RISK COMMUNICATION
AND PUBLIC PERCEPTION OF TECHNOLOGICAL HAZARDS

First Volume

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CONTENTS

1) INTRODUCTION

The subject matter of this study is "strictly" described by the "wide" image of the title. The research is not about risk communication. It is about a wide range of variables which can be "controlled" or "influenced" by risk communication. When the researcher started to work on the project, she tried to attract the attention with an "emotional" title. "The thousand" was a hyperbole in her mind. Then, when looking for variables, she discovered more and more that the "risk perception universe" is very complex. The starting point was that risk communication could be improved only knowing how risk perception is determined and by which factors it is influenced. While going deeper into the study, the questions became dilemmas, the actors involved increased in number, the managerial aspects were drowning in a sea of theory...the hyperbole was revealed as a realistic image.
This is why a large number of variables needed to be included in one only framework: for this purpose a synthetic table was elaborated in order to find out how a category of the variable could influence towards an overestimation of risk, a balanced perception, or even an underestimation. How to use this information? Just identifying in each specific case which factors lead to an overestimation, and trying to obtain an accurate perception with "complementary" factors.
Finally, another "risk" has been faced: the one of drawing recommendations with too much generic proposals. Many tools belong to risk communication. They are used by many companies as public relations instruments, just to "cosmetically" improve their image. The recommendations outlined at the end of this project give a picture of "which" are the first objectives to be pursued, "who" - in a stakeholder system - can better achieve them, "how" - in the European framework - those actors can improve the effectiveness of the communication process.

The report is divided into the following chapters.

Part One:

- Chapter 2 describes the project design, with its subject matter, objectives, questions, methodology, and results.
- Chapter 3 describes the links between risk communication, risk perception and risk management both in an historical, in a theoretical and in a managerial perspective.
- Chapter 4 reviews the main findings coming from the available risk perception literature, ordered by stakeholder.
- Chapter 5 outlines a framework (divided into the "First Table" and the "Second Table"), in order to analyse specific cases where the risk communication strategy is necessary.

Part Two:

- Chapter 6 describes the company to which the technique has been applied. This company embodies a case of risk communication problems, with a history of fights between the stakeholders involved and the untied knots.
- Chapter 7 presents the results of the case analyses. The "First Table" is used to find out a statistic description of some risk perception variables appeared in the local newspapers. The "Second Table" is used to discover in a qualitative way which and how some other risk perception variables influence the process.
- Chapter 8 outlines the recommendations as they come out from the previous Chapters. The recommendations are drawn as for companies in general, but particularly referring to the case study. The context is that of the European legislative framework (new Seveso Directive 96/82/EC, EIA Directive 97/11/EC), the existing environmental management systems (EMAS and ISO 14001), the "non regulated" communication tools.
- Chapter 9 presents the conclusions and the achievements, the problems faced in the course of the research, the ways in which the methodology can be improved.

2) SUBJECT MATTER AND RESEARCH: OBJECTIVES, QUESTIONS, METHODOLOGY

2.1) Subject matter

Risk communication relates the basic risk perception studies to the formulation of policies, the currently evolving legislation dealing with hazards, the key issue of public involvement, the risk and environmental management.

A basic reason for the emergency of risk communication research derives from the highly visible dilemmas that have risen as a result of particular social conflicts over risks (for example, over the sitting or expansion of hazardous facilities). Fostering appropriate forms of communication between the parties to such disputes might contribute in some way to better mutual understanding and hence to a resolution of conflict. In this case the question of whom communicates what to who raises potentially controversial issues.

2.2) Theoretical framework and approach undertaken

By an historical perspective, the risk perception studies arose from risk analysis and produced the risk communication approach. By a managerial perspective, risk communication is part of the risk analysis and the environmental management. It is part of the risk analysis since it can be influenced by risk communication between the stakeholders. It is integrated in the environmental management since it is considered as an important tool of the actual EMSs.

Different conceptual approaches to risk communication can be identified in the literature (see Chapter 3). This project follows that which defines risk communication as an interactive process of exchange of information and opinion among individuals, groups and institutions, but taking into account the wider institutional and cultural contexts within which risk messages are formulated, transmitted and embedded.

2.3) Objective

The aim of the project is the definition of recommendations and proposals to improve risk communication between companies and other stakeholders, within the European and international context

2.4) Key research questions

Main question

How can companies improve the effectiveness of risk communication?

Related sub-questions

◊ Which is the state of the art with respect to the risk communication theory and practice?
◊ Which variables influence the public perception of risk? How they act?
◊ Which variables are relevant for an effective risk communication?
◊ Which are the roles of the main stakeholders in risk communication?
◊ Who are the main stakeholders involved in the risk communication about the specific case?
◊ How can the specific company improve risk communication with other stakeholders?

2.5) Methodology and techniques

A large number of variables obtained from psycho-sociological literature have been used for a specific case, explored through a content analysis of press articles and a review of the available technical documents, as follows:

- Review of the main findings about the risk perception and communication: mostly about the variables which influence the public perception of risk;
- Analysis of the available technical documents;

- Statistic content analysis of the local newspapers;
- Qualitative content analysis of the public documents and reports;
- Collection of background information on the community context (interview to the «citizens committee» spokeswoman).

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The variables from the literature about risk perception are linked to the variables of the content analysis. This is possible by a synthetic table in which all the variables have been put into. By this table it is possible to consider the variables' categories as factors which influence the public perception of risk. They are useful for the content analysis of the press articles and to define recommendations.

The analysis technique itself is part of this research, considering that the link between theory and practice is the core but also the main difficulty of the available studies on risk communication. Usually research about risk communication considers only few aspects of risk perception; in the course of this project, the effort is in trying to extract a wide range of variables which influence the public risk perception and also to put them in a framework (called «the First» and «the Second Table») which can be used as managerial tool. The combination of the two Tables, in fact, can be considered as a checklist to discover «which» are the weak points where it is necessary to intervene. The recommendations indicate «how» it is possible to intervene.

2.6) Output : recommendations

The recommendations regard companies in general, on the basis of the variables taken out from the available literature on risk perception; nevertheless, it is indicate for the specific case which recommendations have a «priority», on the basis of the content analysis.
Finally, the recommendations are drawn in the following European and international framework: the Environmental Management Systems (Emas and ISO 14001), the new «Seveso» 82/96/EC, the EIA Directive 97/11/EC, the «non-regulated» communication tools.

3) RISK COMMUNICATION: A CONCEPTUAL FRAMEWORK

3.1) Introduction

By a theoretical perspective, risk communication is a discipline based on a sociological approach. It comes from - and in some aspects includes – the risk perception studies (psychological approach) and the risk analysis concepts (technical view). By a managerial perspective, risk communication is a tool beside risk management tools and environmental management systems (see also Chapter 8).
This Chapter aims at offering a conceptual framework of risk communication, since it is a relatively new discipline and - for this reason - often misunderstood.

3.2) Risk: an historical view

«The term *risk* comes from the Italian *risco, rischio* (danger, risk), derived from *rischiare, risicare*. The origin of the word is surprising. It must be traced to Greek *rhiza* (root). The word *rhiza* came to designate, in Greek, all which is extended from a trunk in the manner of a root, and later, in Crete, the beach cliffs, formed by the protruding rocks at the foot of the mountain, rather similar to the roots protruding from the foot of a tree. Thus, from *rhiza* came *rhizicon*: something with a similarity to a cliff and hence presents a danger, a *risk*.» (Mathieu-Rosay, J., «Dictionnaire Etymologique», 1985).
The Dictionnaire Etymologique cited above does not give any further time specification about the word "risk". Inherent alarm systems and different kinds of awareness of danger, however, are parts of life itself. Living organisms struggle for survival with available means. Risk awareness and risk minimising promote survival, and risk perception, in its human form, is therefore presumably of ancient origin (Britt-Marie, Drottz-Sjoberg; 1991).
Although risk and danger have always been a part of life, risk analysis has not. Covello and Munpower (1985) traced the first simple form of human systematic risk analysis to the Asipu group of the Tigris-Euphrates valley about 3200 B.C. These people provided consultant services regarding «risky, uncertain, or difficult decisions». Input data or likely outcomes were made available by signs from the gods, and analyses and interpretations yielded predictions about the risky future venture in the form of recommendations. A final report "etched upon a clay tablet" was also provided the customer.
The issues of risk and risk analysis have currently become more visible and important. Risk analysis is conducted to foresee and minimise adverse events, if not to prevent them. In an increasingly complex society, which requires sophisticated large-scale technological solutions to current needs, we cannot disregard the risk aspects involved.

3.3) Risk perception

3.3.1) The increasing risk awareness

Scientific progress often highlights our ignorance in the sense that we know increasingly better what we do not yet know. The risk perception area of research grew from an awareness of discrepancies between estimated objective risks and public reactions to risks. Again, disparate risk estimates and different opinions may always have been at hand, but today they often create problems, since decisions of great importance to many, and with implications for long time periods, must be taken. In the current situation, in societies founded on democratic principles, with an increasingly informed public, different views on risk, acceptable risk, and risk minimising are therefore destined to create controversy.
Covello and Mumpower (1985) mentioned the increase of new risks as one of the differences between the past and the present. These new risks are characterised as «latent, long-term, involuntary, and irreversible». The change of living conditions could perhaps also be described in terms of individuals of the past as being exposed to risks within a society, whereas the present time exposes the societies themselves to risks. This kind of mental representation of the current situation is responsible for a major part of the increased interest in e.g. environmental issues, and to play a major role in perception of risk.
New kinds of risks may also be distinguished from old and well-known risks as additional risks in contrast to voluntary and «necessary-evil» risks. We choose to go downhill skiing, to smoke or to eat peanut butter. If people «need» the car to go to work, they also accept the risks involved. They may not, however, perceive a need of more recent technological innovations, e.g. computers or nuclear

power plants, and they may therefore reject those technologies out of hand, and consider the risks they might imply as additional risks forced upon them to consider.
Another aspect of risk awareness at the present time concerns the invisible nature of an increasing number of harmful agents. Our inherent biological defence and warning systems do not seem designed to cope with this threat of massive invasion, and our own senses can no longer be trusted to detect them
Yet another aspect of increased risk awareness and of expression of reactions to potential risks concerns knowledge and information. To acquire knowledge or information about potential hazards or about people at risk implies to some extent to take on responsibility for the consequences, should these materialise. The issue of responsibility highlights a range of moral implications, and moral concerns constitute another fertile area of heated controversy.
The current availability of information about risks could thus be said to have increased our readiness, as well as our moral obligations to act. The piecemeal constructed risk scenarios based on scarce or incomplete information, however, tend to cause actions to take different, and at the same time opposing, directions.

3.3.3) What is risk?

The definition of risk has naturally been at issue as the special disciplines studying risk perception develop. The United Nations recommends two divergent definitions for evaluating toxicity in chemicals: (a) focused on properties of pure probability; (b) focused on properties of utility.

(a) «Risk is a statistical concept and has been defined by the preparatory committee of the United Nations Conference on the Human Environments as the expected frequency of undesirable effects arising from exposure to a pollutant» (World Health Organisation, 1978). No attempt to define the degree of harm is included here.

(b) «Most literature on this subject begins with the thesis that risk (R) can be estimated as some sort of product of the probability (P) of the event times the magnitude/consequences of the harm (M), or R = f(P,M) R = P x M (Campbell, 1980). Benefits enter this equation because it treats safety as a measure of acceptability of some degree of risk.
The two definitions have different policy implications. By concentrating only on probable frequencies of bad outcomes, the first definition gives the policymaker no headaches about how to compare harms with benefits, and some would claim it wisely steers clear of the scientific pretensions of utility calculations. Interestingly, the idea that risk means only probabilities of harm is very widespread, even where «risk-benefit» is a method deliberately compared with cost-benefits analyses (Douglas, 1986).
The formula R = P x M gives relevance to: the identification of probabilities and consequences of the risk, the preventive measures to reduce P and M, by a risk management system (see further).
Now the definition of risk is rapidly evolving within research, even by a document produced by CEE (1994): *CEE Guidelines on the Labour Risk Assessment*. By this document the definition of risk has been modified: information, training, instructions and participation, involvement of the workers and their representatives are decisive factors to identify and reduce risks, limiting their consequences. This complex factor is named Ki and the new formula becomes:

$$R = f(P, M, Ki) \Rightarrow R = PxM / Ki$$

Ki = integrated factor of information, training, instruction, updating, equipment, flying squad, elimination of wrong behaviours.
Thus, risk is:
- directly proportional to probability and magnitude;
- indirectly proportional to the Ki factor.

The importance of the Ki factor is related to the importance of risk communication, inside and outside the company. In fact, very often risk becomes higher in cases of scarce communication, producing enormous costs for the collectivity.

3.3.4) What is «acceptable risk»?

At present the EPA (Michael D. LaGrega et al., 1994) has defined acceptable risks for carcinogens as within the range of 10-4 to 10-6 excess lifetime cancer risk and for non-carcinogens as a hazard index of less than 1.0. There have been other issues, which have defined «acceptable risk» outside this range. Clearly, «acceptability» is a personal concept and demands that the public - which ultimately must have jurisdiction over what level of risk is acceptable - has to be informed. At many sites it is ultimately the public which determines by its influence, which level of potential health risks are acceptable.

The U.S. EPA uses 10-6 excess lifetime cancer risk as a point of departure, meaning that a higher risk may be deemed acceptable only if there were special extenuating circumstances. It should be noted that risk of cancer is not the same as risk of death, because not all the cancer causes result in death. Still, cancer is the second greatest cause of death in the United States.

Another comparison is that of incremental risk and background risk. The 10-6 target represents an incremental risk of 0.0001% probability, an especially small level in comparison to the 25% background risk of the very same disease for which this regulatory target is directed. The total risk to an individual exposed at EPA's target would increase from 25% to 25.0001%. This increase is hardly meaningful from a scientific perspective, especially considering that the exposed population is not the whole nation but isolated pockets.

While an increase in cancer risk by an increment of 10-6 may not be significant from a scientific viewpoint, it easily can alarm the community near a hazardous waste site. The reason is perception.

3.3.5) The discipline of risk perception

Public reactions to technological risks frequently have proven to be a crucial limitation to the implementation of particular technologies, thus illustrating the relevance of risk perception to policy matters. One of the areas that needs clarification is that of terminology (Otway H. J. in Dierkes M., Edwards S., Coppock R.; 1980). Strictly speaking, there is no such thing as risk perception. In the field of psychology, the word «perception» is usually reserved to describe sensory phenomena related to sight, sound, touch, smell, and taste.

The term «risk perception» was coined by technologists as a result of the observation that public reactions to new technologies often seemed to be «out of proportion» to their estimates levels of risk compared to the (accepted) risks of daily life.

The model of human behaviour thus implied went something like this: behaviours that reflect opposition to a technology are determined by inaccurate perceptions of its risks, but perceptions of risk should be determined by «objective» risk data. Since considerations about the «objectivity» of the data are beyond this project, «objective» information is intended to be contained in the technical data.

«objective» risk data + accurate risk perception => consensus building

The key issue of consensus building requires the distinction. Nevertheless, the two above are conditions necessary but not sufficient to achieve consensus. Other factors may influence the process, but they are beyond this analysis. In fact, this process will focus on the «favouring» of an accurate or balanced perception of risk (see Chapter 5, 7, 8).

More strictly, the new sub-discipline of risk perception is constituted by three different disciplines:

a) the engineering approach, extended from the analyses of risk to the analyses of perception
b) the ecological approach
c) the cognitive science approach

Theoretically sophisticated, but naive in social thought, each discipline transferred only a small part of its traditional methods to the new field.

a) The engineering contribution assumes that the public consists of isolated independent individuals who naturally behave like engineers: they want to know the facts and these facts, once clearly presented, will convince them of the safety or riskiness of a proposal. The risk is sometime calculated

in days or minutes taken off the normal expectation of life, or in fraction percentages of several million parts, illustrated with graphs. Understanding will lay fear to rest.
The engineers felt impatient with the social sciences. The methods used in technology for risk identification and assessment could surely be extended to questions of social acceptability (Farmer, 1981). Risk-benefit was a method for interpreting contemporary consensus on social values. An interesting concept is that of limits of acceptability: risk acceptability increases with increase in benefits within certain ranges. But quantified methods of risk assessment can be manipulated: so that OSHA took a hard and fast line against risk quantification (at least for carcinogens in the work place) in the deliberations of the Interagency regulatory Liaison Group's Panel on risk assessment (Carter, 1979). The general criticism of risk-benefits approach arises by the fact that the credibility of expert risk judgement is in doubt: «Central to public risk assessment is suspicion about industry, utility and regulator commitment to reduce and minimise these risks» (Kasperson et al., 1980).
b) The ecological research starts with the work of White (1952). According to the ecological sequential model of risk response, different sectors of the public (like communities of plants and insects) go through the stages of a developing life cycle, sequentially encountering and adapting to various hazards. This approach is careful to distinguish the term hazard from risk. Indeed, the shift of terminology helps to bridge the difference between plant ecology and human ecology, for the living elements in the former can be said to react to hazards whereas they do not act (by definition) as rational agents calculating risks. Furthermore, reasonably enough, the assessment of combined probabilities of an occurrence and the magnitude of its consequences is too specialised a form of calculation to be helpful in thinking of the ordinary person's perceptions. In this approach inputs of information or experience are traced to outputs of changed opinions. Culture-bound categories or social factors do not enter into the research design. In this approach, hazard is taken as the independent variable and people's response to it as dependent.
c) Cognitive science has tended to dominate risk perception, extending its assumptions and psychometric methods to the whole scene. «The idea of rational, risk-perceiving agent is built up on the model of rational investigator. Both are driven to seek order in the world; both recognise inconsistency; both assess probability.» (Douglas, 1986).

3.3.6) The risk perception as attitude

An attitude may be defined as an evaluative judgement of the degree to which one likes or dislikes some person, object, concept, or symbol, that is, a *feeling* of favourableness or unfavourableness toward the «object» of the attitude. Because the term risk perception emerged to describe people's *feelings* about risks, it satisfies the definition of attitude if the risk in question is considered to be the attitude object. Attitudes are built upon the beliefs that are held about the attitude object. Beliefs are simply the «learned» relationships between the attitude object and its perceived attributes or characteristics.

Having seen that risk perception can be expressed as an attitude, we are naturally interested in its stability. For example, what is the role of technical information in changing public attitudes toward technical issues?
The persistence of customs, myth, ideals, and the regularity with which people conduct their daily lives, all indicative of commonly held and shared attitudes, suggests the basic stability of attitudes once they are formed, and indicates their tendency to evolve over longer periods of time. Confusion has arisen because what appear to be dramatic changes in public attitudes often take place in situations where the beliefs and values that underlie the particular attitude are relatively trivial or new rather than well established and already integrated into the value systems of the people concerned. An example of this is the public relations exercise of «creating an image» for a relatively unknown political candidate or a new brand of consumer good. Attempting systematically to change established attitudes can only succeed in special circumstances.
Recalling how beliefs are formed, it will be remembered that information that can be confirmed by the individual's own senses is most likely to lead to the formation of new *descriptive* beliefs, or to the change of existing beliefs. For example, a device on a factory stack that removes visible exhaust might rather quickly change the belief of local residents that the factory pollutes the air. But most safety-

related technical information is highly abstract and not subject to personal confirmation. The provision of such information might even, paradoxically, stimulate the formation of inferential beliefs to the contrary, or be interpreted so as to lend support to existing positions.

There are basically two kinds of interrelated models of human behaviour, normative and descriptive. Normative models are concerned with prescribing the courses of action that *should* be taken, that is, those that conform to some axioms of rationality or to the beliefs and values of the model-builder. Descriptive models deal with people's own beliefs and values and the ways in which these actually do enter into the determination of their behaviour. Our primary interest here is to identify a descriptive model of risk perception. A normative model would be much easier to construct but would be less useful because people do not necessarily behave according to normative expectations. The technologists' intuitive behavioural model mentioned above is a mixture of the normative and descriptive types. As a starting point for its evaluation, examine the normative assumption that perceptions of risk *should* be largely determined by statistical variables (e.g., the probability and magnitude of loss) to see if it also has descriptive validity.
Since statistical variables do not describe risk perception in rather simple situations, it is expected that they would be clearly insufficient in the case of vastly more complex technological risks. For example, losses may be expressed in terms of deaths; probabilities are often very small and, even then, based upon theoretical estimates; members of the public are exposed to risks without their consent; or there may be distribution inequities among social groups, or even among present and future generations.

The conclusions are the following:
1) Because technical information can seldom be verified by one's own senses, it would not necessarily be expected to play a dominant role in the formation or change of public attitudes on technical issues. Therefore, technical safety studies undertaken with the idea of providing «hard facts» to influence public opinion are unlikely to achieve the desired result.
2) Perceptions of risk are multiply determined and would not be expected to agree with statistical estimates, or even measurements, or risk level.
3) Because opposition to technologies is often due to factors other than risk in its conventional sense, numerical guidelines for «acceptable risk» based upon statistical data on the experience of existing risks (a normative approach) would not be expected to gain public acceptance.
4) Risk estimates and historical risk statistics can be used in the regulatory process, but only to help determine an upper limit of risk that must not be exceeded. It is a necessary, but not sufficient condition that the estimated risks of new technologies be less than this upper limit.
5) Points 2 and 3 imply that the definition of acceptable risk will vary from case to case. The process by which criteria are derived is likely to be lore important to their social acceptability than are any numerical guidelines that might result from the process.

3.4) Risk communication

3.4.1) The origin of risk communication studies

The study and practice of risk communication is a relatively new development, with most relevant literature appearing in the 80's. The increased interest in this particular topic represents a significant proportion of the more general expansion of social science activity in the risk field. Many of the researchers who were prominently involved in the early risk perception studies have subsequently turned their efforts to matters of risk communication.
The study of risk communication relates theory and findings from risk perception studies (appearing during the 60's) to:
a) the formulation of policy (for example for risk managers and regulators);
b) the currently evolving legislative frameworks for dealing with hazards;
c) the key question of public involvement in decision making about hazards (Royal Society Study Group, 1992);
d) the risk management and the environmental management.

Several interrelated factors have led to the emergence of interest in risk communication research. There is an increasing requirement, both in legal as well as moral terms, placed upon government and private industry to inform populations about the environmental and health hazards to which they might be exposed. Such communication may be a statutory part of the emergency planning process (such as those of toxic release). Emergency planning necessitates considerations first of what communication should be made in advance of a potential incident to inform and prepare those that might be affected, and secondly, plans for providing effective warnings in the event of an emergency. Legislation as a result of major accidents, such the «Seveso Directive» by the European Communities, and the «Emergency Response and Community Right to Know Act» by the US have set specific requirements upon public bodies for information provision and preparedness in this respect.
A second reason for the emergency research derives from the highly visible public policy dilemmas that have risen as a result of particular social conflicts over risks (for example, over the sitting or expansion of hazardous facilities). Fostering appropriate forms of communication between the parties to such disputes might contribute in some way to better mutual understanding and hence to a resolution of conflict. In this case the question of who communicates what to whom (and in whose interests) raises potentially controversial ethical issues (Morgan & Lave, 1990).

3.4.2) The different approaches to risk communication

At least four conceptual approaches to risk communication can be identified in the literature. The two simplest are: that which defines risk communication within an «engineering communications» framework (in terms of a top-down or one-way transmission from an «expert» to a target «non-expert» audience); that which views risk communication as an interactive process of exchange of information and opinion among individuals, groups and institutions.
The two most recent approaches are: that which stresses not only exchange of information between actors, but also the wider institutional and cultural contexts within which risk messages are formulated, transmitted and embedded; another approach views risk communication explicitly as part of the wider political processes that operate (or ought operate) within a democracy. Here communication is seen as an essential prerequisite to the enabling and empowerment of the risk-bearing groups in society in ways that allow them to participate more effectively in decision making about risks.
The approach followed by this project is a combination of the second and the fourth: risk communication is seen as an interactive process of exchange of information and opinion among individuals, groups and institutions, enabling the risk-bearing groups in society to participate more effectively in decision making about risks.

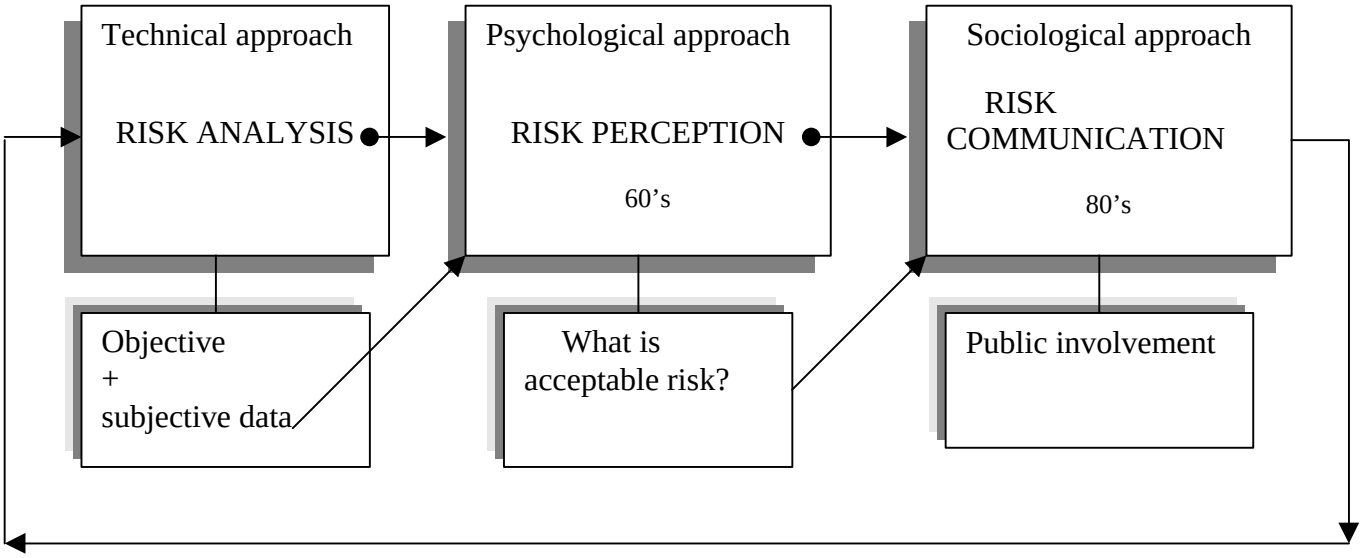
3.4.3) The main dilemmas

Two dilemmas are relevant in risk communication studies. A particular paradox raises by uncertainties that often surround any particular risk assessment: under such circumstances too precise predictions might be interpreted to have been flawed, thus undermining the credibility of the source. Similarly, trust may be lost, following a serious incident or disaster, if the responsible authorities and institutions are not felt to be learning from, and responding to, the event in as open and public a way as is possible.
Another dilemma related to the first is called «reassurance-arousal paradox». It regards the conflicting goals in risk communication; for example, a message about the same activity may need both to reassure (the risk from such an activity is indeed tolerable) while at the same time to warn (but if, in the unlikely event, that there is an emergency the following actions will be necessary).

3.4.4) Risk communication: an historical perspective

Risk communication is a relatively new discipline based on a sociological approach. The discipline comes from and in some aspects includes risk perception studies (psychological approach) and risk analysis concepts (technical view). The circle closes itself when - by risk communication findings - it results that also the technical analysis is influenced by the co-operation between the actors involved.

Figure 3.1: The conceptual framework by an historical perspective



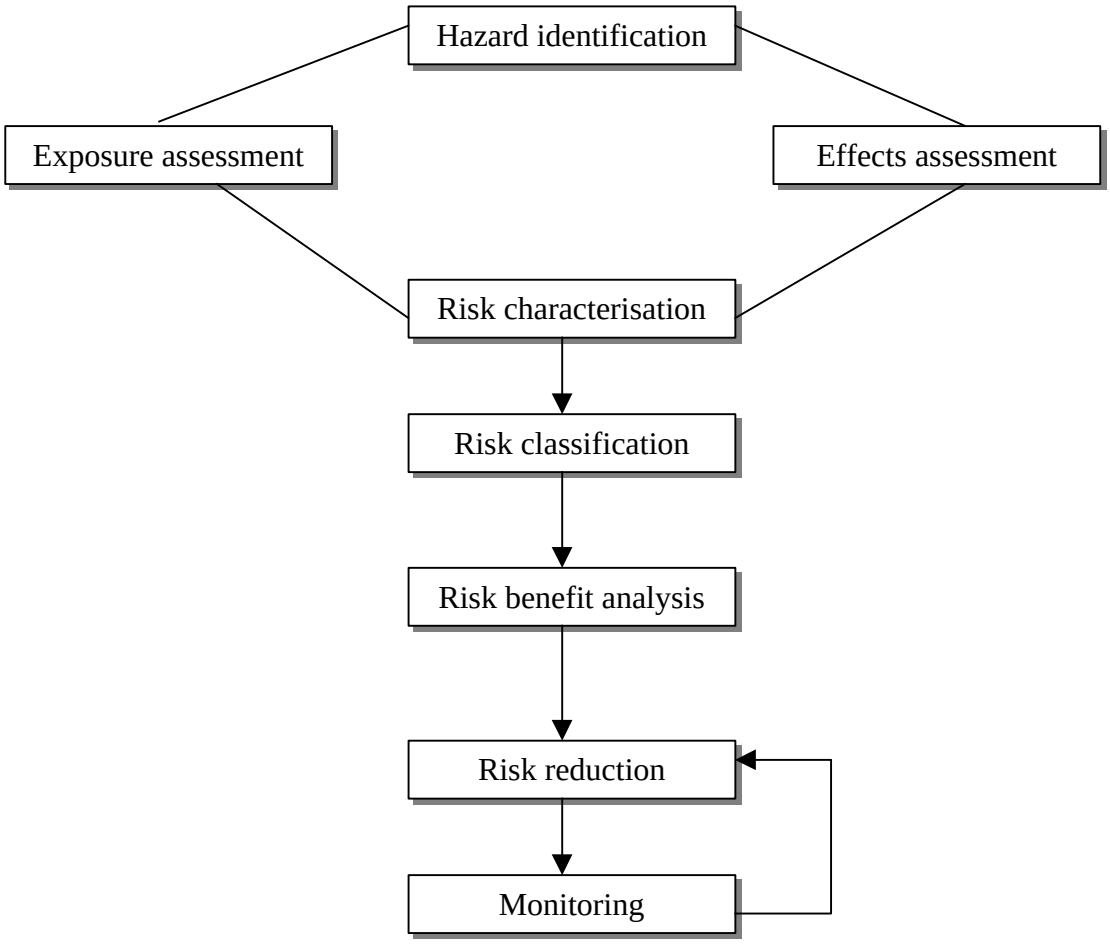
3.5) Integrating risk management, environmental management and risk communication

3.5.1) Risk assessment and management

Risk assessment and risk management are closely related but different processes, with the nature of the risk management decision often influencing the scope and depth of a risk assessment. In simple terms, risk assessors ask, «How risky is this situation?» and risk managers then ask «What are we willing to accept?» and «What shall we do about it?» (van Leeuwen and Hermens, 1995). Risk assessment is usually seen as the objective part of the process and risk management as the subjective part. Although risk assessment is mainly a scientific task, political decisions are required on questions such as «What exactly are we trying to protect and to what extent should it be protected?». Endpoints, unacceptable effects, magnitude of uncertainty factors are controversial topics and based on implicit political choices. Questions about risk often have no scientific answers.

Risk management is about taking regulatory measures based on risk assessment and considerations of a legal, political, social, economic, and engineering nature. The entire risk management process as shown in the Figure 3.2 (Van Leeuwen and Hermens; 1995) consists of eight steps, in which steps 1-4 belong to the risk assessment phase, while steps 5-8 are in the specific domain of risk management.

Figure 3.2: Steps in the risk management process



Some explanations:

Hazard: is the inherent capacity of a substance or compound or mixture to cause adverse effects on man or the environment under the conditions of exposure.
Risk: is the probability of occurrence of an adverse effect on man or the environment resulting from a given exposure to a substance or mixture.
Toxicity: the inherent potential or capacity of a substance to cause an adverse effect on a living organism, seriously damaging structure or function or producing death.
Safety (toxicological): is defined as the high probability that adverse effects will not result from the use of a substance under specific conditions depending on quantity and manner of use.
Risk assessment: is a process which entails some or all of the following elements: hazard identification, effects assessment, exposure assessment and risk characterisation.
Risk management: is a decision-making process that entails considerations of political, social, economic, and engineering information with risk-related information to develop, analyse and compare regulatory response to a potential healthy or environmental hazard.

Hazard identification: is the identification of adverse effects which a substance has an inherent capacity to cause, or in certain cases, the assessment of a particular effect.
Effects assessment: or, more precisely, dose-response assessment, is the estimation of the relationship between dose or level of exposure to a substance, and the incidence and severity of an effect.
Exposure assessment: is the determination of the emissions, pathways and rates of movement of a substance and its transformation or degradation in order to estimate the concentration/doses to which human populations or environmental compartments are or may be exposed.
Risk characterisation: is the estimation of the incidence and severity of the adverse effects likely to occur in a human population or environmental compartment due to actual or predicted exposure to a substance, and may include «risk estimation», i.e., the quantification of that likelihood.
Risk classification: is the evaluation of risks in order to decide if risk reduction is required.
Risk-benefit analysis: is a multi-factorial task, in which the risk manager has to consider not only the risk assessment but also other important aspects, such as technical feasibility, costs, social/cultural factors, legislative/political factors, research uncertainties.
Risk reduction: is taking measures to protect man and/or the environment from the risks identified.
Monitoring: is the process of repetitive observation for defined purposes according to a prearranged schedule over space and time and using comparable and preferably standardised methods.

3.5.2) Risk communication

Risk communication is a part of the risk management process, directly involving the social/cultural factors in the decision making (step 5: risk benefit analyses) and also contributing to the risk reduction (step 6), by the definition of risk management given above.
Moreover, there is a part of the risk communication which is basically directed outside, and which is considered as a fundamental part of the available management systems (see Chapter 8).

3.5.3) Environmental management systems

The new environmental management systems (ISO 14001 and Emas) integrate more and more health security and environment. Being risk transversal to these aspects, it is more and more considered as an important part of the whole environmental management system (see Chapter 8).

3.6) Conclusions

The last section of this Chapter provides some reasons for which risk communication should be integrated in the company's managerial tools. This idea constitutes the motive of this project and the framework of the recommendations drawn in the Chapter 8.
The first sections have another function: explaining how the risk perception studies contained in the following Chapter are linked to the recommendations for the risk communication strategy (Chapter 8). Thus, the risk perception findings are used in this project to find some meaningful variables that can be controlled by the risk communication strategy.

4) VARIABLES WHICH INFLUENCE THE PUBLIC PERCEPTION OF RISK: THE LITERATURE

4.1) Introduction

This Chapter reports a literature search effort, structured so as to identify sociological and psychological studies of human system responses to risks of various type, with particular attention to the technological ones. While not comprehensive of all the "thousand variables", the objective is that this Chapter does convey an overall portrait of the larger literature. This portrait is aimed to find the most meaningful variables which influence the risk perception of the general public. Some of the variables regarding the general public, in fact, will be chosen to design the Tables in the Chapter 5. These Tables can be used as "check lists" to design a communication strategy.

Thus, in this project, the variables regarding the general public are used for two goals:

- verifying which of them contribute more to an overestimation of the risk by the general public in the specific case analysed (Chapter 7);
- giving some recommendations (Chapter 8) on how to act on them, to produce a more accurate perception of the risk.

The variables discussed in this Chapter about the general public and chosen for the next Chapters have the same code of identification; this is given by a number behind each variable.

Some other variables which affect the risk perception of the other stakeholders are part of this Chapter (see further). They are not used for a specific analysis of the case, but represent a complementary theoretical information.

4.2) The stakeholders affected by different risk perceptions

By the literature review, it emerges that different stakeholders have different reactions to the variables which influence the risk perception. That is why the variables found in the literature are divided into seven big groups, depending on the stakeholders which are mainly involved and influenced by them:

1) GENERAL PUBLIC

The general public includes also the local communities, which in some studies are distinguished from the other citizens. (Britt-Marie Drottz-Sjoberg, 1991).

2) PUBLIC AUTHORITIES

3) PROFESSIONALS IN INDUSTRY

The groups 2) and 3) – generally distinguished – by the literature search appear together, joined by the fact that both are managerial figures: "public or institutional" and "private".

4) WORKERS

The studies on risk perception take into account mainly the "workers", not considering the other "employees". For the specific case analysed (see Chapters 6 and 7), it is more important to dispose of studies among "workers".

5) EXPERTS

They can be: experts inside the company (technicians or researchers that work to specific technical studies and projects, and that do not have managerial roles) or experts outside the company (technicians or researchers that work for external institutes).

6) ENVIRONMENTAL ORGANISATIONS

It is not essential to define them. Nevertheless, it is important to notice that the "Citizen Committees" play a role which does not belong to any of the categories above. They are in the middle, between the general public and the environmental organisations: they are constitutes by citizens, but at as environmental organisations.

7) MEDIA

In the literature they are considered not only the mass media, but also the specialised media, since they different risk perceptions.

The most part of the studies has paid attention to the risk perception by the general public. It is possible to find some important information about media, environmental movements, workers, and experts. Very few are the studies about risk perception of industrial managers and public authorities.

4.3) General public

The main factors which affect the risk perception
Societies selectively choose risks for attention (Douglas, M. and A. Wildavsky, 1982): it is important the role of social and cultural factors in setting risk agendas and in determining which risks will be emphasised or de-emphasised.

Some of the main factors that affect the perception of risk have been synthesised by EPA (Michael D. LaGrega et al., 1994): they are indicated in the table and will be discussed further. The factors work in such a manner that, for example, an action voluntarily undertaken by an individual is perceived as posing a smaller risk than one imposed upon that individual, all else being equal.

Risk perception	
Less risky	**More risky**
Voluntary	Involuntary
Familiar	Unfamiliar
Controlled by self	Controlled by others
Chronic	Acute
Natural	Artificial
Fair	Unfair
Detectable	Undetectable
Not memorable	Memorable

Detectability of risk (1)
Exposure to toxic substances and radioactivity belong to the most fear threats. The reason is given by the fact that risks not detectable by senses provoke a big dread and consequently an overestimation of risk. People also dread harmful agents working from "within" the body over considerable time and those which can influence the genetic code.
Such risks have in common the lack of visible damage. The distinction between detectable and undetectable risks can also be expressed as the difference between destruction and contamination. One strong reason for the public dread involved in "invisible" dangers is that these events are seen as threatening the very foundation of human survival in a longer time perspective. Another is that they threaten the individual freedom and ability to guard and protect their lives by themselves (Britt-Marie Drottz-Sjoberg, 1991).

Type of risk (4)
Acute is the risk of a low probability event which causes high damages for health and environment in a very short time; chronic is the risk of a high probability event which causes high damages for health and environment after a prolonged period (which varies from few days to entire years). Acute risk is generally overestimated (Sandman, P. M., 1985).

Voluntariness of risk (3)
Attribution theory (Heider, 1958) purports to give a wide framework for considering how blame is laid. First there is the judgement as to causes, whether natural or human. If the damage is man-made, the attribution of responsibility and blame goes to the locus of control. There is a choice of acknowledging our own fault, pinning blame on another, deciding whether the other was informed and motivated to do harm. If we are already hostile to the presumed agent to harm, our blaming tends to be stronger, and if we suspect the agent of benefiting of our loss, the adverse judgement is even stronger.
Involuntary risks are less acceptable than voluntary risks. Some studies (Glickman T. S., Gough M., 1990) show acceptance of voluntarily risks at one thousand times the level for involuntarily risks (Starr, 1969). Eminent domain, pre-emption and the community's general feeling of outside coercion

thus exacerbate the level of fear. Acknowledging the community's power over the siting decision will lessen the fear and make siting a more acceptable outcome. (12)

Local control of risk (13)

Individuals tend to be optimistic about probabilities affected by their own behaviour (Lalonde, 1974). Risks controlled by others are less acceptable than risks under one's control. People want to know that they have control over not only the initial decision but also the entire risky experience. To some extent this is not possible. Once a facility is built, it is difficult to turn back.

But credible assurances of local control over monitoring and regulation can be expected to reduce risk perception by increasing control. Similarly, trust funds, insurance policies, bonds and such contractual arrangements can put more control in local hands. Quite apart from any other advantages, these arrangements will tend to diminish the perception of risk (Sandman, P. M., 1985).

Nature of the disaster

People react differently to natural catastrophes and man-made disasters. All the man-made disasters lack a "low-point", which is the moment when recovery starts and life slowly goes back to normal (Baum, A.; 1987). The man-made accidents - compared to the natural ones - are characterised by prolonged stress effects and by an overestimation of the risk.

Fairness of the risk (5)

Risks perceived as unfair are less acceptable than risks perceived as fair. A substantial share of the fear of hazardous waste facilities, e.g., is attributable to the fact that only a few are to be sited. A policy requiring each municipality to manage its own hazardous waste would meet with much less resistance. A more practical way of achieving equity is to negotiate appropriate benefits to compensate a community for its risks and costs (this is, of course, after all appropriate health and safety measures have been agreed to). In a theoretical free market, the negotiated "price" of hosting a facility would ensure a fair transaction. The point to stress here is that compensation does not merely offset the risk faced by a community. It actually reduces the perceived risk and the level of fear.

The topic can be extended to the issue of justice. "The best predictor of opposition to nuclear energy is the belief that American society is unjust" (Rothman and Lichter, 1982). In some professional analyses the existing allocation of risks is taken to imply an accepted norm of distributive justice sustaining the moral fabric of society. Those who are in the more favoured sectors of the community as regards the incidence of morbidity and mortality rates may be tempted not to think too deeply about its inequities. However, others would judge a society inequitable that regularly exposes a large percentage of its population to much higher risks than the fortunate top 10 percent.

The question of acceptability of risk involves freedom as well as justice. Consider the worker choice: if they are offered danger money for risky work, are they to be the sole judges of what risks they should take or should they be regulated? The freedom of the individual in liberal democracy is at issue. And when it comes to danger money, it is not clear that the riskier jobs really are the most highly compensated (Graham and Shakow, 1981).

Memorability of risk (26)

Dramatic and memorable risks are less acceptable than uninteresting and forgettable ones (Sandman, P. M., 1985). Psychological research has suggested that people often overestimate the risks of dramatic causes of death - such as aeroplane accidents - and that such overestimates are partly due to the greater memorability and imaginability of such events. Any factor that makes a risk unusually memorable or imaginable – such as a recent disaster or intense media coverage – may distort risk perceptions.

This is generally known as the "availability heuristic": people judge an event as more likely or frequent if it is easy to imagine or recall. The legacy of Kin-Buc (a large, abandoned landfill in New Jersey that is now a Superfund site) - e.g. - has made hazardous waste dangers all too easy to imagine and recall.

A corollary of the availability heuristic is that risks that receive extensive media treatment are likely to be overestimated, while those that the media fail to popularise are underestimated. But the debate over media handling of hazardous facilities is very complex.

Information about the facility (22)
As said above, a large part of the dread of carcinogenity is its undetectability during its latency period. As a veteran war correspondent told at Three Mile Island, "In a war you worry that you might get hit." While it is not possible to do much about the fear of cancer, it is possible to make manifest the proper (or improper) operation of the facility (Douglas, 1986).

Perceived social legitimacy
The perceived social legitimacy is a macro-variable, which includes the social position of individuals and the social relationships of individuals. A weak social position and lack of social relationships are related to overestimation of risk. Perceived "danger" of activities and technologies varied on a dimension of social legitimisation of actions.
The more isolated a person, the weaker and more dispersed is his social network, the less his decisions are subject to public scrutiny, and the more he sets his own norms of reasonable risk (Britt-Marie Drottz-Sjoberg, 1991). But as soon as there is a community, the norms of acceptability are debated and socially established. This activity constitutes the definitional basis of community. A community uses its shared, accumulated experience to determine which foreseeable losses are most probable, which probable losses will be most harmful, and which harms may be preventable. A community also sets up the actors' model of the world and its scale of values by which different consequences are reckoned grave or trivial.

General feeling of security provided by society
The general feeling of security that society provides its members influences the risk perception in a positive way. To trace common-sense ideas about norms for acceptable risks, surely some research would test correlation between community strength and the accuracy of individual members' assessments of risk. The most suggestive work on these lines has been focused on rumour and the social conditions for correctly receiving or for distorting information.
Rumours (unconfirmed messages that pass from person to person) are thought either to snowball or to loose fuzzy detail and wild elaboration in the process of transmission. Increasing negative prestige attaches to the transmission of false rumours; the population develops increasing scepticism, and demand for objectivity leads to drawing of a sharp line between rumours and other information; rumours are labelled as such in telling and names of sources have been attached to doubtful statements. The credibility of experts is often questioned because of suspected vested interests; the extent to which people feel they have been lied to in the past is said to affect public perception of e.g. nuclear technology (Piehler et al., 1974).

Age and sex of individuals
Women and elderly people tend to exaggerate their vulnerability to risk. This is explainable by cultural factors: women tend to be socialised into high-risk awareness; they are trained to expect attack; elderly people are isolated and their sense of danger corresponds to their weak sense of social support. The low correlation between facts and fears among women and elderly may be precisely the result of their cultivated fortress mentality (Britt-Marie Drottz-Sjoberg, 1991).

Information on the effects of the technology (25)
There generally exists a substantial public trust in new scientific and technological developments, but the occurrence of accidents, however, gradually erodes this trust. Public worry and concern rises especially after information about incidents or accidents involving technologies, which were assumed to be safe and under control. A large number of people in these situations believe that there is important information known to the experts which is withheld from them. Openness, to the extent it is possible, enhance trust and interest (Otway, H., 1988).

Focus by the popular documentation
Public knowledge about the latest scientific findings is based on secondary and selective information sources, such as popular magazines, newspapers, TV-documentaries and to some extent books (Drottz

& Sjoberg, B.-M., 1988). The popularised documentation focuses on what is achieved, not on possible adverse events. The public takes for granted that risk aspects have been eliminated. If later developments show that risks to health, life or property are involved, the public reaction is strong and emotional. This is a “boomerang effect” based on perceived misuse of confidence.

Incidence of the risk

Risk to society is perceived as higher than risk to people generally and especially high compared to the perceived personal risk. The difference between the three ratings is very significant. There also exist relaxed public attitude in matter of personal safety, in comparison with social risks, even in cases of much larger exposure to risk (e.g. smoke versus radiation).

One reason is given by the fact that private risks do not have a natural public forum. That is, the individual is personally responsible for guarding his or her private life, family and property. Strong concern over technological disasters result in formation of attitudes which may be expressed in discussions and political action with the general aim to create an overall change of conditions. Another reason is that high ratings of risks to others and to society seem to include concern over the quality of life of future generations (Drottz-Sjoberg, B.-M., 1990).

Trust in responsible (7)

The residents living nearby must be assured a threshold level of safety. If information about it is absent or not reassuring, the result will be an overestimation of risk.(24) Moreover, the citizens would accept any risk assessment only if they trust those responsible for the construction or transformation of the facility (Kunreuther, H., & Easterling, D., 1990). By a national survey made in Sweden about nuclear waste issues, trust in four different kinds of experts was investigated: the state authorities; the universities; the nuclear industry; experts who officially had denounced nuclear power. Men generally trusted the knowledge of expertise or official authorities more than women did. Both men and women trusted the experts at the industry more than those of state authorities.

Accuracy of information (29)

Strong public reactions to low probability disasters are sometimes met with a scornful snort, and dismissed as public ignorance. There are indications, however, pointing to a positive relationship between reactions and severity of threat. (9) This implies that if there is uncertainty and confusion surrounding an accident, this is also the general impression transmitted to the public (Hohenemser, C., and Renn, O., 1989). Imprecise and contradictory information on the effects of an accident or on protective measures increase the worries (Renn, O. , 1990). (23)

Meaning attributed to the term risk (8)

What do people normally mean when they use the term “risk”? People who focus on consequences of an event in defining risk tend to rate the risk of an event higher than subjects who focus also or exclusively on the probability of an event. This means that special attention should be paid to explaining the meaning of the term risk when it is used: if risk is intended to be as consequences of an event it is overestimated, while it does not happen if risk is intended to be more as probability of an event (Drottz- Sjoberg, B.-M., 1990).

Familiarity of risk (18)

The best-established results of risk research show that individuals have a strong but unjustified sense of subjective immunity. Unfamiliar risks are less acceptable than familiar risk. In very familiar activities there is a tendency to minimise the probability of bad outcomes. Apparently, people underestimate risks which are supposed to be under their control. They reckon they can cope with familiar situations. They also underestimate risks of events which are rarely expected to happen. (Douglas, 1986). Most common everyday dangers tend to be ignored. On the other end of the scale of probabilities, the most infrequent, low-probability dangers also tend to be played down. Putting these tendencies together, the individual seems to cut off his perceptions of highly probable risks so that his immediate world seems to be safer than it is and, as he also cuts off his interest in low probability events, distant dangers also fade.

The public tends to overestimate dangers of rare events and underestimate those of common events (Slovic, Fischoff, and Lichtenstein, 1981). The most underestimated risks are those, such as household accidents that people have faced for long periods without experiencing the undesired event. The sense of risk diminishes as we continue to evade it successfully. Thus, the perceived risk of a hazardous waste facility is, in part, a reflection of its unfamiliarity. Stressing its similarity to more familiar industrial facilities can diminish the fear; so can films, tours and other approaches aimed at making the facility seem less alien. Even more important is to make the wastes to be treated seem less alien. Detailed information on the expected waste stream – what it is, where it comes from and what it was used to make – should reduce the fear level considerably.

Way of determining risk: thinking probabilistically

The accepted theory of risk perception maintains that the rational principle of selection would combine the probability of an event with its value. However, people tend to fasten attention on the middle range of probabilities. High-probability dangers get overlooked. Heavy losses are entailed by risks of accidents in the home or on the road, but it is extremely difficult to get the average house-holder or driver to take effective precautions, such as lying down non-slip surfaces on domestic floors or wearing seat belts in cars. At the same time, many risks that combine heavy consequences with low probabilities, such as floods and earthquakes, are ignored. (17)

The distinction between objective (or mathematical) probability and subjective (or psychological) probability has always been important in risk analyses. People do not consistently make the choices that will minimise their expected winnings or minimise their expected losses, even though there is reason to assume that they have these goals. Such a discrepancy is often treated as a cognitive weakness.

Lay people often have difficulty understanding and interpreting probabilistic information, especially when the probabilities are small and the risk are unfamiliar. Experts experience similar difficulties interpreting probabilistic information, although expert knowledge can mitigate the effects of various judgmental biases (see further).

The culturally learned intuitions which guide our judgement for any of our fields of competence teach us enough probabilistic principles, but they are heavily culture-bound (Douglas, 1986). We are all lost when we venture beyond the scope of our culturally given intuitions. Presumably the technically competent in probability would be equally lost if asked to predict outside his skilled experience, though he would be good at formally structuring the problem.

Though this may save humans from the academic charge of not being capable of thinking probabilistically, it leaves several practical problems of risk perception. Particularly, it enhances the gap between expert's and the lay person's judgement. If people can only think probabilistically from a position of expert competence, and if there is no way for all or many of us to become experts, the question of how we are to make a political judgement of such risks is still open. This story starts out with a need to understand why experts in industry and government cannot convince the public of the safety of new technology.

The generalised tendency of humans turns out to be quite the other way, not naturally timorous but rather over-intrepid and difficult to persuade of the reality of dangers. But if the dangers in question are thought to be inflicted by a powerful minority (the industrialists) on a helpless majority, the sense of subjective immunity is not evoked. The difference is that the attitude to risks inflicted by others is political. The public considering new technology may not necessarily be afraid so much as angry. If so, we need to understand attitudes to blame (Weinstein, N. D., 1987).

Certainty of the risk assessment (16)

Uncertain risks are less acceptable than certain risks. Most people loathe uncertainty. While probabilistic statements are bad enough, zones of uncertainty surrounding the probabilities are worse. Disagreements among experts about the probabilities are worst of all. (33)

Basing important personal decisions on uncertain information arouses anxiety. In response, people try either to inflate the risk to the point where it is clearly unacceptable or to deflate it to the point where it can be safely forgotten. Unfortunately, the only honest answer to the question "Is it safe?" will sound evasive. Nonetheless, the temptation, and the pressure, to offer a simple "yes" must be resisted. Where

fear and distrust coexist, as they do in hazardous waste facility siting, reassuring statements are typically seen as facile and self-serving. Better to acknowledge that the risk is genuine and its extent uncertain (Sandman, P. M., 1985).
On the other hand, the public often expects that scientists and engineers should have absolute knowledge about risks before making decisions that affect them. The public also often expresses more concern with the possible magnitude of the worst-case scenario, either not understanding or electing to ignore how unlikely if not credible it may be. Merely learning that the assessment is filled with uncertainty may make the public uneasy about the estimates, believing that the true risk may be even greater than indicated. Better acknowledging about uncertainty, but not focusing on the worst-case scenarios (see above). (10)

The selective attention
The research about syndromes represents one of the rare cases where risk perception studies are interested in selective attention. Spangler (1981) develops the concept of syndrome: "a set of concurrent concepts including related emotions and decision predisposition that form an identifiable attitudinal pattern." Syndromes have a collective character, involving moral ideas of good and bad and reflecting shared social experience.
In risk perception psychologists agree that attention selectivity is the real issue, and at the same time go on categorising the configuration of stimuli. The selection is a central factor that reinforces now one response, now another. Social structure is a moral system, which creates the main lines of cost-benefits payoffs and produces the different ways of categorising the physical world. As with animals, human attention is focused by the concern to survive. But for humans, survival involves the human kind of communicating, and this involves establishing the conceptual categories for public discourse.

Comparisons (30)
Cross-hazard comparisons are seldom acceptable. It is reasonable and useful to compare the risks of a modern facility to those of a hazard chemical dump. The community needs to understand the differences. It is also reasonable and useful to compare the risks of not siting a facility-midnight dumping and abandoned sites. This comparison lies at the heart of the siting decision. On the other hand, to compare the risking of a hazardous waste facility with that of gas station or a cross-country flight is to ignore the distinctions above. Such a comparison is likely to provoke more outrage than enlightenment (Sandman, P. M., 1985).

Type of attention (14)
People are less interested in risk estimation than in risk reduction. Adversaries who will never agree on their diagnosis of a problem can often agree readily on how to cope with it. In the case of facility siting, discussion of how to reduce the risk is ultimately more relevant, more productive and more satisfying than debates over its magnitude (Plough, A. and Krimsky, S., 1987).

Legitimisation of the fear (15)
People are not interested in either risk reduction until their fear has been legitimised. Risk reduction, however, is not the only top priority for a fearful community. There is also a need to express the fear and to have it accepted as legitimate. No matter how responsive the Commission is to the issue of risk it will be seen as cold and callous unless it also responds to the emotional reality of community fear (Plough, A. and Krimsky, S., 1987).

Protective measures possibility
Risks that do not permit individual protective action are less acceptable than risks that do. Even for a very low-probability risk, people prefer to know that there are things that they can do, as individuals, to reduce the risk still further. The proposed protective action may not be cost-effective, and the individual may never carry it out, but its availability makes the risk more acceptable. Discussion of hazardous waste facility siting has appropriately focused on measures to protect the entire community. Some attention to individual protective measures may help reduce fear (Sandman, P. M., 1985).

Fishoff et al. (1994) identified other complexities that affect “acceptable risk”:

Decision problem definition (32)
A decision-maker’s responsibility in site reclaiming climaxes with the evaluation of several remedial alternatives and the selection of one. The public views this evaluation as unnecessary exercise, because the safest decision is “to haul the waste out of the community”.

Relative values assessment
Concentrating resources on the first item is thought by decision-makers to portray their decisions as purely objective. On the contrary, assessing risk and selecting from remedial alternatives is fraught with value judgements. Acknowledging the existence of values is far simpler than identifying and explaining the set of values underlying the decisions.

Addressing the human element in decision making process (31)
Addressing the human element probably represents the most important avenue for closing the perception gap between the decision-maker and the public. To not do so is a failure in dealing with risk in the broadest sense: “Thinking about risks may be more productive than calculating them.”

Assessing the quality of the past decisions (34)
Finally, rarely do decision makers revisit the issue long after the decisions have been made to determine if the decision was a good one and whether their decision making process needs adjustments. Were the right questions asked? Did we solve the real problems?

“The public often sees proponents of risk assessments as trying to convince people to accept risks that the proponents do not face, rather than acting to remove them”. The remedy desired by the public is to remove the hazardous waste “somewhere else” even if in scientific terms this may pose the largest risk. The difficulty in explaining risks to the affected people derives only in part from the highly technical nature of the issue.

Santos and Edwards (1987) suggest that to achieve effective risk communication three questions must be answered about the presentation itself:
a) Is the communicator listening and acknowledging the concerns of the audience? (27)
b) How capable is the spokesperson?
c) Can the objectives of the presentation be met still meeting the information needs of the public?
Finally, the outcome by the communicator is important and does not depend on his ability, but on his decisions and wills. A well-formed outcome by the communicator is, e.g., “I want to make myself understood”; an ill-formed outcome is “I want people to understand me” (De Marchi Bruna,1990).

Several topics convey the emphasis found within the findings regarding the hazard perceptions, collected by Drabek (1986). These topics are:
- the hazard awareness and salience;
- the role of experience;
- other correlates of hazard perception;
- primary groups impact;
- public education efforts;
- community variations in threat perceptions;
- disaster subcultures.

Hazard awareness and salience
Repeatedly, investigators have documented that the public lacks knowledge of and underestimates the hazardous quality of their environment (Covello, Vincent T., 1983). This underestimation reflects busy people. They are occupied with their own life priorities, day-to-day issues of living. Thus, aside from

the matter of risks associated with nuclear energy – which appears to be an exception of the opposite extreme – the general pattern is underestimation.
Researchers have shown that experts and lay people are typically overconfident about their risk estimates: overconfidence leads people to believe that they are comparatively immune to common hazards (Covello, Vincent T., 1983). (20)
The most striking results is that perceived risk shows no significant correlation with the factor mortality itself. Thus, the variable most frequently chosen by scientists to represent risk appears not to be a strong factor in the judgement of the subjects.
The public tends to overestimate mortality rates from well-publicised hazards such as botulism, floods and tornadoes; it underestimates those from most chronic causes of death, such as diabetes, stomach cancer, and strokes.
Among the public the relative salience of specific hazards varies over time; there is instability and change. Thus, variation in hazard perception and estimation can be accounted for by a combination of the following:
- magnitude of the hazard: the bigger the hazard, the bigger the overestimation of it; (2)
- frequency of accidents: the higher the frequency, the bigger the overestimation of it, with intermediate frequency generating greatest fear; (17)
- recent occurrence and frequency of personal experience, with intermediate frequency generating greatest fear;
- importance of the hazard to income or location interest: the less the interest, the more the overestimation of the risk;
- personality factors such as risk-taking propensity, fate control, and views of nature. This variation is not related to common socio-economic indicators such as age, education, and income.

The role of experience
Individuals having more previous experience with the specific hazard and those having a direct economic relationship to the hazard (a dry land farmer in relation to drought hazard), tend to have greater accuracy of hazard perception. (6)
“Experience” does matter, but one need not be a direct victim to have experience. It is awareness itself that affects people’s response to warnings. (21)
Independent of these aspects of the “experience” variable is the matter of frequency. The perception of environmental problems and hazards is closely related to the frequency of such events. Long intervals between individual disasters encourage people to be lulled into a sense of false security.
In short, at times - under conditions not yet specified - it appears that experience increases hazard perception, although not uniformly among all types of individuals. The factors that constrain this social process, giving it these variations in pattern, remain unclear.

Other correlates of hazard perception
Hazard awareness (21) varies directly with age; scepticism regarding personal vulnerability, due to natural hazards, varies directly with age.
Awareness is lowest among:
- young adults,
- those who live in household with school-aged children,
- the less educated and members of lower income strata.
The most likely aware of risk are:
- people over 50 years of age,
- people with especially strong attachment to their local communities,
- those who live in especially vulnerable circumstances,
While they may be more aware, the elderly tend to be more sceptical too. That is, while they know more about the hazard generally, they are more likely to discount the threat: “It will not hit us.”
Males evidence a greater degree of hazard awareness than females, but will report less fear or anxiety. (21)
Several studies have indicated that people residing in rural areas have greater degrees of hazard awareness and more accurate perceptions. In part, this urban-rural variability may reflect familiarity

with certain hazards that derives from work experience. Engaged in hazardous occupations and aware of the risks they tend not to define day to day exposure as continually life-threatening. (19)
Persons exhibiting internal-oriented personalities and less fatalist world views will have greater levels of hazard awareness and more accurate hazard perceptions.

Primary groups impact
As with other informational areas - politics, religion, or what have you - primary groups impact individual hazard perceptions. People receive information about hazards from relatives and friends. At times, specific events that have been etched in the memories of those who were on scene may remain referent points that are shared with others for decades to come. This is especially true if no comparable vent has occurred in the meantime. More detailed data have been provided by the former Washington state research team, i.e., Perry, Lindell, and Greene. Their studies documented the relative importance of primary groups as informational sources.
Primary group members provide specific hazard information regularly to about two-thirds of the adult population.
Approximately the same proportions of people in each sample reported receiving information from friends, neighbours and relatives (70%). The proportions of people reporting direct contact with emergency officials (state, federal, county or local) declines sharply with increasing distance from the hazardous site.
The high level of perceived threat is associated with a similarly high frequency of received information. (11)
Respondents were asked to indicate the sources from which they generally received information. five sources were mentioned: television, newspapers, radio, friends or relatives, and emergency personnel. The mass media dominated, with 98% of the sample mentioning television as source, 91% citing newspapers, and 87% citing radio. 70% of the people reported that they received hazard information from friends or relatives. Only 21% respondents had received information through direct contact with state, county, or local officials.

Public education efforts
Research suggests that merely increasing the frequency of public information campaigns does not produce sweeping change. Why? Saarinen's (1982) summary of a series of experiments conducted by Slovic and his associates (1977) stated well the matter.
Slovic et al. (1977) came to three conclusions bearing on the issue of education for behaviour change. A basic one is that people are resistant to change. Once initial impressions are formed they tend to structure and distort the interpretation of new evidence. Another is that making decisions about risky activities is difficult and humans may not be intellectually equipped to respond to that difficulty constructively. Instead, life's gambles are oversimplified to allow easy solutions, avoiding cognitive strain and emotional anxiety. A third conclusion is that otherwise intelligent individuals do not always have accurate perceptions of the risks to which they are exposed. Hazards that are easy to imagine or recall, that are certain to produce death, that take multiple lives, and have particularly dreaded consequences are overestimated, while risks from common non dramatic events involving only one person at a time are underestimated.
Although we know relatively little about the processes involved, certain approaches have limited impact. Broadly based, non-focused appeals are least effective. (28)
This chorus is matched by another (sometimes including the same voices) recommending that more effort should be made to improve public understanding by better educational campaigns. The faith in education is a logical next step from the initial acceptance of risk perception as a problem of misperceptions by the lay public. Green and Brown (1981) found that where reliable and precise objective estimates are available, their respondents' beliefs are quite accurate. It seems people first take a moral position – what ought to exist – and couple this with pragmatic considerations looking toward a complex future; in this light it makes sense to recommend that more and better information be given.

Community Variations in Threat Perceptions

Survey data document important differences among communities regarding threat perceptions. These studies indicate that hazards vary widely in the relative degrees to which they are perceived to be a threat, regardless of available scientific evidence.

There is a widespread belief in the communities studied that disasters involving hazardous chemicals are a community threat.

Respondents in small cities perceive the probability of a chemical disaster as significantly lower than their counterparts do in medium and large cities. However, there are no significant differences between medium and large cities in their ranking of the three chemically related disaster agents (Helms, John, 1981).

Community size, however, is not the sole variable that structures such perceptions. Several variables were considered that might account for the differences found in the perceived threat represented by three potential types of chemical disasters, i.e., a sudden toxic release, a chemical substance spill, and a major chemical plant explosion. Two factors emerged as especially important, i.e. these accounted for 88% of the variation in «perceived threat». Helms defined these as follows:

a) Threat 2 – "existence or non-existence of a large chemical complex and/or port facility within the community";

b) Public Expectations –"an assessment by organisational respondents of the public's expectations of a chemical disaster. Although it is rather tangential measure of public awareness, it may more accurately reflect pressures to which officials are responding than would a general survey of the public".

This work suggests the following hypothesis, which is more appropriate to be regained further: hazard awareness among community officials varies directly with their perceptions of public expectations.

Disaster subcultures

The influence of prior experience and a sub-cultural setting appear to affect public perceptions of the nature of disaster agents far more than official perceptions of these characteristics

Disaster subcultures dampen the threat dimension of hazard perceptions for specific disaster types for which these communities are more vulnerable

Some respondents believed that there is no risk of catastrophe, due to the presence of the official warning system. Its mere existence had apparently created a sense of complacency.

4.4) Organisational executives: authorities and professionals in industry

Direct focus on risk perception among professionals at industry is rare in the sociological literature. Some results from studies among "social control agencies" include officials at industry.

Hazard perceptions among organisational executives parallel those of the general public, both in content and in pattern variations. This means that hazard awareness among community officials varies directly with their perceptions of public expectations. But this matter has not been documented with much thoroughness.

Hazard experience appears to be the major variable impacting awareness. And, as with the public, most executives demonstrate minimal hazard awareness levels.

Community officials were asked by a survey to indicate on a five point scale the probability of their area being impacted by one of 36 different natural and technological disaster agents: the five highest, in rank order, were chemicals spills, multiple car wrecks, a major explosion in a chemical plant, a plane crash, and a sudden toxic substance release. Professionals tend to selectively identify those hazards that they have been specifically trained to deal with.

Officials tend to underestimate the level of public insight; a larger percentage of the public is aware of the risk and organisational responsibility for warning and evacuation than the officials realise.

There is a tendency for the officials to take a somewhat more optimistic view of the hazards. For example, a larger percentage of them believe that not only are the warnings fairly accurate, but the time for preparatory activity is longer.

Social control agencies view:

- individual actions in disturbances as being relatively unorganised and unplanned;

- disturbances as emanating from fairly specific event rather than from a series of sequential happenings;
- disturbance-generating events as the result of individual actions rather than as the consequences of social conditions.

Social control of curiosity

Most institutions tend to solve some of their organisational problems through public allocation of blame (Douglas, 1986, p. 56). Naturally, these problems and the blaming procedures vary according to the kind of organisations. Lastly, some machinery for renewing members' commitment to the institution's objectives is activated by the threat of disaster. Blaming the victim is a strategy that works in one kind of context, and blaming the outside enemy, a strategy that works in another. Victim blaming facilitates internal social control; outsider blaming enhances loyalty. Both ploys would serve an intention to prevent the community from being driven by dissertation. Members committed to a society founded on principles of open adversarial confrontation would not be likely to give credence to either of these stock responses to disaster. The accumulation of instances cited only shows that the incidence of misfortune is likely to be put to political uses.

Institutional constraints

Any major mishap in an organisation sparks off questions about responsibility. If the organisation has been established long enough to have taken a particular form, the questions are not going to be random. Still less will the answers seem credible unless they reinforce the members' concerns about the form of the organisation they live in. For example, if people in an organisation dislike the way that top authority has been exercised, it will be credible that the responsibility for accidents be pinned at the top; in the course of being made answerable, the harshness and arbitrary weight of authority will be investigated and criticised. In the reverse direction of concern, if the majority is worried about the disruptive behaviour of junior members in an organisation and fearful of a possible challenge to traditional authority, then minor and major misfortunes will seem very plausibly to have been caused by the young. This is compatible with attribution theory, extended beyond individuals to the life of institutions. It is important to recognise that the inquiries following on misfortune which focus on institutional norms and values represent the normal exercise of individual rational thought. Whether the institution has been developing in one direction or in another, the search for a culpable agent will be biased accordingly. This is how disasters, defined as either man-made or natural, become enmeshed with the micro-politics of institutions.

Engineers and public health officials have been compared in order to assess the viewpoint of professionals in government and industry. The concern of the public health official about environmental quality tends to decline with number of years in the profession. Both for engineers and public health officials, seniority brings increasing dedication to the agency, but the engineers perceive a wider range of problems facing society.

The individual takes a middle-range and short-range view of probabilities. Institutions carry perception into the long term. Different institutions vary the focus and constitute for individual members a differentiated experience of real world probabilities.

4.5) Workers

Communicating information about workplace hazards: effects on worker attitudes toward risks (Johnson B.B., Covello V. T., 1987).
Employee access to information about workplace risks has generated intense debates over government policies and growing conflicts on the shop floor. The success of lobbying and negotiating efforts on the part of workers, their unions, and health professionals is reflected in the proliferation of collective bargaining agreements, state and local laws, and European regulations which mandate the transfer of hazard information from management to employees (Ashford and Caldart, 1983; Brown, 1984). Colloquially known as the "right-to-know" movement, interest in educating workers about the dangers of toxic substances on the job follows a long history of employer neglect toward communicating risk information and varying degrees of employee interest in occupational health and safety.

By the end of the 70s, workers and their unions realised that legal language did not always translate into safer conditions. They began to argue that workers had to be informed about hazards on the job. The right-to-know campaign grew out of the well-documented history of employer refusals to identify and communicate information about known toxic substances, and efforts to mislead workers into believing their jobs were safe.

Chemical substances are present in most work environments, even those popularly thought to be clean and safe. Millions of workers may be exposed to regulated chemicals; however, the level of exposure and the degree of risk is constantly in dispute.
Workers are less concerned with the scientific debates over testing and dose-response curves than with identifying hazards on the shop floor. This involves the production and communication of two kinds of information. People want to know what substances are used on the job and the effects associated with them and they want to determine if they are suffering from work-related illnesses and the source of these health problems.

When the identity of substances is known, communication of detailed hazard information is possible. Management may inform workers through the use of material safety data sheets, training programmes or warning labels. Alternatives to management sources of data include unions for organised workers, health professionals, government agencies, and co-workers. However, unless government agency or union-sponsored inspections occur, workers have no choice but to ask management for information about exposure levels. Without such information, workers cannot determine the extent of risk, the degree of employer compliance with regulatory standards, and their options for action. Lack of adequate exposure monitoring is a key factor in limiting worker knowledge of hazards.
The responses of workers in a variety of situations to job risks can be classified into three categories:
- denial;
- acceptance;
- activism.

Denial

Work, for most people, means doing their job, social interaction, and a paycheque. No one likes to think about the possibility that a job may not only put food on the table but result in debilitating illness or affect the health of one's children. Confronted by risk, some refuse to acknowledge its relevance to their lives. Others justify and then ignore the risk as part of the job. This may include avoiding information about the seriousness of risk.

Robert Beilin (1982) argues that people use denial to preserve existing relationships that would be upset if they integrated knowledge of potentially tragic outcomes into their lives. In contrast, the theory of cognitive dissonance holds that people filter information in an effort to achieve consistency of knowledge with beliefs and actions (Janis and Mann, 1976). If forced to confront information which conflicts with beliefs, the theory suggests they will change their behaviour or suffer from stress. Both

approaches suggest that people will not be likely to seek information if they believe that risks are minimal or non-existent and there is little that can be done about them.

In this context, management messages reinforce a pattern of denial. Employers' arguments imply that if workers follow orders, they will be safe. Employees do not have to take an active role in health and safety; management can be trusted to protect them. Many workers want to believe that their employer would not create conditions that will lead to harm. They have no methods of coping with the long-term implications of continued exposures. Oriented toward short-term goals such as avoiding accidents and collecting a paycheque, workers can have attitudes to underestimate the objective risk.

Interviews suggest that supervisors or senior workers who care little about hazards and are more interested in getting the job done with a minimum of conflict set the tone for the entire workplace. A maintenance worker in an egg-processing plant described how he was ridiculed by his supervisor and co-workers for wearing gloves when using a powerful cleaner. In these cases ridicule becomes an enforcement mechanism by which the group avoids coming to terms with the implications of the presence of hazards in the workplace.
Even when group norms are not enforced or do not exist, individuals may cope with risk by denying its significance or lapsing into fatalistic attitudes. Much of this is connected to feeling that there is little one can do to change either the situation or to adopt protective measures.
Denying risk may extend to the point of refusing to become more knowledgeable about hazards. Avoiding information from the union and thus avoiding the implications of working in a risky environment enables some workers to side-step difficult decisions about their health, their pocketbook or both.

Acceptance
Some of the workers interviewed for this study believed that the hazards they face are an acce0ptable part of their job. This attitude reflects several different types of situations. Some believe that risk has been reduced as low as possible and the benefits of the job compensate in some way for the residual. Others, cognisant of the risks of continued employment, are sceptical of finding alternative sources of income in a troubled economy. Some workers find substantial satisfaction in their chosen occupation despite significant hazards. Firefighting, for example, is a job with enormous short-term and long-term risks, yet there is a heroic dimension to their work.
Economic hard times compound difficult decisions about risk. The fewer the job opportunities, the more workers are apt to stay with hazardous jobs.

Activism
Although workers may avoid hazard information as too threatening, they still may wonder about the consequences of exposures to hazards. Some do not simply ask the question, but seek out answers and struggle for change on the shop floor. Thus, there may not be a great deal of difference in perceptions of risk between those who end up accepting their situation and workers who become activists. The interviews give little support to the notion that access to hazard information generates demand for change. What seems to be the case is that people become activists for other reasons, but information seeking is critical for their effort to change. Activists tend to be a very small minority of the workforce with distinctive personalities and social characteristics. Some workers put health and safety issues into a larger perspective. They are unwilling to accept a status quo they perceive as unfair. Several others ascribe their activism to an unwillingness to meekly accept conditions. More than that, they believe that everyone has a duty to speak out, yet recognise that not everyone does and they are outspoken.

Surprisingly, few workers mention experiences with hazards as the events which triggered beliefs that they have to get involved. Experiencing risk does not seem to be as significant an impetus to action as much as a recognition that conditions are not likely to change unless an individual worker chooses to seek changes.

An important motivation among many of the activists is their orientation to the future. Some see

activism in a personal light: their children should not have to put up with the conditions they endure every day.

While several note that their union is a good source of information, many are disappointed in the effort of management or government agencies. Often, activists become more committed to changing their conditions of employment when they began to see both themselves and their co-workers at risk. Identifying with their co-workers as a class whose interests clash with management, they are reluctant to abandon activism even when they are jeopardising their own health.

The following considerations represent some necessary conclusions to this section.

Knowledge forces workers to confront the rationality of believing that either risks are minimal and they are personally immune, or that the short-term benefits justify the long-term risk of ill health. When workers believe that risks cannot be changed, information is perceived as useless and a potential source of either friction with management or emotional stress.

Management communication about risks reinforces feelings that workers have little control. Claims that known risks are minimal or that conditions are being investigated suggest to workers that immediate action is unnecessary and that management is acting in responsible manner. This is a very effective argument with workers who want to believe that someone is taking care of them. Moreover, if appropriate alternative messages from trusted sources such as a union do not exist, workers tend to do their jobs and not think about the risks.

This contrasts with workers who perceive that change is possible and they should speak up about problems. They discount management claims, especially when they run counter to their experiences on the shop floor or when their union argues that exposure should be reduced. The existence of uncertainties provokes an argument that prudence dictates exposure reductions. In their view it is better to avoid potential health problems than wait for unequivocal data.

4.6) The experts

Experts play a major role in risk selection and evaluating the significance and acceptability of technological risks. In performing this role, experts are often perceived by themselves and by large segments of the public to be unbiased, objective, and value-neutral.
What research does not address is the strong influence of social and cultural factors on the risk judgements and interpretations of experts. This is clearly demonstrated by Covello (Johnson B.B., Covello V. T., 1987). By some studies, in fact, it is argued that experts are themselves culture bound. More specifically experts share with non-experts two basic characteristics.
a) Experts act within the constraints of particular organisations, communities, and societies.
b) The risk judgements of experts are strongly influenced by their social networks and social interactions.

At the most fundamental level, the core of the scientific enterprise itself – expert knowledge – can be viewed as an “agreed-upon reality”. In reaching agreements about nature of reality, experts use criteria for acceptance or rejection of new scientific knowledge that are themselves social constructs.

Among the various social and cultural factors that influence expert judgements, perhaps the most important is the occupational community or communities to which an expert belongs. Occupational communities can be defined broadly as groups of people who see themselves as doing the same kind of work, who identify positively with their occupation, and who share ideas, values, and viewpoints (Van Mannen and Barley, 1984). Solidarity within such occupational communities is promoted by several factors, one of the most important being the shared possession of specialised, esoteric, rare, and socially valued skills.

A central characteristic of such occupational communities – especially those that seek to attain or maintain the status of a "profession" – is that they often attempt to rigidly control the contents and "agreed reality" of the profession's specialised knowledge and skills is used by the profession to justify and legitimise its autonomy, elite status, and opinions on matters relevant to the profession (Winne, 1982). The success of this effort ultimately depends, however, on the wider society, which exercises control over professions through its power to confer legitimacy and resources (Namer, 1984).

Risk and relativism in science for policy

From one perspective, the relativistic view can be interpreted to imply that people are incapable of perceiving what is really dangerous, since there are no actual or objective risks in the world. For risk managers, this interpretation implies that the only choice available is an impossible choice between situational chaos and naive realism. However, Steve Rayner (1984) argues that the situation is not hopeless. Adopting a perspective shared by several other authors, he argues that a case can be made for better and worse social construction of risk. The basic argument is that risk issues can be seen as moving through a sequence from "consensual science" through "clinical consulting", to "total environmental assessment" depending on the degree of scientific uncertainty in the risk estimates and on the importance of the issue to the parties at interest. The further the issue is from scientific consensus and the greater the importance of the issue, the greater will be the significance of the cultural variation and the more problematic will be standards of objective validity.

Fortunately, the field of risk analysis has already produced a model of the production of scientific knowledge. Funtowics and Ravetz (1985) have described three kinds of science predicated by two variables: *systems uncertainty* and *decision stakes*. Whereas systems uncertainty contains the elements of inaccuracy, uncertainty, and ignorance encountered in the technical studies; decision stakes involves the costs and benefits of the various policy options to all interested parties. This model generates three kinds of science, each with its own style of risk assessment (Figure 1).

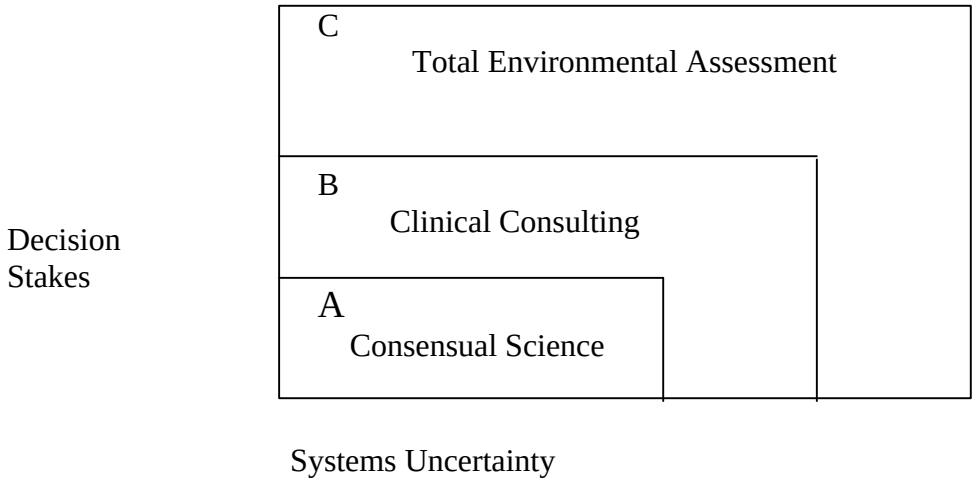


Fig. 1. Funtowics and Ravetz s three kinds of science.

A) Low systems uncertainty and decision stakes describe situations in which databases are large and reliable, and the technical community largely agrees on appropriate methods of investigations. The consensus here is achieved, in part, by the low decision stakes. Controversies about scientific facts are unlikely to be heated where the symbolic loads that such facts carry are either well established or unimportant. Knowledge is likely to have a very strong component of natural feedback based on long-term practical interaction between the social systems represented here and the non-human universe. The variations in perspective on risk emphasised by cultural relativism are likely to be minor within this framework.

B) When both systems uncertainty and decision stakes are considerable, but professional expertise is still a useful guide to action, a different style of activity is defined, the clinical mode of technical consulting. This kind of activity involves the use of quantitative tools, supplemented explicitly by experienced qualitative judgement. The exercise of this judgement increases the decision stakes for the consulting scientist and begins to bring to the fore differences of interpretation rooted in perhaps competing institutional, educational, and disciplinary cultures. There is some kind of unstable balance or alternation of over-determination between natural feedback and cultural constraints on the knowledge process throughout this kind of activity.

C) Finally, when decision stakes and systems uncertainties are very high, the scientific style is termed *total environmental assessment*. This kind of activity is permeated by qualitative judgements and value commitments. Inquiry, even into technical questions takes the form largely of a dialogue, which may be in an advocacy or even an adversary mode. Although the proportion of risk assessments that fall into this mode is only a tiny proportion of the whole, they are often those of greatest political significance. Total environmental assessment provides the most plausible opportunity for the application of a cultural-relativist perspective, for here the social constraints on the knowledge process are clearly dominant over natural feedback.
Rather than being an antidote to cultural relativism, the distinction of three kinds of science more properly defines those instances where the role of cultural variation in knowledge is, respectively, trivial, integral, and dominant as we move from consensual science, through clinical consulting to total environmental assessment. The role of natural feedback varies inversely to that of cultural constraints through the same progression.

4.7) Environmental Organisations

In recent years, risk assessment and risk management activities have become increasingly politicised. Virtually every major health, safety, and environmental decision is subject to intense scrutiny and lobbying by a vast array of environmental, consumer, and other citizen groups (Luther P. Gerlach in Johnson B.B., Covello V. T., 1987). Not only have the number and size of such groups increased, but also their level of scientific expertise and political sophistication.
These developments have contributed to at least two others.
A) It has become increasingly necessary for decision-makers to consult representatives from citizen groups on virtually every major health, safety, or environmental decision.
B) The dissemination of competing risk analyses by government, industry, and citizen groups has contributed to public confusion about a wide array of risk issues.

A critical issue is how and why the environmental groups identify and select specific risks for attention and political action. The protesters argue that the technologies and their uses are unfair in their distribution of costs and benefits, often unnecessary and above all, unsafe.
A technical (technological) controversy, according to one analyst has three important factors (Mazur, Allan; 1981):
a) Its focus is some product or process of science or technology.
b) Some of the main participants in the controversy must qualify as experts in technology or science.
c) There must be experts on opposing sides of the controversy who disagree over relevant scientific arguments which are too complex for most laymen to follow.
This is a useful introduction to the topic. Yet, most of Mazur's (1981) essay deals with how the scientific and technological dimensions of technical controversy are used and shaped by the kinds of social forces including protest movements which characterise so many other public controversies. They become, as physicist Alvin Weinberg (1985) has observed, "transcientific".

Thus, another characteristic of public technical controversy is that members of the scientific and technical establishment do not control the dispute. They are not able to contain its conduct within the framework of scientific discourse. Some lay activists are not hesitant to enter the scientific-technical debate, no matter how complex. When criticised for this by officials, they are more likely to seek to improve their command of the subject than to leave it to specialists.

A related characteristic is that such disputes are not contained within the normal, mundane, political process of representative democracy. Just as people consider the issue too important to be left to scientific technological elite, so do they consider it too immediately important to be left to elected or appointed officials. Similarly, they contest the actions and question the capability or integrity of executives in the corporation promoting the technology. Doing this, protesters often identify themselves as being "grassroots", representing ordinary citizens rather than being of "the system", the people in official power, the "established order".

A movement is here intended to be a group of people who are organised for, ideologically impelled by and committed to a purpose which implements some form of personal or social-cultural change; and who are actively engaged in the recruitment of others, and whose influence is spreading in opposition to the established order within which it originated. This definition identifies five key factors or characteristics as critical, namely organisation, ideology, recruitment, commitment, and opposition. It is as these factors take certain form and interact that collectively moves along the continuum, from interest group to become a full-fledged movement.

The simplest form of collective action is that of people organised in a local group for a single, specific, short-lived purpose. The entities involved in such bounded protest have been termed and indeed deprecated as "Not in my Backyard" (NIMBY) organisations or as "single issue" groups. The critics complain that such groups are narrow and selfish. They, for instance, want the environmental benefits of waste management but do not want to accept responsibility for resolution. The most complex form

of collective action is taken by people organised in movements ideologically integrated, motivated, and legitimated, organised for predatory expansion, recruiting new participants, challenging not only projects and principles, but the proponents and perpetrators of them. They stand against an opposition, part real, part perceived and defined through the filter of ideology. Identifying, fighting, and defeating this opposition is not only a goal of the activists; it is also a factor which helps launch and then drive the movement system. No matter what the type of movement, there is a characteristic "we-they" ingroup-outgroup orientation on the part of most participants. "A movement grows with the strength of its opposition much as a kite flies against the wind" (Luther P. Gerlach, 1987). Opposition, real or perceived, is necessary to promote a movement, to provide a common enemy against which it can unite its disparate segments to offer a basis for its commitment process.

A common complaint made of participation by protesters is that they were not involved early enough to shape the assumptions and basic plans underlying proposed projects. Planners and decision makers respond with the complaint that protesters do not get involved to the extent that they share in solving the entire problem, or in accepting responsibility for failure to make or implement decisions, or in preparing themselves technically to understand the issue. Since these officials cannot dispense with participation they search for ways to involve people earlier and longer more "constructively". Experience has led both decision authorities and grassroots activists to believe that people will only become involved if they see that their own future is seriously at stake through what is decided, and they can affect their decisions.

Established orders do not like to admit that protest movements made them change (though they may admit that this helped them to think about changing). Established orders want to say that they arrived at their decisions in ways which they controlled, using procedures appropriate to their organisations, and knowledge rationally obtained through their official means. If they admit to responding to pressures from outside their organisations, it will seldom be protest movements which they will acknowledge as the source of this pressure. The nuclear energy industry, for example, says that it is the economy and government regulations which have made them change their timetables and programmes; not the antinuclear movement.
Probably, this reluctance to admit to the success of movements is simply a good tactic to dissuade people from turning to social movements as a means to achieve their ends: much as governments do not want to admit that hostage-taking pays off. But probably there are deeper roots to this reluctance. Social movements are characteristically regarded as forms of deviant behaviour stemming from conditions of deprivation, disorganisation, demoralisation, devitalisation (Hine, 1974). This implies that participants are themselves defective, looking for revitalisation, reorganisation, reintegration. From this perspective the best thing that can be said for participants in a movement is that they really are not troubled, but instead are using or making the movement in order to serve their very selfish ends. In the U.S. this means that ecology activists are regarded by their critics either as sincere deviants, pushed into butterfly protecting by their structural or economic marginality (Douglas and Wildavsky, 1982), or as selfish suburban straight, using ecology or anything to protect their backyards (Tucker, 1982).

4.8) Media: coverage and influence

During the 1970s, several researchers initiated studies of media responses to hazards of various types. We now know that most people receive hazard information frequently. Indeed, one study indicated that 90% did so twice daily, or more. Much of this barrage comes from media. As the previous section indicated, however, relatives, friends, and other primary group members constitute an important source of hazard information too. But they are in second place; the media rank first. There is not one-to-one correspondence, however, between what the media transmit and what people remember.

The mass media are the most salient source of information for all samples of respondents, including those in community that have experienced disaster. In each community, approximately 60 percent to 75 percent of the respondents reported radio and television were important source of their disaster knowledge. Newspapers also were important to a sizeable percentage. For many of the respondents, the media were not only an important source of information, they were the only source.
Implicit in several of the interpretations are notions about content and context. Analyses of newspapers provide some relevant clues about both matters. For example, Larson's literature review (1978) disclosed studies revealing that about two percent of all news items deal with accidents or disasters. Furthermore, the public perception of what was important in the news was not in direct proportion to the amount of space a story received in the paper or to the time it got in the air.

As illustrated by the following quotations, degrees of "sensationalism" that some have found may not be interpreted as such by all.
In conducting a detailed monitoring of news reporting by six newspapers in the Los Angeles area for a 3-year period (1976-78) and a less intensive monitoring of television and radio coverage of earthquake news, we have been generally impressed with these media's highly responsible news treatment. If these media have erred, they have erred less in the direction of sensationalism than in the direction of underplaying threat and rumour.
A second theme we find in media treatment of news about a prospective earthquake is a concern with protecting the public. Newspaper, television, and radio editors are anxious to avoid any reporting that may produce mass panic or other undesirable responses. Most media representatives share the popular misconceptions about the likelihood of mass panic.
The most cosmopolite papers would exhibit the smallest degree of unevenness, or sensationalism, in hazard news coverage.

Throughout the long period before the hazard becomes an acknowledged issue, coverage by special interest international media has virtually no influence on governments or international organisations. When the mass media become involved, however, they have a decided impact. The attention of the mass media and the subsequent development of the hazard as an issue are largely responsible for the redefinition of its importance by governments and international organisations.
Pursuing this "agenda setting" function further, Roger and Sood (1980) proposed that it is essential to differentiate among the roles played by different media:
a) The prestige press plays a more important role in a slow-onset disaster than in a sudden disaster. The prestige presses can legitimise a slow-onset event as a disaster, as it sets the agenda of news for the other media.
b) Although the local press in a developing country tends to give a disaster more coverage than the Western press does, local media tend to underplay negative aspects of a disaster and provide less perspective on the disaster than the foreign media do.
c) Newspapers tend to follow and report on disaster related "events", whereas magazines wait for events to gain before they provide coverage.
d) In sudden disasters, the severity is generally estimated through casualty and damage figures. In slow-onset disasters, the criteria for severity are the size of the affected population and the extent of the threat to that population.

4.9) Conclusions

This Chapter furnishes the variables which are useful to analyse the specific case of the Oil Harbour (Chapter 7) and to furnish recommendations to companies on how to improve risk communication (Chapter 8). In the following Chapter, the most meaningful variables (indicated in this Chapter by a code) are put into one frame (I and II Table). To obtain this frame, the variables were reconstructed, with their categories and their effect on the general public. The same variables are used for the content analysis of the press articles about the application case. In fact the same categories are used for the content analysis, to see how frequent they are and how acting on them.

On the other side, the variables regarding the other stakeholders are anyway taken into account, in the analysis of the specific case (see “stakeholder system” in the Chapter 7).

5) VARIABLES WHICH INFLUENCE THE PUBLIC PERCEPTION OF RISK: THE TABLES

5.1) Introduction

The discipline of risk perception is very often considered as something "undetectable". It is very difficult to use the enormous amount of studies on risk perception as tools for management objectives. This constitutes one effort of this project, by inserting all the variables found in the literature within two tables, with the same structure.
That is why the following Chapter contains a "reconstruction" of the most tested variables of risk perception which are described in the Chapter 4. The tables, which contain these variables, spring from the necessity of having a synthetic picture, as managerial tool. In fact, they constitute a schematic framework, which will be important in analysing the application case in the Chapter 7, and in furnishing the recommendations in the Chapter 8.
The structure of the two tables - in presenting the variables - does not follow the same structure of the Chapter 4. This difference is due to the fact that the variables reported in the table are grouped by criteria which do not coincide with the theoretical ones.

5.2) Tables explanation

The table contains the *independent variables*, their *categories*, the *sign of the relations* (positive or negative), and the *dependent variables*. The last are composed by the *target* influenced and the *type of influence*, which can be an *overestimation* of the risk, a *balanced (accurate) estimation* of the risk, an *underestimation* of the risk.

The "controllability" and "availability" of the variables will be considered further.
The "code" will be useful to identify only the variables which will be used in the Chapters 7 (Case study analysis) and 8 (Recommendations).

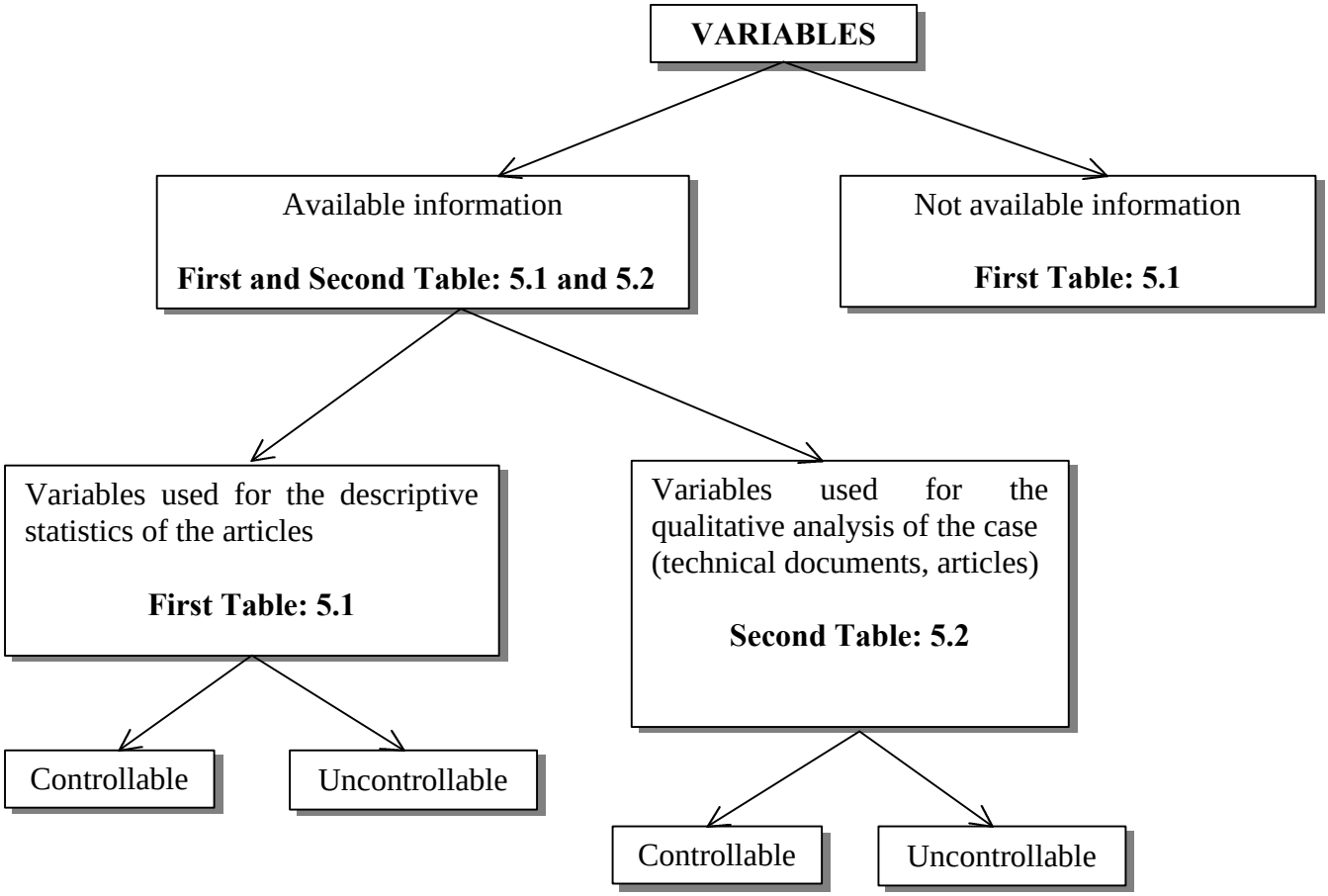
The target influenced considered by the table is the *general public* (where it is possible – they are distinguished the two categories in it contained: local community and citizens). All the variables have been classified by four macro-groups, which are: the variables about the risk itself, the socio-psychological variables, the variables which regard information given about risk, the variables related to the decision-making process at large.

Table sample

CONTROLLABILITY And AVAILABILITY	CODE	**INDEP. VARIABLE**		SIGN REL.	**DEP. VARIABLE**			
		VARIABLE	CATEGORY		TARGET INFLUENCED	TYPE OF INFLUENCE		
						OV	BL	UN
					GENERAL PUBLIC			
		Macro: RISK						
		TYPE OF RISK	Chronic	+	Lc		√	
			Acute	+	Lc	√		

It is important to underline that the different perception is relative to the categories of each variables. When, for instance, you see from the table that:
- acute risk influence the perception towards an overestimation,
- while chronic risk influences the perception towards an accurate perception,
it means that acute risk is relatively more overestimated than chronic risk, and viceversa that chronic risk produces a more accurate perception than acute risk.

The variables contained in the table will be divided in the following way:



Some of the variables are not used in this study, since they require information which are not available (indication in the first column of the Table 5.1).
Within the "available" variables, some will be useful to analyse the content of the press articles, obtaining as output a quantitative description of their distribution (Table 5.1). The results will be compared to the data of the technical documents, to see the difference between the "objective" data and how these data appear by the press. Some other variables will be used for a qualitative analysis of the case, by the technical documents, the literature, the press articles (Table 5.2).
Independently from the type of analysis, the variables will be classified as "controllable" or "uncontrollable" (indication in the first column of both the Tables). Regarding the controllable variables, it will be said in the Chapter 8 (Recommendations) who - within the stakeholders - can control them and how, within the European and international management and communication instruments.

5.3) First Table

As explained above, the following table contains the variables, which will be used for the descriptive statistics of the press articles. This analysis is aimed to discover the "weak" factors which - in the specific case - produce an overestimation of the risk. By the Table it is also possible defining which is the direction to contrast the wrong perception of the risk.
The following are some explanations of the "First Table", but they remain valid for the "Second Table".

C = controllable variables
* = not available information (indicated only in the Table 5.1)
Lc = local community
Cz = citizens
OV = overestimation
BL = balanced or accurate perception
UN = underestimation

Table 5.1: Variables which influence the public perception of risk (useful to analyse the articles)

CONTROLLABILITY and AVAILABILITY	CODE	**INDEP. VARIABLE**		SIGN REL.	**DEP. VARIABLE**			
		VARIABLE	CATEGORY		TARGET	TYPE OF INFLUENCE (type of perception)		
						OV	EQ	UN
					GENERAL PUBLIC			
		Macro: RISK						
	1.	DETECTABILITY OF RISK	Detectable risk	+			√	
			Not detectable risk	+		√		
C	2.	MAGNITUDE OF THE HAZARD	High	+		√		
			Low	+			√	
C	3.	VOLUNTARINESS OF RISK	Voluntary risk	+	Lc		√	
			Involuntary risk	+	Lc	√		
	4.	TYPE OF RISK	Chronic	+	Lc		√	
			Acute	+	Lc	√		

C	5.	FAIRNESS OF RISK	Fair risk	+	Lc		√	
			Unfair risk	+	Lc	√		
		Macro: SOCIO-PSYCHOLOG.						
*		FREQUENCY OF PERSONAL EXPERIENCE	High	+			√	
			Medium	+		√		
			Low	-			√	
*		RECENT OCCURRENCE OF PERSONAL EXPERIENCE	High	+			√	
			Low	-			√	
C	6.	ECONOMIC RELATIONSHIP TO THE HAZARD	Importance of the hazard to economic interests for the local community	+	Lc		√	
			Lack of economic interests	+	Lc	√		
*		PERSONALITY ORIENTATION	Internal-oriented personalities -> greater awareness	+			√	
			External-oriented personalities -> lower awareness	+		√		
*		*SOCIALISATION OF RISK (AGE + SEX)*	*Women*	+		√		
			Elderly people	+		√		
			Men	+			√	

*		*SOCIO-ECONOMIC PROFILE (ideal-types)*	Young adults + living in household with school-aged children + less educate + with lower income -> lowest awareness	+		√		
			People over 50 years + strongly attached to their local communities + living in vulnerable circumstances -> greatest awareness	+			√	
*		RISK TAKING PROPENSITY	High	+			√	
			Low	+		√		
*		MEANING ATTRIBUTED TO THE TERM "RISK"	People who focus on consequences of an event in defining risk	+		√		
			People who focus also or exclusively on the probability of an event	+			√	
*		SOCIAL POSITION OF INDIVIDUALS	Strong	+	Lc		√	
			Weak	+	Lc	√		
*		SOCIAL RELATIONSHIPS OF INDIVIDUALS	Presence	+	Lc		√	
			Lack	+	Lc	√		
C	7.	TRUST IN RESPONSIBLE	Low	+	Lc	√		
			Medium or high	+			√	
		Macro: INFORMATION						
C	8.	RISK MEANING EXPLANATION	Consequences of the risk	+		√		
			Probability of the risk	+			√	
C	9.	INFORMATION ABOUT SEVERITY OF THE THREAT	Present but imprecise	+		√		
			Present and precise	+			√	
			Absent	+		√		

C	10.	ACKNOWLEDGEMENT ABOUT THE RISK UNCERTAINTY	Merely acknowledging about the uncertainty of the assessment	+		√		
			Not acknowledging about the uncertainty of the assessment	+		√		
			Acknowledging that the risk extent is uncertain, considering the worst-case scenarios	+		√		
			Acknowledging that the risk extent is uncertain, not focusing on the worst-case scenarios	+			√	
*		COMMUNICATOR OUTCOME	Well-formed: "I want to make myself understood"	+			√	
			Ill-formed: "I want people to understand me"	+		√		
*		PRESENTATION	Meeting the objectives of the presentation, still meeting the information needs of the public	+			√	
			Meeting the objectives of the presentation, ignoring the information needs of the public	-			√	
C	11.	FREQUENCY OF RECEIVED INFORMATION ABOUT RISK	High	+		√		
			Low	+				√
		Macro: DECISION MAKING						
C	12.	COMMUNITY INVOLVEMENT	Acknowledging the community's power over the siting decision	+			√	
			Not acknowledging the community's power over the siting decision	+		√		
C	13.	LOCAL CONTROL	Increasing control	+	Lc		√	
			Decreasing control	+	Lc	√		
C	14.	TYPE OF ATTENTION CONCERNING RISK	Attention to risk estimation	+		√		
			Attention to risk reduction	+			√	
C	15.	LEGITIMISATION OF THE FEAR	Legitimising the fear	+			√	
			Not legitimising the fear	+		√		

5.4) Second Table

This "Second Table" contains the variables which will be used for the qualitative analysis of the available documents regarding the Oil Harbour. This qualitative analysis is aimed to discover the "weak" factors, which in the specific case produce an overestimation of the risk.

Table 5.2: Variables, which influence the public perception of risk (qualitative analysis)

CONTROLLABILITY	CODE	**INDEP. VARIABLE**		SIGN REL.	**DEP. VARIABLE**			
		VARIABLE	CATEGORY		TARGET	TYPE OF INFLUENCE (type of perception)		
						OV	EQ	UN
					GENERAL PUBLIC			
		Macro: RISK						
C	16.	*CERTAINTY OF RISK ASSESSMENT*	Uncertain risk	+		√		
			Certain risk	+			√	
C	17.	*FREQUENCY OF ACCIDENTS*	High	-	Lc, Cz		√	
			Medium	+		√		
			Low	+	Lc, Cz			√
C	18.	*FAMILIARITY OF RISK*	Familiar risk: that people have faced for long periods without experiencing the undesired event	+	Lc			√
			Unfamiliar risk	+	Lc	√		
		Macro: SOCIO-PSYCHOLOG.						
	19.	*ENGAGEMENT IN HAZARDOUS OCCUPATIONS*	Present -> greater awareness and scepticism among the threat	+			√	
			Absent	+		√		

C	20.	*ASSESSMENT ABOUT THE PAST*	Assessing the quality of the past decisions and adjustments	+			√	
			Assessing the quality of the past decisions, but without adjustments	+		√		
			Assessing the quality of the past decisions, but with contradictory judgements and adjustments	+		√		
			Not assessing the quality of the past decisions	+		√		
	21.	CONFIDENCE	Overconfidence of lay people	+	Cz			√
			Lack of confidence of not lay people	+		√		
C	22.	*AWARENESS*	high (men)	+			√	
			low (women)	+		√		
		Macro: INFORMATION						
C	23.	*INFORMATION ABOUT THE FACILITY*	Making manifest the proper/improper operation of the facility	+	Lc		√	
			Not giving information about the proper/improper operation of the facility	+	Lc	√		
C	24.	*INFORMATION COHERENCY*	Non contradictory information	+			√	
			Contradictory information	+		√		
C	25.	*THRESHOLD LEVEL OF SAFETY*	Assuring a threshold level of safety	+			√	
			Assuring a threshold level of safety, but with imprecise information	+		√		
			Not assuring a threshold level of safety	+		√		
			Absent information	+		√		

C	26.	*INFORMATION ON THE EFFECTS OF THE TECHNOLOGY*	Present but imprecise	+		√		
			Present and precise	+			√	
			Absent	+		√		√ boo mer ang
	27.	*AVAILABILITY EURHISTIC*	Dramatic and memorable risks: extensive media treatment + certainty of death + multiple lives involved	+	Lc	√		
			Uninteresting and forgettable risks	+	Lc			√
C	28.	*COMMUNICATOR SENSITIVITY*	Listening and acknowledging the concerns of the audience	+			√	
			Ignoring the concerns of the audience	+		√		
C	29.	*TYPE OF APPEALS*	Broadly based, non-focused appeals	No correl			√	
			Narrowly based, focused appeals	+			√	
C	30.	*INFORMATION ABOUT INDIVIDUAL PROTECTIVE MEASURES*	Present but imprecise	+		√		
			Present and precise	+			√	
			Absent	+		√		
C	31.	COMPARISONS	Cross-hazard comparisons	+		√		
			Stressing the similarity of the unfamiliar facilities to more familiar facilities	+			√	
		Macro: DECISION-MAKING						
C	32.	*CONSIDERING THE HUMAN ELEMENT*	Calculating risk (technical view)	+		√		
			"Thinking about risk" (sociological view)	+			√	
C	33.	*DECISION PROBLEM DEFINITION*	Taking into account that people want the safest decision: "out"	+			√	
			Ignoring that people want the safest decision	+		√		
C	34.	*AGREEMENT*	Disagreements among experts about probabilities	+		√		
			Agreement among experts about probabilities	-		√		

5.5) Conclusions

Giving an ulterior explanation of each of the variables contained in the Tables would result redundant, since their description is given diffusely in the Chapter 4, and since the most part of them will be discussed again regarding the application case.

Here it is important to underline that the categories of the variables contained in the First Table will be used as categories of the content analysis of the press articles (Chapter 7). The categories and variables contained in the "Second Table" will be used for a qualitative analysis of the available documents regarding the Oil Harbour (Chapter 7).

From this analysis it will be possible to see which variables mostly influence the public perception of risk towards an overestimation and how to control them towards a balanced perception of the risk about the Oil Harbour activity (Chapter 8).

Finally, both the Tables will be taken again in the Chapter 8, to furnish general recommendations to companies on how to improve a risk communication strategy. Through these Chapters, the variables will maintain the same code: this can be useful to identify them.

The following Chapter is a necessary introduction about the case: probably it will result as an interruption between the Tables contained in this Chapter and in the Chapter 7, but it is useful if logically connected to the Section 7.4 (stakeholder system) and to the Chapter 8 (recommendations).

BIBLIOGRAPHY

Ashford, Nicholas A. and Charles, C. Caldart (1983). "Framework Provides Path Through Right-To-Know Law", *Occupational Health and Safety*, October.

Bartolomeo M., Longo E. (1998). Ambiente, comunicazioni, società. Negoziare il futuro sostenibile, Il Sole24Ore, Milano.

Baum, A. (1987): Toxins, technology and natural disasters. In G. R. Van den Bos and B. K. Bryant, *Cataclysms, Crises, and Catastrophes: Psychology in Action*, pp.9-53. Washington, D.C.: American Psychological Association.

Beilin, Robert (1982). "Social Functions of Denial of Death", *Omega: Journal for Death and Dying*, 12(1), 25-35.

Britt-Marie Drottz-Sjoberg (1991). *Perception of Risk. Studies of Risk Attitudes, Perceptions and Definitions*. Stockholm School of Economics, Centre for Risk Research.

Brown, Michael S. (1984). *The Right To Know: Hazard Knowledge and the Control of Occupational Health Risks*, Ph.D. dissertation. Ithaca, New York: Cornell University, Department of City and Regional Planning, June.

Campbell, T. Colin (1980). "Chemical Carcinogens and Human Risk Assent." Special articles in *Federation Proceedings* 39:2467-84.

Carter, Luther J. (1979). "Dispute Over Cancer Risk Quantification." *Science* 203:1324-25.

Covello, V.T., and Mumpower, J. (1985). "Risk Analysis and Risk Management: An historical perspective." *Risk Analysis*, 5, 103-120.

Covello, Vincent T. (1983) "The Perception of Technological Risks: A Literature Review." *Technological Forecasting and Social Change* 23: 285-297.

De Marchi Bruna (1990), in *Communicating with the public about major accident hazards*, Elsevier Science Publishers, Brussels and Luxembourg.

Douglas, M. and A. Wildavsky (1982), *Risk and Culture: An Essay on Selection of Technological and Environmental Dangers*, Berkeley: University of California Press.

Douglas, Mary (1986). *Risk Acceptability According to the Social Sciences*, Routledge & Kegan Paul, London.

Douglas, Mary and Aaron Wildavsky (1982). *Risk and Culture: An Essay on the Technological and Environmental Dangers*. Berkeley: University of California Press.

Drabek Thomas E. (1986). *Human System Responses to Disaster: An Inventory of Sociological Findings*, Springer-Verlag, New York Inc.

Drottz & Sjoberg, B.-M. (1988). Attitudes to radioactive waste. SKN rapport No. 23. Stockolm: National Board for Spent Nuclear Fuel.

Drottz- Sjoberg, B.-M. (1990). "Risk perception and definition of risk", *Working paper*. Brussels: The European Institute for Advanced Studies in Management.

Drottz-Sjoberg, B.-M. (1990). Risk perception and definition of risk. Working paper. Brussels: The European Institute for Advanced Studies in Management.

Farmer, F.R. (1981). "Quantification of Physical and Engineering Risks." *Proceedings of the Royal Society*, London, A376:103-9.

Fischoff, B. S. Lichtenstein, P. Slovic, S. L. Derby, and R.L. Keeney (1994). *Acceptable Risk*.

Funtowics, S.O. and J.R. Ravetz (1985). "Three Types of Risk Assessment: A Methodological Analysis" in C. Whipple and V. Covello, *Risk Analysis in the Private Sector*. New York: Plenum.

Glickman T. S., Gough M. (1990). *Readings in risk*, Resources for the Future, Washington.

Graham, Julie, and Shakow, Don. (1981). "Risk and Reward: Hazard Pay for Workers." *Environment* 23:14-20, 40-45.

Green, and Brown, R. A. (1980). "Through a Glas darkly: Perceiving Perceived Risks to Health and Safety." Prepared for the *Workshop on Perceived Risk*, Eugene, Oregon, central Directorate on Environmental Pollution.

Heider, Fritz (1958). *The Psychology of Interpersonal relations*. New York: Wiley.

Helms, John (1981). "Threat Perceptions in Acute Chemical Disasters." *Journal of Hazardous Materials* 4:321-329.

Hine, Virginia H. (1974). "The Deprivation and Disorganisation Theories of Social Movements", pp.

646-661 in *Religious Movements in Contemporary America*, Irving I. Zaretsky and Mark P. Leone (eds.). Princenton, New Jersey: Princenton University Press.

Hohenemser, C., and Renn, O. (1989). "Chernobyl other legacy: Shifting public perceptions of nuclear risk." *CENTED* reprint No. 65. Worcester, MA.: Clark University.

ISO/International Standard Organisation (1996). 14001 Environmental Management Systems, Specification with Guidance for use.

ISO/International Standard Organisation (1996). 14004 Environmental Management Systems,General Guidelines on Principles, Systems and Supporting Techniques.

J.F. Larson (1978). *America s Window on the World: U.S. Network Television Coverage of International Affairs*, 1972-1976.» Ph..D. dissertation. Stanford University,.

Janis, Irving L. and Leon Mann (1976). "Coping with Decisional Conflict", *American Scientist*, 27, 261-275.

Johnson B.B., Covello V. T. (1987), The Social and Cultural Construction of Risk, Essays on Risk Selection and Perception, D. Reidel Publishing Company, Dordrecht.

Kahneman, D. and A Tversky (1984). "Choices, Values, and Frames", *American Psychologist*, April, 39(4), 341-350.

Kasperson, Roger E. (1980). "The Dark Side of the Radio Active Waste Problem." In *Progress in Resource Management and Environmental Planning*, vol..2. Edited by T. O. Riordan and K.Turner. New York: Wiley.

Kunreuther, H., & Easterling, D. (1990). "The formation of economic values. Are risk-benefit trade-offs possible in siting hazardous facilities?", *The American Economic Review*, 80/2, pp.252-261.

Lalonde, Mark (1974). *A new Perspective on the Health of Canadians: A Working Document*. Ottawa: Ministry of National Health and Welfare, Government of Canada.

Luther P. Gerlach in Johnson B.B., Covello V. T. (1987), The Social and Cultural Construction of Risk, Essays on Risk Selection and Perception, D. Reidel Publishing Company, Dordrecht.

Marsanich A. (1997). "Indicatori Ambientali nelle Dichiarazioni Ambientali Emas", Tesi di Master in Gestione e Controllo dell'Ambiente, FEEM, Milano.

Mathieu-Rosay, J. (1985). Dictionnaire Etymologique, Aleur, Belgium: Marabout. (Original in French).

Mazur, Allan (1981). The Dynamics of Technical Controversy. Washington, D.C.: Communications Press, Inc.

Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans and The Environmental Resources Management Group (1994). *Hazardous Waste Management*, McGraw-Hill International Editions, pp 865-868.

Morgan & Lave (1990). "Ethical considerations in risk communication practice and research", in *Risk Analysis* 10, 355-358.

Namer, Gerard (1984). "The Triple Legitimisation: A Model for a Sociology of Knowledge," pp.209-222 in Nico Sthr and Volker Meja (eds.), Society and Knowledge: *Contemporary Perspectives in the Sociology of Knowledge*, New Brunswick, New Jersey: Transaction Books.

"New Seveso Directive 82/96/EC" (1997), in Dossier Ambiente n. 38, Eidos, Milano.

Otway H. J. in Dierkes M., Edwards S., Coppock R. (1980) *Technological Risk, Its Perception and Handling in the European Community*, Publication of the Science Centre Berlin for the Commission of the European Communities.

Otway, H. (1988). Book Review of "Averting catastrophe: Strategies for Regulating Risky Technologies". *IEEE Transactions of Engineering Management*, 35, 119-121.

Peter M. Sandman (1985). *Getting to Maybe: Some Communications Aspects of Siting Hazardous Waste Facilities*, reprinted from Seton Hall Legislative Journal, vol. 9.

Piheler, Henry R.; Tverski, Aaron D.; Weinstein, Alvin S.; and Donaher, W. A. (1974). "Product Liability and the Technical Expert." *Science* 186:1089-93.

Plough Alonzo and Krimsky Sheldon (1987). "The emergence of Risk Communication Studies: Social and Political Context," *Science, Technology, & Human Values*, Massachusetts Institute of Technology and the President and Fellows of Harvard College.

Rayner, Steve (1984). "Disagreeing About Risk: The Institutional Culture of Risk Management and planning for Future Generations," in S. Hadden (ed.) Risk Analysis, Institutions, and Public Policy.

Port Washington, New York: Associated Faculty Press,.
Renn, O. (1990). “Public responses to the Chernobyl accident”. *Journal of Environmental Psychology*, 10/2, 151-167.
Rogers, Everett M., and Rahul S. Sood (1980). “Mass Media Communication and Disasters: A Content Analysis of Media Coverage of the Andhra Pradesh Cyclone and the Sahel Drought.” In *Disasters and the Mass Media: Proceedings of the Committee on Disasters and the Mass Media Workshop, February 1979*, Committee on Disasters and Mass Media. Washington, D.C.: National Academy of Sciences.
Rothman, Stanley, and Lichter, Robert S. (1982). “The Nuclear Energy Debate: Scientists, the Media and the Public.” *Public Opinion*, August/September; pp.47-52.
Royal Society Study Group (1992). *Risk analysis, perception, management*, Report of a Royal Society Study Group, London.
Santos, S. L., and S. Edwards (1987). “Risk communication: A Critical Part of the Public Participation Process”, *Superfund 87*, Hazardous Materials Control Research Inst., Washington, D.C., pp. 254-259.
Slovic, Paul; Fischoff, Baruch; and Lichtenstein Sarah (1981). “Perceived Risk: Psychological Factors and Social Implications.” *Proceedings of the Royal Society* (London) A376:17-34.
Starr (1969). “Social Benefits Versus Technological Risks”, *165 SCIENCE* 1232-38.
Tucker, William (1982). *Progress and Privilege, America in the Age of Environmentalism*. Garden City, New York: Anchor Press/Doubleday.
Van Maanen, John and Stephen R. Barley (1984). “Occupational Communities: Culture and Control in Organisations” pp.287-365 in Barry M. Staw and L.L. Cummings (eds.), *Research in Organisational Behaviour*, Vol. 6 Greenwich, Connecticut: JAI Press.
Wallas-Jones Jane (1997). “The Effectiveness of Provisions and Quality of Practices concerning Public Participation in the EIA Procedures in Italy and the UK.” Thesis of the European Master in Environmental Management.
Weinberg, Alvin M. (1985). “Science and its Limits: The Regulator’s Dilemma”, *Issues in Science and technology*, Fall 1985, 2(1), 59-82.
Weinstein, N. D. (1987). “Unrealistic optimism about illness susceptibility: Conclusions from a community-wide sample.”, *Journal of Behavioural Medicine*, 10, 481-500.
White, G. F. (1952). *Human Adjustments to Floods: A Geographical Approach to the Flood Problem in the U.S.* Research Paper 29, Department of Geography, University of Chicago.
Winne, Brian (1982). “Institutional Methodologies and Dual Societies in the Management of Risk,” pp127-143 in Howard C. Kunreuther and Eryl V. Ley (eds), *The Risk Analysis Controversy: An Institutional Perspective*. Berlin: Springer-Verlag.
World Health Organisation (1978). *Environmental Health Criteria, Six: Principles and Methods for Evaluating the Toxicity of Chemicals*, pt. I Geneva: World Health organisation.