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Gabriel Băbuț*, Roland Moraru*, Lucian-Ionel Cioca**

CONSIDERATIONS REGARDING GLOBAL ENVIRONMENTAL RISK TAXONOMY AND ASSESSMENT

1. INTRODUCTION

Risk evaluation had appeared soon after man agreed that he use toxic or other noxious substances in order to satisfy his vital needs and, consequently, a rational use management of these substances was required and became a requirement. First of all, this goal was achieved in an informational manner and afterwards under the compulsory restrictions imposed through legal, statutory acts and sanctions [3].

The study of the connections linking environmental factors and human health is placed in a highly complex field of research, submitted to a significant uncertainty degree. However, at this moment of time, human health and environment are subjected to a special social attention level, continuously increasing, the difficulties mentioned above being not a barrier in approaching antropic environmental changes. Within this context, the precautionary principle starts to act, mainly to keep clear in mind that scientific uncertainty does not justify the lack of action.

Starting from about two decades before, in view of facing the uncertainty situation challenge, new concepts had appeared, directed on a hand to facilitate the synthesis of knowledge existing in the environmental risk field, and on the other hand, to employ the available knowledge in decision-making processes. We are making mention of the „risk assessment" and the „risk management" concepts. More than their interface character, their basic advantage consists in the fact that they are taking into consideration the scientific incertitude, being grounded on a series of explicitly enunciated. The use of these two concepts allows both the simulation processes development and decision-making process optimization.

* Romania, University of Petroşani, Department of Mining Engineering and Industrial Safety, gabriel_babut@yahoo.com; roland_moraru@yahoo.com

** Romania, „Lucian Blaga" University of Sibiu, Department of Economic Engineering, lucian.cioca@ulbsibiu.ro

The risk assessment and management concepts are rapidly evolving, knowing dramatic and deep change, basically due to the very complex character of the approached topic, very controversial topic also.

The basis for such concepts can be taken from a novel approach to risk evaluation, classification and management developed by the German Advisory Council on Global Change [5]. There are two crucial elements of this approach: first an expansion of factors that should be considered when managing systemic risks; second, the integration of analytic-deliberative processes into the regulatory framework. What risk managers need is a concept for evaluation and management that on the one hand ensures integration of social diversity and multidisciplinary approaches, and on the other hand allows for institutional routines and standardised practices.

This new challenge of risk management is accompanied by the emergence of a new concept of risk, called systemic risks [2]. This term denotes the introduction of any risk to human health and the environment in a larger context of social, financial and economic risks and opportunities. Systemic risk are at the crossroads between natural events (partially altered and amplified by human action such as the emission of greenhouse gases), economic, social and technological developments and policy driven actions, both at the domestic and the international level. These new interrelated risk fields also require a new approach of risk analysis, in which data from different risk sources are either geographically or functionally integrated into one analytical perspective. Systemic risk analysis requires a holistic approach to hazard identification, risk assessment and risk management.

2. HOLISTIC ENVIRONMENTAL RISK ASSESSMENT CRITERIA

Systemic risk management and evaluation needs to include the following tasks:

- widening the scope of targets for using risk assessment methodologies beyond potential damages to human life and the environment, including chronic diseases; risks to well-being; and interaction with social lifestyle risks (such as smoking, sport activities, drinking and others);
- addressing risk at a more aggregate and integrated level, such as studying synergistic effects of several toxins or constructing a risk profile of an individual or collective lifestyle that encompasses several risk causing facilities;
- studying the variations among different populations, races, and individuals and getting a more adequate picture of the ranges of sensibilities with respect to operators' performance, lifestyle factors, stress levels, and impacts of external threats;
- integrating risk assessments in a comprehensive problem solving exercise encompassing economic, financial and social impacts so that the practical values of its information can be phased into the decision making process at the needed time and that its inherent limitations can be compensated through additional methods of data collection and interpretation;
- developing new production technologies that are more forgiving tolerate a large range of human error and provide sufficient time for initiating counteractions [2].

A holistic and systemic concept of risks cannot reduce the scope of risk assessment to the two classic components: extent of damage and probability of occurrence. This raises the question: Which other physical and social impact categories should be included in order to cope with the phenomenological challenges of systemic risks and how can one justify the selection [4]?

The concept of systemic risks grasps different risk phenomena as well as economic, social and technological developments and policy-driven actions at the national and international level. Four major properties are significant:

- Complexity refers to the difficulty of identifying and quantifying causal links between a multitude of potential candidates and specific adverse effects. The nature of this difficulty may be traced back to interactive effects among these candidates (synergisms and antagonisms), positive and negative feedback loops, long delay periods between cause and effect, inter-individual variation, intervening variables, and others. It is precisely these complexities that make sophisticated scientific investigations necessary since the dose-effect relationship is neither obvious nor directly observable.
- Uncertainty comprises different and distinct components such as statistical variation, measurement errors, ignorance and indeterminacy, which all have one feature in common: uncertainty reduces the strength of confidence in the estimated cause and effect chain. If complexity cannot be resolved by scientific methods, uncertainty increases.
- Ambiguity denotes the variability of interpretations based on identical observations or data assessments. Most of the scientific disputes in risk analysis do not refer to differences in methodology, measurements or dose-response functions, but to the question of what all this means for human health and environmental protection. Emission data is hardly disputed. Most experts debate, however, whether an emission of x constitutes a serious threat to the environment or to human health. High complexity and uncertainty favour the emergence of ambiguity, but there are also quite a few simple and almost certain risks that can cause controversy and thus ambiguity.
- Ripple effects indicate the secondary and tertiary consequences regarding time and space, i.e. functional and territorial dimensions of political, social and economic spheres. The cross-border impact of systemic risks exceeds the scope of domestic regulations and state-driven policies. To handle systemic risks interdisciplinary mechanisms in international governance are required.

Based on their studies concerning the environmental risk perception, Klinke and Renn have proposed nine assessment criteria which can be employed to develop a global environmental risk ranking system, namely:

- extent of damage: adverse effects in natural units such as deaths, injuries, production losses etc.;
- probability of occurrence: estimate for the relative frequency of a discrete or continuous loss function;
- incertitude: overall indicator for different uncertainty components;

– ubiquity: defines the geographic dispersion of potential damages (intra-generational justice);
– persistency: defines the temporal extension of potential damages (intergenerational justice);
– reversibility: describes the possibility to restore the situation to the state before the damage occurred (possible restoration are e.g. reforestation and cleaning of water);
– delay effect: characterizes a long time of latency between the initial event and the actual impact of damage; the time of latency could be of physical, chemical or biological nature;
– violation of equity: describes the discrepancy between those who grasp the benefits and those who bear the risks; and
– potential of mobilization: is understood as violation of individual, social or cultural interests and values generating social conflicts and psychological reactions by individuals or groups who feel inflicted by the risk consequences; they could also result from perceived inequities in the distribution of risks and benefits.

3. GLOBAL ENVIRONMENTAL RISK CLASSIFICATION

Given the nine criteria and the numerous sub-criteria, a huge number of risk classes can be deduced theoretically. But a huge number of cases would not be useful for the purpose of placing them in a rather simple traffic light model. Considering the task of generating, legitimizing and communicating risk management strategies, risks with one or several extreme qualities need special attention.

Events of damages with a probability of almost one were excluded from this classification. High potentials of damages with a probability of nearby one are clearly located in the intolerable area and therefore unacceptable. Also excluded from the analysis were small-scale accidents that reach large numbers of victims due to their ubiquitous use (such as car accidents). Given these specifications and exceptions, the exercise produced six different risk clusters that the WBGU illustrated with Greek Mythology. The mythological names were not selected for illustrative purposes only. When studying the Greek mythology of the time between 700 and 500 BC, the Council became aware of the fact that these “stories” reflected the transition from an economy of small subsistence farmers and hunters to an economy of more organized agriculture and animal husbandry. The various mythological figures demonstrate the complex issues associated with the new self-awareness of creating future rather than just being exposed to fate.

– Sword of Damocles: the threat rather comes from the possibility that a fatal event could occur any time even if the probability is low. This can be transferred to risks with large damage potentials. So the prime characteristics of this risk class are its combination of low probability with high extent of damage. Typical examples are technological risks such as nuclear energy, large-scale chemical facilities and dams.

– Cyclops: for risks belonging to this class the probability of occurrence is largely uncertain, whereas the disaster potential is high and relatively well known. A number of natural hazards such as earthquakes, volcanic eruptions, floods and El Nińo belong to this category. In other cases human behaviour influences the probability of occurrence so that this criterion becomes uncertain. Therefore, the appearance of AIDS and other infectious diseases as well as nuclear early warning systems and NBC-weapons also belong to this risk class.
– Pythia: that means that both the probability of occurrence and the extent of damage remain uncertain. So the incertitude is high. This class includes risks associated with the possibility of sudden non-linear climatic changes, such as the risk of self-reinforcing global warming or of the instability of the West Antarctic ice sheet, with far more disastrous consequences than those of gradual climate change. It further includes technological risks for which neither the maximum amount of damage nor the probability of certain damaging events can be estimated at the present point in time.
– Pandora's box: a number of human interventions in the environment cause wide-ranging, persistent and irreversible changes without a clear attribution to specific damages - at least during the time of diffusion. Often these damages are discovered only after the ubiquitous diffusion has occurred. (e.g. persistent organic pollutants).
– Cassandra: the probability of occurrence as well as the extent of damage is high and relatively well known, but there is a considerable delay between the triggering event and the occurrence of damage. The anthropogenic climate change and the loss of biological diversity are such risk phenomena. Many types of damage occur with high probability, but the delay effect leads to the situation that no one is willing to acknowledge the threat.
– Medusa: damage extent is low, probability of occurrence is partially uncertain. Some innovations are rejected although they are hardly assessed scientifically as threat, but they have special characteristics that make them individually or socially frightening or unwelcome. This risk class is only of interest if there is a particularly large gap between lay risk perceptions and expert risk analysis. A typical example is electromagnetic fields, whose extent of damage was assessed as low by most experts because neither epidemiologically nor toxicologically significant adverse effects could be proven. Exposure, however, is wide-ranging and many people feel involuntarily affected by this risk.

4. GLOBAL ENVIRONMENTAL RISK MANAGEMENT STRATEGIES

The essential aim of the risk classification is to locate risks in one of the three risk areas in order to be able to derive effective and feasible strategies for risk management as well regulations and measures for the risk policy on the different political levels. The characterization provides a knowledge base so that political decision makers have better guidance on how to select measures for each risk class. The strategies pursue the goal of transforming unacceptable into acceptable risks, i.e. the risks should not be reduced to zero but moved into the normal area, in which routine risk management becomes sufficient to ensure safety and integrity. Three basic global environmental risk management strategies can be emphasized:

- science-based strategies (risk-quantification);
- precautionary strategies;
- discursive strategies (ambiguity management).

The two risk classes Damocles and Cyclops require mainly science-based management strategies, more precise, considering that they are generating a considerable uncertainty degree, both related to damage extent and to the occurrence

The risk classes Pythia and Pandora demand the application of the precautionary principle, and the risk classes Cassandra and Medusa require discursive strategies for building consciousness, trust and credibility. These three management strategies relate to the main challenges of risk management: complexity, uncertainty and ambiguity.

5. CONCLUSIONS

How can one deal with complexity, uncertainty and ambiguity in risk management? Deliberative methods should play a major role to cope with all three challenges.

Based on a critical literature review, the paper tried to synthesize the basic elements emerging to develop a coherent framework of global environmental risk classification, assessment and management. In order to whip up the Romanian researchers' interest, based on the WBGU approach, our option was unconformable, resorting to analogies with heroes and "stories" from the ancient Greek mythology. Finally, an essay was done having as goal to correlate the above-presented elements with specific global environmental risk management strategies.

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