risk, there are two distinct concepts, but is a complementary relationship, where, in its evolution, 'risk' reach value 1 - 'certainty' - destructive event materializes and begins its evolution. First, if an event with destructive consequences can be said that where the risk ends danger begins.



**Figure 1. Evolution of risk to certainty and concrete threat**

Addressing the concept of 'risk', only a probabilistic component (abstract) destructive event - especially since this component has certainly changes over time - while the destructive event to be discussed in terms of its evolution, is perfectly justified and does not pose the same problems, can be taken into account at any time, in this form, in any combination.

Regarding the specific component of the destructive event, that occurrence (onset) and its evolution, its destructive potential can have different forms of

expression, grouped under the generic meaning, seriousness of the consequences.

The current understanding, as the severity of the consequences is higher, they say that the event is more dangerous. Is why this part of the event can be characterized by the concept of 'danger'. Global risk assessment is a requirement for various fields and its approach based on correlation „, probability of occurrence - gravity - consequences" is quite useful in practice.

On any organization, and especially industrial, should be considered an 'integrated approach' current and emerging risks, in terms of all interactions between human activities and potential factors generators:

- ERA (Environmental pollution);
  - Risks of accidents and occupational diseases (mechanical, chemical, thermal, biological, radiation, noise, vibration, etc.).
  - Risks to disasters (earthquakes, explosions, fires);
  - Risk management combined with organizational factors (legal, ergonomic, psychosocial, etc.).
- Therefore, general management policy of the organizations in process industries as fundamental tasks assigned, action to help prevent integrated all categories of risks that could threaten the dramatic and sometimes catastrophic consequences, human activities and materials, present and future.

## 2. PROCEDURAL STEPS IN INTEGRATED RISK MANAGEMENT

Risk management is a process of identification, analysis and reporting of systematic risk factors. It involves maximizing the level of all sources of potential risk probability and consequences of positive events, respectively, minimizing the probability and consequences of the events estimated opposing objectives.

To be successful, an industrial operator should be ready to address risk management issues, whenever they should occur. A measure of its seriousness is given to how developing procedures for collecting and analyzing information about potential risk situations.

Main integrated risk management processes are / 2 /:

- ◆ risk identification - determining risk factors that could occur and their documentation;
- ◆ risk assessment through qualitative analysis (making an order of priorities in addressing risk factors) and their quantitative (measuring the likelihood and consequences of risk factors and estimating their implications for achieving objectives);
- ◆ planning response to risk factors - development of procedures and techniques to enhance opportunities and reduce threats to target audiences;
- ◆ monitoring and control of risk factors - monitoring risk factors for permanent identification of new risk factors, risk reduction plans and performance evaluation of their effectiveness throughout the life cycle of industrial objective.

### 2.1. Identification / preliminary assessment of potential sources of risk

Phase identification / preliminary assessment of potential sources of risk is the most laborious and it depends on achieving an efficient risk management. This stage involves collecting and organizing an extremely high volume of complex information to be stored in data banks.

Sources of risk associated with industrial processes strictly related business processes, but they may have at home or can be fostered by external factors, such as for

example:

- failure of technological facilities;
- toxicity / flammability of substances present in the normal or accidental emissions;
- natural phenomena or environmental factors that favor transmission, transformation and accumulation of toxic substances;
- human error.

Thus, preliminary data to be analyzed in integrated risk management include:

- data on the facility design process technology and auxiliary equipment;
- process parameters (temperature, flow, pressure, etc.).
- economic indicators (productivity, consumption);
- data on concentrations of pollutants in gaseous and liquid effluents from the process;
- amounts of waste and chemical compositions (including potentially toxic compounds);
- properties of emitted pollutants (toxicity, reactivity) and possible interactions with other substances;
- toxicological data obtained in experimental animal toxicity studies, which made it possible to obtain correlations dose (pollutant concentration x time) - response (alter the receptor);
- data on environmental conditions that favor the spread and accumulation of environmental factors (climatic conditions, topographic data, etc.).
- historical data on the occurrence of accidents with consequences for the environment, human health, property, facilities similar technology;
- limits on pollutant emissions (average concentration allowed mass flow zones, the maximum permitted concentrations for different periods of turnp, threshold values and concentration values of intervention levels, etc.).
- process parameters prescribed in the rules of operation, etc.

Such data may be the result of direct measurements, balance calculations, mathematical modeling, estimation, allocation, contributions to the entry / exit system, etc. Collection, processing, organization and use these data must be made with more discerning calling for statistical methods do not introduce errors in the next steps that the calculation of risk and decision making. It is recommended that the inventory data to be used after a preliminary analysis of uncertainties.

### 2.2. Risk assessment

Risk assessment in different areas of process industries have been designed a series of qualitative methodologies and / or quantitative, with varying degrees of complexity.

Selecting the most appropriate methodology is made in relation to various factors such as: nature of the problem, assessing the results of previous research in this area, accessible information, available resources, etc.. In general, quantifying the risks involved in a first phase to identify hazards and then assess the actual risk associated with these hazards, by assessing the

likelihood and consequences of producing effects that may arise from the dangers materialize. Components of risk assessment are therefore estimate the risk (including hazard identification, prediction probability of occurrence of an event and assess the implications of this event size) and the risk calculation (including hazard classification by their importance, assessed with consequences for individuals and / or affected environment).

The difference between the two possibilities of evaluation is that qualitative risk assessment considers the probabilities and consequences in qualitative terms (ie "mid", "mart", etc..), While quantitative risk assessment using mathematical methods. Probability of an event / accident and estimate the environmental consequences can not be calculated precisely. Only the existence of complete database and allows to obtain very detailed performance in this respect. However, estimates can be made with an

accuracy good enough so that they can be the basis for establishing practical measures to prevent / minimize the risks.

Risk estimation (qualitative or quantitative) requires that sources of risk (hazard) identified in the analysis of inventory to be associated with a probability of generating events / accidents. This probability is expressed by numbers from 0-1 (where 1 is absolute certainty the number of the event). Probability can be expressed by frequency or percentage. Risk estimations based on plausible scenarios imagining production incidents that may lead to accidental release of large, medium risk of development scenarios for a long period of pollutants in the environment, especially those the trend of accumulation, chronic toxicological effects on biological factors.

Figure 2 presents schematically the methodology for assessing qualitative / quantitative risk / 3 /.

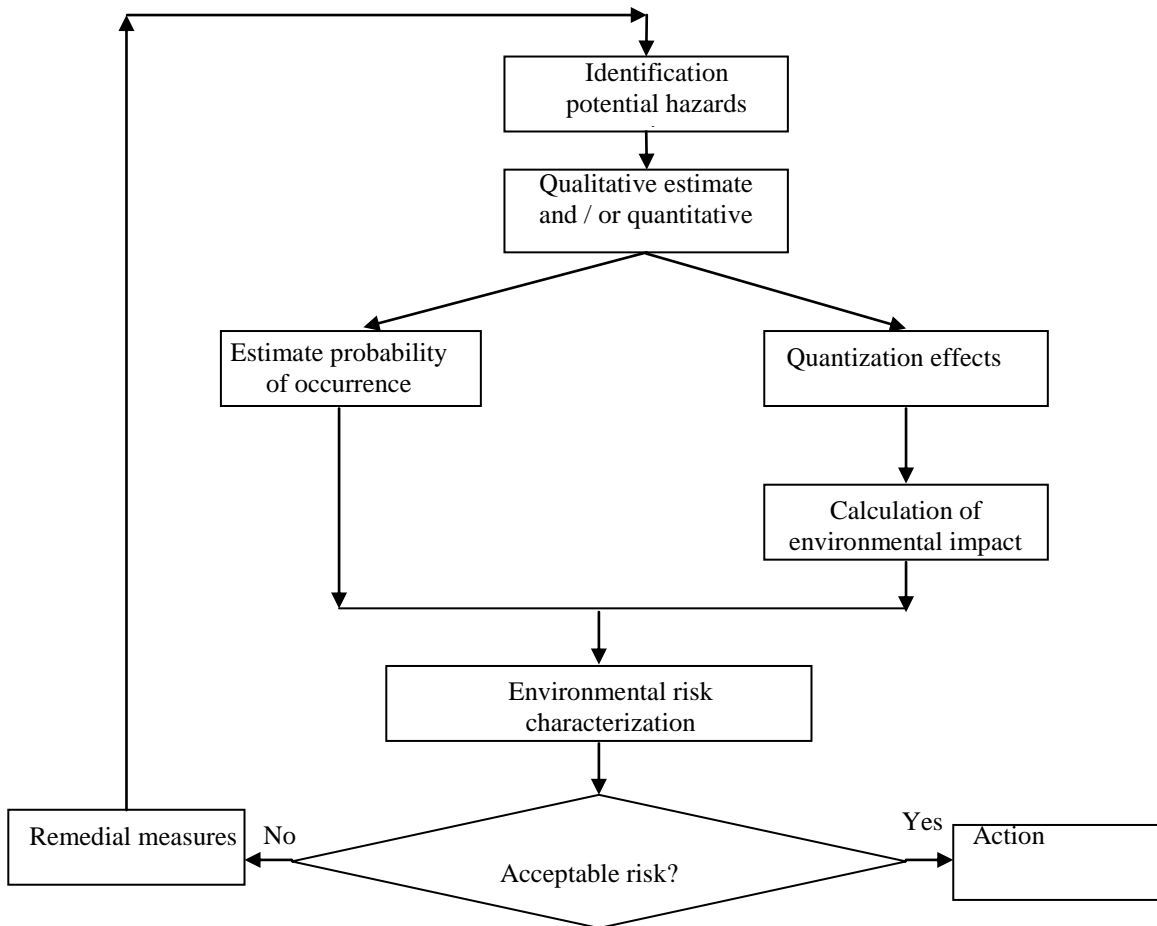


Figure 2. Schematic representation of methodology for environmental risk assessment

Calculation of risk includes quantification of environmental risk consequences, human health, material goods. Stage is actually performing risk assessment of environmental impact sources.

### 2.2.1. Qualitative estimate of risk

Operation of qualitative estimation of risk assessment is to assess the possibility of hazards (sources of risk) to be potential risks and consequences of these risks by estimating the environmental, human and material assets / 2 /.

Qualitative estimate of risk is based on detailed knowledge of the relationship source of risk - means of transport of substances to receiver - receiver consequences.

For a qualitative estimate of risk is most often used risk matrix (proposed U.S. rule 882). In constructing this matrix, using two scales:

- probability scale, which includes six classes (see Table 1);
- scale of severity of consequences, including five different types of consequences in relation to factors affected: human health, environmental, material goods (see Table 2).

Risk matrix, shown in Figure 3, facilitate risk categorization by severity and probability of production and considering the possibility of risk acceptance.

To investigate the possibility of establishing a risk

acceptance level of safety (based on accumulated experience and information on risk analysis) represented by broken line in Figure 3. Risks above the line are considered unacceptable, and those under it, within the category of acceptable risk.

**Table 1. Classes of probability and their significance**

Class	Description	Significance
A	Huge	1/ year
B	high	1/ year ÷ 1/10 year
C	Moderate	1/10 year ÷ 1/100 year
D	Significant	1/100 year ÷ 1/1000 year
E	Minor	1/1000 year ÷ 1/10000 year
F	Very low	1/10000 year ÷ 1/100000 year

**Table 2. Scale severity of consequences**

Level	Category of consequences	Significance		
		For human health	For environment	For material goods (Damage, million \$)
I	Catastrophic	Over 20 deaths, hundreds of major diseases, more than 500 people evacuated	Strong contamination, serious effects on large areas	> 20
II	Very serious	Over five deaths, more than 20 major diseases, up to 500 people evacuated	Contamination strong localized effect on relatively large areas	5 - 20
III	Grave	Major diseases, serious discomfort	Contamination relatively easy, but with relatively large effects	1 - 5
IV	Limited	Mild illnesses, prolonged discomfort	Slight contamination with mild local effects	0,5 - 1
V	Insignificant	Easy and temporary discomfort	Without contamination, with mild local effects	< 0,5

Risk matrix be a useful tool in making decisions on risk mitigation actions required. Due to the complexity, long duration and high cost of quantitative risk estimates, in practice this matrix is frequently used, often stopping risk analysis to achieve risk matrix.

Based on risk analysis according to risk matrix presented, they may choose for the following actions:

- risks with catastrophic consequences and very severe (above the safety line);
- risks with serious consequences and limited (above the safety line);
- acceptable risk (with limited impact and insignificant).

Other qualitative risk estimation methods are:

- analysis of "what if ?" is recommended to be done particularly in the design phase of a plant, but can be used to commissioning or during operation.
- analysis of "HAZOP" ("Hazard and operability") is a method based on similar keywords analysis, what if"and identify sources of risk due to deviations from

normal operation, and constantly monitor the process parameters.

**2.2.2. Quantitative risk estimation**

Quantitative estimate of risk / 3 / is done differently in relation to such sources of risk (chronic and acute) and involves going through four distinct stages (see Figure 4).

**Figure 3. Risk matrix**

<b>A</b>	Unacceptable risks				
<b>B</b>					
<b>C</b>					
<b>D</b>					
<b>E</b>					
<b>F</b>					
	<b>V</b>	<b>IV</b>	<b>III</b>	<b>II</b>	<b>I</b>

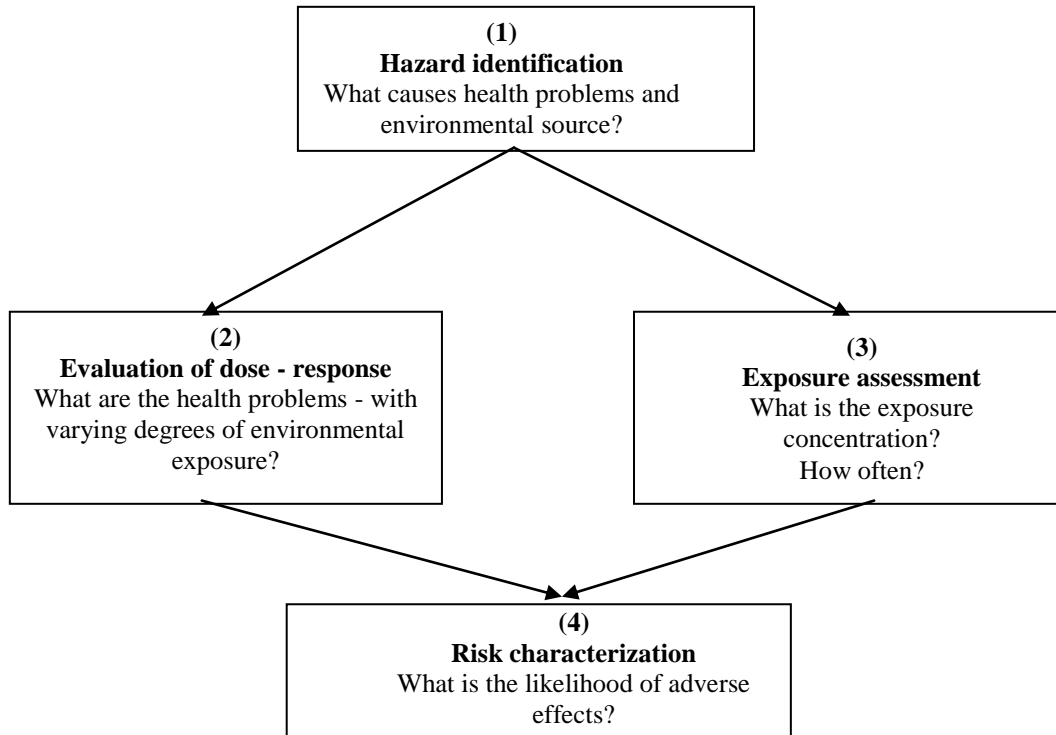


Figure 4. Stages of quantitative risk assessment

### 3. CONCLUSIONS

Top management involvement is essential in developing a philosophy of organizational management of risk and risk awareness at different levels of organization.

Implementation of integrated risk management in an organization must develop risk management programs, for each organizational level. Communication processes of policy and management programs should be given particular attention. Risk management process should be integrated into other planning and management activities.

Risk management should form an integral part of overall system management. Establish procedures for the integration and interaction of risk management system of environmental management system or other management systems implemented organization should not lead to increased resources to this process.

Analyzing and assessing risk management issues to identify and prioritize risks that the organization's control. This hierarchy supports the decisions on treatment options and planning how to achieve continuous improvement environmental performance, in conjunction with environmental management system.

Risk management is an ongoing process that can be used initially as a decision tool for identifying risks that require conducting a detailed review.

This tool involves a qualitative analysis of prioritized risks. Preliminary analysis will allow to determine whether sufficient data for evaluation and management process should be deepened. In other cases, preliminary analysis provides sufficient information to take informed decisions (for example, by identifying risks are

acceptable only in some particular location). Sometimes it is possible to determine whether a risk is acceptable only on a preliminary analysis.

Because fewer risks are of static whole risk management cycle must be repeated regularly. Resumption on the basis of acceptability of increasingly stringent ensure at the same time, continuous improvement of integrated management of risks.

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