RISK COMPARISON AND COMMUNICATION IN RESEARCH AND POLICY

John E.T. Moen[1] and Ben J.M. Ale[1]

[1] National Institute of Public Health and the Environment, Laboratory of Radiation Research
P.O. Box 1, 3720 BA Bilthoven, The Netherlands; E-mail address: lsojem@rivm.nl

## INTRODUCTION

In the field of ionizing radiation quantitative risk analysis is a commonly accepted tool in assessing the acceptability of practices and applications of radioactivity. Harmonization has been greatly promoted by the efforts of the International Commission on Radiological Protection and other international bodies. In the last few decades, risk is also becoming one of the yardsticks in many areas of environmental policy in measuring both the acceptability of an activity and the effectiveness of specific measures. Risk analysis is thus developing into a major tool and risk assessment into one of the primary procedures with which standards are being developed and policies being set [1]. The increasing pressures of economic market forces and the globalization of the economy is urging organizations and countries to be cost-effective, competitive and also to define their position in environmental matters in relation to others. The importance and the broad scope of applications of risk analysis are illustrated by many studies (for a review see, for example, reference 1). The process of environmental risk analysis often follows a similar path, as illustrated by the diagram in Figure 1.

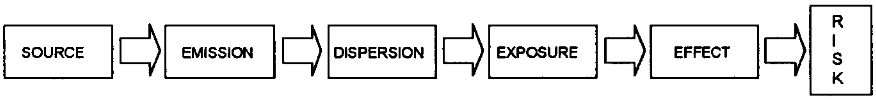


Figure 1. A diagram of environmental risk analysis processes.

Risk as an expression of the result of one's effort can be a binding quantity. However, as risk analysis and assessment have been developing in different scientific disciplines and on the borderline of science and policy, a lot of divergence in terminology and methodology has entered into the field. In practice, this leads to considerable confusion to the extent that assessment sometimes is used while meaning analysis. Such confusion weakens the possibility of defending any resulting policy decision in the political arena, defying the original purpose of the risk analysis exercise. Simply expressed, the more widely risk analysis is accepted as a tool of policy support, the less widely the results of such risk analyses may be accepted by politicians and the general public in defining their political choices.

## PROBLEMS

In the development of the techniques of risk analysis many choices as to the definitions of key elements in the analysis had to be made. Consider the definition of the risk target in most studies: the human being. In some cases this target is defined as a "spinach-eating infant", in others one takes a human to be a 20-year-old well-trained marine. Sometimes emergency-response actions are considered to be immediate and effective, sometimes they are supposed to be too little too late. Comparable variations exist with regard to almost all parameters being used in risk analyses in human and ecotoxicology and in chemical safety studies. These observations are not new, and are in fact well documented in several papers and publications (e.g. 1, 2, 3). However, they have led to surprisingly few changes in day-to-day applications of risk analysis.

In various fields of environmental policy, and in some countries even within the same field of environmental policy, differing assumptions have found their way in the risk analysis process and subsequently in policy development. In the field of major chemical hazards, in the United Kingdom the individual risk is expressed as the frequency of a protected individual receiving a dangerous dose, whereas in the Netherlands it is expressed as the frequency of an unprotected individual receiving a

[1] Many definitions of risk exist. We mean by *risk* the probability, or frequency, of occurrence of a particular effect (adverse event); by *risk analysis* the process of obtaining a numerical outcome for this risk; by *risk assessment* the valuation of the calculated risk.

fatal dose. The different numerical outcomes of analyses based on such widely different presuppositions create profound difficulties in policy-making and negotiations with the parties involved, such as industries. Recently, in a report on problems associated with risk analysis and environmental risk management (4), a committee of the Health Council of the Netherlands gave a general indication of the problems that may arise from confusing terminology.

Even more complications are met in risk communication, in explaining the results of risk studies to - often non-expert - politicians and, most importantly, to the public. The public may be well aware that it functions as potential victim in risk studies, and therefore claim a position in discussions on risk outcomes in its role as the primary driving force behind the (democratic) policy process. Unclear statements and diffuse terms may influence the debate on the acceptability of risks, and act as a trigger for far-reaching action with possibly unpredictable results. The situation is even more aggravated by virtue of the fact that interested parties may want to introduce definitions to steer the outcome in a desired direction. For instance, the comparison between driving by passenger car and flying with a commercial airline will have a markedly different result if compared on the basis of numbers of casualties per calendar year, per passenger-hour or -mile.

COMPARABILITY OF RESULTS

Nevertheless, the possibility of comparing the results of analyses and the policy indications is the original idea behind the development of structured risk analysis techniques and should remain so in the future. Any difference in the results of decision-making between countries or fields of policy should be the result of a conscious weighting of risks against profits and not the accidental result of unknown or unexpressed differences in definitions, techniques or assumptions. Adequate risk comparison is related to making the criteria for risk limitation explicit, for instance "individual vs. collective risk", "fatalities vs. morbidity", "regular vs. potential emissions or explosions" etc. When this explicitation is lacking, discussions on risk analysis and assessment may lead to lengthy and fruitless sessions.

EXAMPLES

The environmental risk policy debate in the Netherlands forms a typical example for the developments described. Originally, risk policy was developed for petrochemical installations. A maximum risk exposure was defined as the chance per year of an unprotected individual being killed as a result of an accident (5). The limit was set to $10^{-6}$ per year per installation. Subsequently, the same limit was declared applicable for all possible confrontations with risks induced by exposure to human-induced hazards, including chemicals in the environment, accidental releases of nuclear power plants and applications of ionizing radiation in general. This creates some interesting problems.

Firstly, exposure to a chemical disaster - which was the original subject of risk policy - has immediate lethal effects stemming from intense thermal radiation, explosive effects and high dosages of toxic chemicals. Delayed effects are rare, to the extent that they are almost never considered. An exception may be the long-term effects of exposure to accidentally emitted chemicals such as dioxins (Seveso). These effects, however, are never included in "normal" risk analyses for chemical plants.

On the other hand, when assessing the environmental aspects of possible applications of radioactive substances and radiation, the main effects of ionizing radiation taken into consideration nowadays are delayed effects, with the possible exception of the planning of new nuclear power plants. Assumptions on these delayed effects involve assumptions on the duration and pathways of exposure. Often complicated processes and pathways of environmental dispersion related to inhalation and ingestion of contaminated food are critical in the risk calculations.

Furthermore, risk analyses for the collective exposure of populations to ionizing radiation are based on assumptions related to the age distribution of the population, food intake etc. The individual population risk is obtained by dividing the collective risk by the total population. This approach is hardly or not at all comparable with the assumption of the "unprotected individual" as used in the field of chemical safety. Nevertheless the resulting figures are both designated individual risk and as such are taken to be directly comparable.

The same applies when this "individual risk" is being compared with other risk sources, such as the aforementioned driving or flying. Yet, many publications do present seemingly unambiguous lists of risks, usually trying to prove the apparent innocence of some source of risk.

WHAT SHOULD BE DONE?

There is a clear and urgent need for clarification and, if possible, harmonization of terms, procedures and assumptions, driven by the continued difficulties that arise in making policies and explaining them to the public. Several efforts have been made, or are still in progress, to at least clarify the terms of reference in the various fields. The efforts of the ICRP in radiation protection have already been mentioned. A recent document of the Health and Safety Executive in the United Kingdom (6) is an example of an attempt in the field of industrial safety to clarify several important aspects. A project under the auspices of the expert group on chemical accidents of the OECD is under way. However, to our knowledge all these activities are limited to only one of the fields previously mentioned, whereas in the opinion of policy-makers and the general public clear interactions exist.

What is even more striking is that, with the exception of ICRP, all attempts at clarification and harmonization originate from the policy scene. The participation of the scientific and technical community is limited. However, scientists are the originators of information forming the basis for policy decisions. It is therefore vital for continued or reinstated trust in these analyses that scientists be unambiguous about what they mean when presenting a number as the result of an analysis. For the further development of the field of risk analysis it would be of great importance if scientists and experts came together to clarify and organize their doings in a more interdisciplinary way.

A simple academic exchange of ideas and viewpoints alone does not seem to suffice. This year a project was started at the National Institute of Public Health and the Environment (RIVM) to present different types of risks geographical and coherently. In this so-called CUMU-project geographical mapping of risks and the use of GIS technology is proving to be a way to a useful organisation of discussions between experts on risk from different disciplines. Mapping risks forces the participants to take the whole chain, from source to risk, into consideration, and to reflect on their own premisses and axioms. During the mapping process a confrontation with the more philosophical aspects of risk comparability is almost inevitable. However, such discussions take place in the positive atmosphere of working together towards a collectively produced "risk map". In this way, making the relevant positions explicit is more fruitful than in comparing risk approaches as such without a common goal. We feel that this approach may be of a wider significance than for this project only.

To facilitate further discussion, RIVM plans to organize a conference on risk-map technology and risk comparison in the spring of 1997. In our opinion, active participation in activities aimed at crossing borders between the different fields of "risk" and contributing to more broadly coherent ways of risk assessment and risk communication could be of great interest to the radiation protection community.

REFERENCES

1. The Royal Society. Risk: Analysis, Perception and Management, Report of a Royal Society Study Group. London (1992).
2. S.L. Brown. Harmonizing chemical and radiation risk management. *Environ.Sci.Technol.* 26, 2336-2338 (1992).
3. D.C. Kocher, F.O. Hoffman. Environmental carcinogens: Where do we draw the line? *Environ. Sci.Technol.* 25, 1986-1989 (1991).
4. Health Council of the Netherlands: Committee on risk measures and risk assessment. Not all risks are equal (*in Dutch, with executive summary in English*). Health Council Publication no. 1995/06, The Hague (1995).
5. Integrale Nota LPG (*Integrated Policy Document on LPG*). Staatsuitgeverij, The Hague (1984).
6. J. Le Guen. Generic Terms and Concepts in the Assessment and Regulation of Industrial Risks. Health and Safety Executive of the United Kingdom, London (1995).