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2.2.1

RISK PERCEPTION AND RISK MANAGEMENT
LA PERCEPTION DE RISQUE ET LA ADMINISTRATION DE RISQUE

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INTRODUCTION

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Since the 50ies psychologists have become interested in designing studies to investigate the intuitive mechanisms of people to collect, assimilate, and evaluate information about activities or technologies with uncertain outcomes (Covello 1983, Slovic et al. 1982). The major objective of these studies has been to explain the psychological relevance of probabilistic information for the formation and change of attitudes and corresponding behavior. The interest in public perception was provoked because there is often a marked difference between decision makers and sections of the public in their appreciation of the balance between risks and benefits for certain hazards (Renn 1988).

In considering risk perception, it is vital to differentiate between different segments of the public and different semantic concepts of risks in public understanding (Renn 1985). In some contexts, risk refers to the thrill and excitement of undertaking a difficult challenge, such as mountain climbing or rescuing a person from a burning house. In another context, risk is perceived as a chance to achieve a possible goal, such as investing in the stock market or participating in a lottery. Large scale technologies, on the other side, evoke associations of continual pending danger. Risks posed by these technologies generate considerable public attention and anxiety because the catastrophic event can occur at any time and leaves little time for protective actions. The probability of such an event is usually not considered as a factor in evaluating the seriousness of such a risk, but it is rather the perceived randomness of occurrence and the time span between the accidental release and the resulting health effects that most people use as yardsticks to delineate judgments about the riskiness of a technology or activity.

In addition to social context, risks are also perceived differently depending on the social position, the cultural beliefs, or values of the individual or group involved (Douglas and Wildavsky 1982; Vlek and Stallen 1981). Surveys have clearly demonstrated that persons who feel closely attached to the values of economic performance and standard of living, perceive technological risks as less threatening than persons who have developed a special sensitivity towards environmental protection and equity issues (WEC 1989). The more people depend economically on the production sector of society the more they feel that risk-taking is an inevitable and ultimately rewarding activity for individuals and society.

In spite of these differences in understanding and processing risk, many studies have shown surprising similarities in the fundamental mechanisms that most people employ to assess the potential risk of an activity or technology and to justify their concern or neglect of such risks. The following paragraphs are an attempt to briefly describe such fundamental universals in risk perception found in almost all western, industrialized countries and to discuss the relevance of these findings for risk management.

INSIGHTS FROM RISK PERCEPTION STUDIES RESULTATS DES ETUDES SUR PERCEPTION DE RISQUE

The Determinants of Risk Perception Determinants de Perception du Risque

Starting with the pioneering work by Decision Research in Eugene, Oregon, (Fischhoff et al. 1978; Slovic 1987) psychometric methods have been employed to explore the characteristics of risk that influence the intuitive judgment of seriousness of risk and its acceptability. The following aspects of risk have been found to affect the perceived riskiness of objects or activities:

- o the expected number of fatalities or losses:

Although the perceived average number of fatalities correlates with the perceived riskiness of a technology or activity, the relationship is weak and generally explains less than 20 percent of the variance (Renn 1983). The major disagreement between technical risk analysis and risk perception is not on the number of affected persons, but on the importance of this information for judging the seriousness of risk. In risk perception studies on energy systems, for example, many respondents expressed fairly accurate predictions on the estimated average losses of life and limb over time for different options of electricity generation. In contrast to the expert community, however, they did not base their evaluation of riskiness on this

prediction, but relied more heavily on so-called qualitative characteristics, such as dread of potential consequences or perception of institutional control. Communication programs that are geared toward informing the public about the probabilities of rare events are therefore only of limited value, since the perception of riskiness is a function of many different factors of which the results of technical risk assessments is only one among others.

o the catastrophic potential

Most people show distinctive preferences among risk choices with identical expected values, but variations in the range of outcomes over time (Covello 1983; Royal Society 1983). Low-probability high-consequence risks are usually perceived as more threatening than more probable risks with low or medium consequences. Thus, coal fired power plants are usually perceived as less risky than nuclear power plants since the catastrophic potential of nuclear energy is seen as more dramatic and far-reaching than that of coal energy. Neither the acid rain problem nor the threat of the greenhouse effect have significantly changed that perception (WEC 1989).

o the circumstances of the risk (qualitative characteristics)

Surveys and experiments revealed that perception of risks is influenced by a series of perceived properties of the risk or the risk situation (Fischhoff et al. 1986; Slovic et al. 1982; Renn and Swaton 1984). Among the most influential factors are: dread; personal control; familiarity with risk; the perception of equitable sharing of both benefits and risks; and potential for blame (possibility to make a person or institution responsible for the creation of a risky situation). A more comprehensive list of qualitative risk factors is shown in Table 1. With respect to different energy systems, nuclear energy is associated with many negative qualitative factors, such as dread, inequitable risk-benefit distribution, and unfamiliarity; whereas decentralized solar energy mobilizes mostly positive associations, such as subject to personal control, low catastrophic potential, and equitable distribution of risks and benefits. So it is not surprising that most studies on public perceptions reveal a positive risk perception pattern for solar energy versus a more negative for nuclear energy (Renn 1984).

o the beliefs associated with the cause of risk

The perception of risk is often part of an attitude that a person holds about the cause of the risk, i.e. a technology, human activity, or natural event (Otway 1980). Attitudes encompass a series of beliefs about the nature,

Table 1: Summary of Risk Perception Studies
 Tableau 1: Resume des Etudes de Perception du Risque

Perception is a function of:

- 0 intuitive heuristics, such as availability, anchoring, overconfidence, and others
- 0 perceived average losses over time
- 0 situational characteristics of the risk or the consequences of the risk event
- 0 associations with the risk source
- 0 credibility and trust in risk-handling institutions and agencies
- 0 media coverage (social amplification of risk-related information)
- 0 judgment of others (reference groups)
- 0 personal experiences with risk (familiarity)

Perception is influenced by:

- 0 voluntariness
- 0 controllability
- 0 catastrophic potential
- 0 delay of consequences
- 0 tendency to kill rather than to injure
- 0 perceived threat to future generations
- 0 equal exposure to risk
- 0 equal risk-benefit distribution
- 0 familiarity with risk
- 0 perception of benefits
- 0 exclusiveness of benefits

consequences, history, and justifiability of a risk cause. Due to the tendency to avoid cognitive dissonance among beliefs, most people are inclined to perceive risks as more serious and threatening if the other beliefs contain negative connotations and vice versa. A person, for example, who believes the use of pesticides is linked to profit-seeking behavior of agro-industrial corporations is more likely to think that the concomitant risks are high than a person who associates pesticides with the global struggle of societies to fight hunger and malnutrition. Risk perceptions of nuclear power or coal are also linked with other beliefs about these two technologies. The more people perceive an energy system as a necessary and needed technology the more they are inclined to perceive the risks as less dramatic. Risk estimates are therefore constantly adjusted to the overall judgment of the desirability of the technology in question.

o the credibility of the risk management institutions

Many risks are taken by society without consent of each individual affected and his or her possibility to mitigate the risk through personal actions. Those collective risks are only accepted if the affected population is confident that the lack of individual control is compensated by institutional control (Gould et al. 1988; Vlek and Stallen 1981). Confidence in risk management institutions relies on perceived competence and trustworthiness. The public expects these institutions to have the expertise to monitor and control the risk and to be impartial and independent in their judgments and actions. Attitudes towards nuclear energy in the United States, for example, are closely correlated with the assignment of credibility to the Nuclear Regulatory Commission (WEC 1989). The more people trust that the NRC is effectively controlling the nuclear industry, the more they favor the expansion of nuclear energy. The credibility of an institution is largely determined by two factors: the perception of past performance (competence) and the perception of openness and flexibility to incorporate and process new information and public demand (responsive and honest interaction with society). In addition, the public expects institutions to be fair in distributing protective services and to accept the concept of checks and balances (Renn and Levine 1988).

o the distribution of risk among the affected population

Equity issues play a major role in risk perception. The more risks are seen as unfair for the exposed population, the more they are judged as severe and unacceptable (Gould et al. 1988; Royal Society 1983). It should be noted that the estimation of severity and the judgment about acceptability are closely related in risk perception. The analytical

separation in risk estimation, evaluation, and management, as exercised by most technical risk experts, is not paralleled in public perception. Most people integrate information about the magnitude of the risk, the fairness of the risk situation, and other qualitative factors into their judgment about the (perceived) seriousness of the respective risk. Therefore they take equity issues into consideration and evaluate the magnitude of the risk in terms of equal distribution of risks and benefits. This concern for equity has often been labelled as the NIMBY (Not In My Back Yard) syndrom. Although evidence suggests that many people express inconsistent preferences when it comes to nearby or remotely sited facilities, most studies show, however, that the underlying argument is not so much to avoid a risk for oneself and impose it on others (as the NIMBY syndrom would suggest), but to avoid situations in which risks are imposed on one part of the population while another part enjoys the benefits.

This list of factors demonstrates that public understanding of risk is a multi-dimensional concept and cannot be reduced to the product of probabilities and consequences. Although risk perceptions differ considerably among social and cultural groups, the multi-dimensionality of risk, the importance of qualitative risk factors, and the integration of beliefs related to risk, the cause of risk, and its circumstances into a consistent belief system appear to be common characteristics of public risk perception among all segments of the population and among different cultures. Risk perception studies have been conducted in most western European countries, the USA, Canada, Australia and some eastern and developing countries (cf. the citations in Covello 1983; Borcharding et al. 1986; Renn 1984). All of these studies conclude that similar mechanisms are involved, but that these mechanisms can be compensated, attenuated or amplified by specific social, cultural, or political factors.

The Perception and Processing of Probabilities
La Perception et Evaluation de Probabilites

In addition to the circumstances and qualitative aspects of risks, the meaning and understanding of probabilities have been subjects of numerous studies (Kahneman and Tversky 1974; Vlek and Stallen 1981). Apparently, common sense reasoning is governed by the deterministic model: either something is safe or unsafe, healthy or unhealthy, acceptable or unacceptable. Such a dichotomous approach is a simplification of the complexity involved in stochastic events, but it provides a sufficiently accurate mechanism to guide one's own action. The processing of probabilities is influenced by the following intuitive heuristics (Kahneman and Tversky 1974; Renn 1988):

- o Availability: Events that come to people's mind immediately are rated as more probable than events that are less mentally available. Most people can recall at least one or two major nuclear accidents (such as Chernobyl or TMI), but do not recall any dam failure although statistically many more fatalities have been recorded as a result of dam failures than of nuclear accidents.
- o Anchoring effect: Probabilities are adjusted to the information available or the perceived significance of the information. The easier it is to imagine a disaster or another adverse effect the more likely people perceive such an outcome to occur. If people can smell or visually detect a pollutant, the more they feel that such a pollutant is likely to affect their health. Symbolic cues, such as warning labels or monotonous high pitched music (often used to illustrate the danger of radiation) can serve as substitutes for concrete anchors and often amplify the perception of a high probability that danger is eminent.
- o Representativeness: Singular events experienced in person or associated with properties of an event are regarded as more typical than information based on frequencies. Someone who experienced an unlikely event, such as witnessing a person struck by lightning, tends to overestimate the likelihood of such an event. Redundant information stemming from an identical source is usually perceived as more reliable than singular, non-redundant information. In each of these cases, inferences are made on the basis of limited or biased observations. A mere list of all unusual events in nuclear power plants promotes the impression that technical failures are more common there than in other energy facilities where such a listing is not requested.
- o Avoidance of cognitive dissonance: Information that challenges perceived probabilities that are already part of a belief system will either be ignored or downplayed. If a person holds already a negative attitude toward one of the energy systems, s/he is likely to oppress all information that challenges his or her prior attitude and seeks information that reinforces his or her initial position. The avoidance of cognitive dissonance is a powerful filter for selecting and rejecting information and one of the reasons that public information or communication campaigns have only a very limited effect on attitude change (Renn and Levine 1988).

Because probabilities are vital components of risk perception, risk managers must account for the intuitive preference for deterministic reasoning and the overt biases of processing probabilistic information. Furthermore, the terms used in framing probabilities, for example chance of lives lost versus lives saved, or the probability of dying versus survival, lead

to different reactions by the receivers. Risk perception studies are therefore vital instruments for designing risk management policies and risk communication programs.

LESSONS FOR RISK MANAGEMENT AND COMMUNICATION
LECONS DE LA ADMINISTRATION ET COMMUNICATION DE RISQUE

Risk managers are faced with a serious dilemma: On one hand they are obliged to minimize risks in terms of lives lost, on the other hand they have to be sensitive to the perceptions of people and to be responsive to public concerns. In most risk areas, in particular in the field of energy systems, both goals are often in conflict with each other. The energy option or policy that would minimize the number of potential victims (as estimated in probabilistic risk assessments) is often the least preferred by an attentive public. Selecting such a risk minimization strategy evokes often public protest and opposition; adhering to the public preference, however, implies frequently to tolerate a higher risk level than necessary. How can this conflict be resolved?

The response to this dilemma requires first a thorough reflection on what public perceptions mean for making rational decisions. The view that the public perception is distorted and biased and that experts should define the "real" risks is overly simplistic and naive (Fischhoff et al. 1986; Renn 1985). Experts are also subject to heuristic biases, such as overconfidence, and can only rely on the available data for making their risk assessments. Different risks have different ranges of uncertainty and many probabilistic estimates are based on subjective judgments of experts. Such assessments are necessary and legitimate inputs for making prudent decisions (since nothing more accurate is available), but they cannot serve as the only criteria for evaluating the acceptability or tolerability of a risk. It is not necessarily irrational to take a different view of the concept of risk than that suggested by the expert approach. Putting extra weight on risks with high uncertainties, avoiding risks that have high catastrophic potential in spite of extremely low probabilities of such a catastrophe to occur, being more cautious with unfamiliar risks, and building up institutional control and monitoring before a risky technology is allowed to become implemented are all valid and reasonable tools to assist risk management decisions. At the same time, however, risk managers have to be aware that these legitimate elements of public risk perceptions are accompanied by a variety of heuristic biases, which should not be adopted as rational principles for making risk decisions.

Professional risk assessments and public perceptions of risk have both merits and limitations for designing risk management. The results of PRAs represent the best of expert knowledge with

respect to expected performance and malfunctions of a technology and the corresponding impacts for public health and environment. Public perceptions cannot match the accuracy or methodological vigor of professional assessment, but include a larger variety of dimensions and concerns, such as society's ability to cope with a rare, but catastrophic event, which are either ignored or "averaged out" in professional risk estimates (Lynn 1986; Watson 1983). Therefore, risk management should incorporate the results of risk perception studies for three different purposes:

- o Those factors which people who have to bear risks consider to be violations of their values and interests must be regarded as important determinants of any management approach to balance risks and benefits of a proposed decision (Renn 1985). Public health or environmental deterioration may not be the only dimensions that the affected population is concerned about. Long-term effects on pollutant concentration in soil or water, the shift of reputation or image of a community, the potential transformation of a landscape, the social repercussions of a risk-causing technology on community life, and the threat of losing or changing the cultural identity of a community may all be concerns of citizens that are often overlooked or ignored. Many risk debates in public hearings or other public forums suffer from the inability of risk managers to acknowledge these secondary concerns. Citizens are often forced to phrase their objections in terms of technical risk arguments which do not adequately express the nature of their concerns. Such debates usually end with frustrations for all involved parties since the real issues are never discussed (Ruckelshaus 1982). Risk perception studies can help to uncover these underlying concerns and assist the risk manager in setting the agenda for the meetings with the public.

- o The basic dimensions of qualitative risk factors are important aspects in designing and implementing technologies and in creating acceptable risk control strategies. The major shortcoming of professional risk assessments is the degree of abstraction from the situation and the timing of exposure. Public perception of risk focusses on the circumstances of risk and incorporates aspects such as equity, catastrophic potential, dread, and possibility of personal or institutional control. These aspects play an important role for individuals and groups and determine the degree of comfort or discomfort with a specific technical solution or activity (Jungermann 1982). Beyond the consideration of public acceptance, however, it appears prudent from a normative point of view to design or re-design technologies in a way that these qualitative risk characteristics can be positively met. Risks with low catastrophic potential, risks that entail a "forgiving" technology, risks that lead to a more equitable

distribution, and risks that provide sufficient opportunities for protective actions in the case of an emergency have not only the advantage of facing less public opposition, they also help modern societies to improve risk management by restricting the scope for "unpleasant" surprises, by placing the burden of technological risk on the shoulders of a large segment of society, and by providing effective emergency planning prior to implementing the technology. To take these qualitative aspects seriously may often conflict with the risk minimization objective. Large-scale technologies pose often less risks to individuals than a variety of small-scale technologies that would provide identical services. In these instances, tradeoffs have to be made between two or more conflicting values. It depends on the decision making structure and the political mandate of a risk management institution how these conflicts are resolved and how weights are assigned to these different dimensions. Important is here that risk perception studies can help to identify the qualitative characteristics and to indicate the strength of concern people have in evaluating the risk in question.

- o Risk perception studies are also essential in designing risk communication programs (Covello et al. 1986; Renn 1988). Communicating to the public about risks and risk management is contingent on the knowledge of the concerns and worries of different groups and individuals. Without perception studies, the communication program may address issues that are either not contested or irrelevant for public opinion. The effectiveness of communication, however, rests not only on the knowledge of what matters to the targeted audience, but also on the willingness of the risk manager to incorporate the revealed concerns into the selected risk policies. In this respect, the two points mentioned above are prerequisites for designing effective risk communication programs. Often communication is regarded as a panacea for shifting public opinion. Such programs are prone to fail. Communication is defined as a two-way learning experience: if risk managers are unwilling or unable to adjust their viewpoints, the public will refuse to adopt or even consider what they have to say. If, however, representatives of the public gain the impression that risk managers are incorporating the concerns of public groups into their decision making, they are more likely to accept information that helps them to correct distorted views or to overcome certain biases in assessing the risk.

In which way can risk perception studies help to design effective risk communication programs? Risk communication must first of all address the qualitative characteristics of risk. It is not sufficient to confine the communication process to the discussion of probabilities and consequences. Communication should include such aspects as whether their exposure is

voluntary, possibilities of personal control, the different management options to monitor, mitigate or control risk consequences, and other relevant characteristics (Covello et al. 1986).

Secondly, risk communicators should explain the functional equivalents of voluntariness and personal control for collective decision making (for example siting of hazardous facilities), risk regulation and emergency management. Many studies have revealed the central importance of control options in perceiving risks (Gould et al. 1988; Vlek and Stallen 1981). Control can be exercised by institutions rather than individuals, but such a delegation of control depends on a trusting relationship between the risk management institution and the affected public. Potential elements of a trust-building communication program should include the assurance of a democratic decision making process, the independence and impartiality of operating and regulating institutions, and the ability of regulatory agencies to constantly monitor routine emissions or safety devices and intervene in the production process if the risks turn out to be more severe than expected (Renn and Levine 1988). People have demonstrated their willingness to accept involuntary risks if they had confidence in the licensing and regulatory agencies. If this confidence is lost or challenged, risk rejection or avoidance is likely to become the predominant response.

Thirdly, the result of a communication program is always uncertain regardless how well-designed such a program may be. The processing of information by the media, the competition of information from different sources, the co-existence of personal, professional, and institutional selection of information, and interaction among different target audiences create enough complexity and uncertainty that the final effect of the communication process can hardly be measured at all. For this reason, guidelines for effective risk management can rely only partially on empirical evidence. Studies on risk perception can, however, provide helpful clues for designing communication programs.

CONCLUSIONS

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By reviewing the literature on risk perception, we acknowledged the major difficulties of communicating risk related information. In particular we had to face the following problems revealed by a variety of psychometric and attitudinal studies:

- o Inaccurate perception of the meaning of probabilities
- o Different meaning of risks depending on social context and on one's social or cultural group membership

- o Discrepancy between the professional concept of risk and the public view of risk
- o Incorporation of qualitative risk factors in risk perception in addition to expected losses over time
- o Thirst and desire for scientific certainty and deterministic estimates of safety in public perception
- o Fear of unfamiliar, low probability-high consequence risk sources
- o Strong preoccupation with risk related factors such as equity, voluntariness, and societal ability to manage and control risk sources

Although some of these problems relate to obvious biases in drawing inferences from incomplete information, many elements of public perception have a valuable role to play for risk management. While experts confine the term risk to a combination of magnitude and probability of adverse effects, laypersons associate with risk a variety of criteria, such as voluntariness, possibility of personal control, familiarity, and others. The better our knowledge about the risk perception processes, the more we are able to improve our risk management skills (Watson 1986). The artificially constructed contrast between an allegedly rational assessment by professionals and an allegedly irrational perception by laypersons has not only disguised the limitations and values of both approaches, but has also put considerable constraints on an effective risk communication program. The professional calculation of risk should be an important and essential component of the decision making process concerning risk acceptance and risk management. This demand, however, is hardly disputed by any public group (Renn 1985). Nobody wants to substitute scientific knowledge by intuition. To make professional assessments the sole criteria for judging the "acceptability" or "desirability" of a technology or a risk management policy, however, contradicts the mandate of decision makers to design public policies in the public interest and in accordance with socially accepted values.

Risk management can incorporate the results of risk perception studies in two ways: First, management can address the concerns of the affected public and find policy options that reflect these concerns; secondly, risk reduction or mitigation should be tailored towards the goal of meeting not only the risk minimization objective but also the implicit criteria of the qualitative risk characteristics. If these criteria are in conflict with each other, tradeoffs have to be made and justified through legitimate instruments of conflict resolution. Risk perception studies can help to shape the arena for facilitating the process of assigning tradeoffs and to identify the values and concerns of all parties involved.

The inclusion of risk perception elements into management policies is already the first step for a successful risk communication strategy. Risk communication relies on a two-way exchange of arguments and the willingness of both sides to learn new arguments and adjust their position accordingly. In addition, risk perception studies can help to determine the beliefs of the various parties involved and to address these beliefs in the information package. Finally, the results of perception studies offer valuable clues for improving the credibility of an institution, a major condition for people to pay attention and believe the content of the information released.

Risk managers are therefore well advised to encourage risk perception studies and to develop a decision making process in which risk perception variables are routinely included in the analysis of impacts and consequences of different policy options. The example of nuclear energy has demonstrated that ignoring public perception and using PR-methods to sell this product to the public have failed in almost every country of the world. Taking risk perception seriously does not only pay off in terms of public acceptance, it is also mandatory for making rational decisions in a democratic society.

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ABSTRACT

While experts confine the term risk to a combination of magnitude and probability of adverse effects, laypersons associate with risk a variety of criteria, such as voluntariness, possibility of personal control, familiarity, and others. The better our knowledge about the risk perception processes, the more we are able to improve our risk management skills. Responsive and rational approaches to risk management should include the results of risk perception studies in two ways: First, management has to address the concerns of the affected public and find policy options that reflect these concerns; secondly, risk reduction or mitigation should be tailored towards the goal of meeting not only the risk minimization objective but also the implicit criteria of risk characteristics that matter to the public. If these criteria are in conflict with each other, tradeoffs have to be made and justified through legitimate instruments of conflict resolution. Risk perception studies can help to identify public concerns and shape the arena for conflict resolution. In addition, risk perception studies offer valuable insights for designing and implementing risk communication programs.