EVALUATION OF RISK COMMUNICATION:

CONCEPTS, STRATEGIES, AND GUIDELINES

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Risk communication activities have become major challenges for risk analysis and management institution. Probabilities are poorly understood by the public and the rationale of risk analysis is often rejected. In addition, the plurality of information sources and the recoding of primary information by the media are causes for public confusion and dissatisfaction. Poor communication may aggravate the performance of a risk management institution, decrease the level of public protection and impede its credibility.

Based on studies about communication research and risk perception, a list of guidelines for conducting successful risk communication programs will be presented and discussed. The complexity of the intuitive understanding of risk in the public should be reflected by a multi-dimensional, customer tailored information package employing a two-way communication design.

INTRODUCTION

Risk analysis has gained a growing popularity as a scientific tool to determine the magnitude and probability of an adverse effect related to a technology or human action and to use the results of such analyses to design or evaluate environmental and technological policies. The use of risk analyses for policy purposes require efforts to communicate risk information to decision makers, stakeholders, and the general public. The problem, however, that many decision makers and risk analysts face is the unfamiliarity of most people to understand, assimilate and process probabilistic information.

Therefore, one goal of risk communication is to convey the basic concept and rationale of risk assessment to a layperson audience so that people understand and comprehend the results and implications of risk analyses (enlightment function). Linked to this goal is the need for risk managers to communicate the findings of risk studies for initiating individual actions to enhance personal protection, alert people about hazardous situations, foster changes in lifestyle, and inform residents about local emergency guidelines (1). A third major goal of risk communication is to introduce risk analysis as a suitable tool for forming compromises in negotiations with affected parties (2). In addition, risk analysts and managers can use risk communication as a means to learn from the public by listening to the concerns of local residents, public interest groups, and informed citizens. Public input is necessary to include risk-related properties other than magnitude and probability. Issues such as equity of risk bearing, catastrophic versus routine occurence of losses, the circumstances of risk and the ability of institutions to monitor and control hazardous facilities are excluded from formal risk analysis and hence not reflected by any risk calculation. Those who are the potential victims of risk have a much better sense of these situational factors and can communicate their concerns and observations to risk managers or regulators (3).

Based on these major goals of risk communication, we may define the term risk communication as an effort to convey to interested parties the outputs of various stages of the risk analysis and risk management process, including:

- the nature and circumstances of the risk
- the magnitude and probability of the risk
- the urgency of the risk,
- the perceptions of risks
- the distribution of risks among affected populations
- the acceptability of risk
- strategies for reducing and mitigating the risk
- the relative merits of different manegement options
- the justification for selected management options
- the reputation of the risk management institution
- the social and political arena in which risk controversies take place (4).

But how should risk communication be designed to meet the functions of enlightenment (orientation knowledge), enhancement of personal protection, conflict resolution and policy input via two-way communication? The purpose of this paper is to describe and analyse the contingencies of risk communication activities based upon the major findings of risk perception studies and communication research. The first chapter contains the theoretical foundations for analyzing the principles of communication processes about risk and technologies. The major insights from risk perception studies are the subject of the second chapter. In the third chapter problems of and guidelines for risk communication will be discussed based on the risk communication model and the empirical evidence presented in the previous chapters. The main lessons for risk communication are summarized in the conclusions.

THE BASIC MODEL OF RISK COMMUNICATION

The Sender-Message-Receiver Model

Communication theory focusses on the exchange of signals between information sources, intermediate transmitters, and final receivers. During the process of transmission, the original signals will be altered, intensified or attenuated, and then filtered (signal amplification). An information source sends out a cluster of signals comrising a message to a transmitter or directly to the receiver (5). The signals are decoded at the transmitter stations and converted into a meaningful message which may differ from the original message or the original intention of the information source. Each transmitter alters the original message by intensifying or attenuating some incomming signals and adding or omitting others. The new cluster of signals is sent to the next transmitter or the final receiver who decodes the message and evaluates the information contained herein.

The Information Sources for Risk Communication

Nature and technology are both sources for hazardous events, such as earthquakes, fires, explosions, pollution or radiation. Scientific analysis attempts to determine the physical impact of such events or to hypothesize about the magnitude and the probability of potential impacts for extremely rare events for which statistical data is not available (see Figure 1). Observation and analysis of actual events and simulation of potential events lead to an estimate of the magnitude of the impacts, the probability of their occurence, and the distribution of these impacts over time, space and population subgroups. Those estimates can only be coded in form of signals, for example in scientific reports or studies. In addition, eyewitnesses of hazardous events may produce anecdotal evidence also coded in signals and sometimes competing with the information provided by scientists.

Primary sources collect and select signals from the physical world, recode them into verbal signals and assign them different degrees of significance and often symbolic value (6). Special properties of the risk situation may arouse specific attention, while others may easily be overlooked. Scientific conventions focus primarely on the typical aspects of the observed risk. Thus the uniqueness of the specific event or hazard under consideration is often ignored or not adequately considered. Likewise, anecdotal evidence seems to center on the uniqueness of the situation and the specific circumstances of the event and to neglect the typical patterns that characterize risk in general. One major problem of risk communication is the integration of scientific and anecdotal evidence which is aggravated by the stochastic nature of risk.

The Secondary Sources of Risk Communication

Secondary sources are either scientific institutions, management agencies, or interest groups. They rely mostly on information that frequently collected by inhouse members or at least sponsored by the institution. Eyewitness reports may also be included, but will probably get less attention because institutions are more interested in the identification of typical risk elements in order to be prepared for a similar event in the future. The main objectives of the concerned institutions are to forecast, analyse, or manage the hazards. The intention of the source to communicate the common aspects of risk situations and to put the risk in the "proper perspective" conflicts frequently with the interest of the receiver to learn more about the concrete incidence and the real or potential victims.

Other secondary sources with different interests and tasks will also select and process incoming information, but illuminate different aspects of the primary material. Even if all sources relied on the same primary information, they still would differ in the selection and amplification of the informational elements. Industry, regulators, scientists and environmental watchdogs focus on different aspects of the problem, amplify signals that each of them regards as confirmation of their "Weltbild", and emphasize their role and function in the assessment and management of the respective risk.

The process of signal reception and recoding in this stage is thus less related to the properties of the hazard, although this information may be packaged within the message, but rather to the efforts of the institution to assess, analyze, and evaluate the risk or the risd management effort.

The Transmitters for Risk-Related Information

The third stage of communication deals with the professional transmitters, i.e. the information agencies and the media which convert primary messages into new messages for the intermediate or final receiver. They process information from direct eyewitnesses of

hazard events (anecdotal evidence), they have usually access to the primary scientific reports (scientific evidence), but may prefer to use its popular derivats (such as articles in popular science journals), and they will be bombarded with press releases from risk managing institutions or socially relevant groups. This abundance of material has to be collected, selected, digested, and finally recoded (7). As receivers of information transmitters decode the messages according to professional (journalistic), institutional (according to type and policy of medium), and personal criteria (perceptive and attitudinal biases). All signals must pass all three filters and recoding stations.

The difference in perspectives on the seriousness of the risk and the need for protective actions between secondary information sources will be one of the major topics covered by the public media. The nature and the magnitude of the original hazard is of less interest to most transmitters, they rather focus on the way institutions handle risks and communicate about their activities.

The widely accepted rule of fairness in news coverage demands equal treatment for all points of views. While conflict resolution rests on "true" evidence in science communities, and on the majority vote in democratic decision making, conflicts are usually not reconciled in the media; rather the different sides are merely presented regardless how much scientific evidence they can present and how many adherents they are able to collect. Transmitters in a pluralistic society tend to reinforce diversity, dissent and relativity of values (8). Thus dissent and ambiguity are inevitable and irreversible parts of risk information in addition to the uncertainty of the consequences.

Other issues apart from the received messages are events that have been covered up, management failures that were not reported, internal disputes inside of agencies, hidden agendas and other information that was either withheld or simply overlooked by the primary or secondary sources. This investigative journalisms challenges not only the initial message of the sources, but also the reputation and credibility of the information source.

The Receiver of Risk Information

The final stage comprises the reception of the message by the receiver, a member of the public who reads the newspaper or watches TV. The receivers are also overwhelmed with information of which they can only digest a small fraction. Since information agents and the media depend on getting the attention of the receiver, they have to send out signals that they expect the receiver to absorb. The common phrase "Bad news are good news" reflects the anticipated attention a message will receive by the media consumers.

Decoding the meaning of the sent messages, the receivers will select and amplify the ones that contain significant information. Significance is attributed to information that appeals to the

receiver, either by addressing one of his concerns, refering to a highly esteemed value or providing novel and enlightening insights into a subject. Symbolic associations, comparisons with related attitudes and with the alleged viewpoint of peer groups and consonance with values and lifestyle will affect the memorization of the communication content. Information that relates directly to the receivers' perception or imagination to be at risk themselves will probably trigger changes in the belief system and possibly, but less likely change their behavior.

In this stage alleged or real properties of the hazard, perceptions of institutional performance, the conveyed self-image of transmitters and of other involved parties as well as symbolic attributes of the risk form the basic elements for the formation of the cognitive component of an attitude towards the risk source and the managing institution.

INSIGHTS FROM RISK PERCEPTION STUDIES

The Determinants of Risk Perception

Starting with the pioneering work by Decision Research in Eugene, Oregon, (9) psychometric methods have been employed to explore the characteristics of risk that influence the intuitive judgement of seriousness of risk and its acceptability. Experimental designs or surveys are the main instruments to reveal the factors of risk perception. On the basis of the existing literature, the following aspects of risk have an effect on the perceived riskiness of objects or activities (10):

- the expected number of fatalities or losses
- the catastrophic potential
- the circumstances of the risk (qualitative characteristics such as voluntariness, personal control, familiarity, and others)
- the beliefs associated with the risk source
- the credibility of the information source about the risk
- the distribution of risk among the affected population

The perception of benefits, the distribution of benefits and risks among the population, and the confidence in the risk management institutions are additional key factors for determining risk acceptance. The mere list of factors already demonstrate that risk in public understanding is always a multi-dimensional concept and cannot be reduced to the product of probabilities and consequences.

Qualitative Characteristics of Risks

In particular psychometric studies have focussed on the qualitative characteristics of risk and identified some intuitive mechanisms that shape the perception process. The most important of these are summarized in Table 1 (11). Risk communication must address the revealed qualities of risk since they concern the people. It is therefore not sufficient to confine the communication process to the discussion of probabilities and consequences. Communication should include such aspects as voluntary exposure, possibilities of personal control, the different management options to monitor, mitigate or control risk consequences, in particular if they will be delayed, and other relevant characteristics. Risk communicators should explain the functional equivalents of voluntariness and personal control for collective decision processes (for example siting) and risk management. Potential equivalents are the assurance of a democratic decision making process, the independence of operating and regulating institutions, and the ability of regulatory agencies to constantly monitor the outcome and intervene in the production process if the risks turn out to be more severe than expected. People have demonstrated their willingness to accept involuntary and dread risks if they had confidence in the licensing and regulatory agencies. In this case they feel that their concerns are adequately represented and addressed. If this confidence is lost or challenged, risk rejection or avoidance is likely to become the predominant response.

The Perception and Processing of Probabilities

In addition to the circumstances and qualitative aspects of risks, the meaning and understanding of probabilities have been subjects of numerous studies. Apparently, common sense reasoning is governed by the deterministic model: either something is safe or unsafe, healthy or unhealthy, acceptable or unacceptable. Such a deterministic approach is a simplification of the complexity involved in stochastic events, but it provides a suffciently accurate mechanism to guide one's on action. The processing of probabilities is influenced by the following intuitive heuristics (12).

- availibility Events that come to people's mind immediately are rated as more probable than events that are less mentally available.
- anchoring effect Probabilities are adjusted to the information available or the perceived significance of the information.
- Representativeness Singular events experienced in person or associated with properties of an event are regarded as more typical than information based on frequencies.
- avoidance of cognitive dissonance Information that challenges perceived probabilities that are already part of a belief system

will either be ignored or downplayed

Because probabilities are vital components of risk communication, the composition of such an information must take into account the intuitive preference for deterministic reasoning and the overt biases of processing probabilistic information. Furthermore, the terms used in framing probabilities, for example chance of lifes lost versus lifes saved, or the probability of dying versus survival, render different reactions by the receivers (13).

STRATEGIES OF RISK COMMUNICATION

Problems of Risk Communication

The common thread of all studies on risk communication is the complexity of the risk concept in public understanding and the multi-stage coding and recoding process during the transmission of messages. Transmitters and receivers reduce complexity by simplifying the message and focussing on those aspects that they regard as relevant.

Furthermore, interaction among transmitters, plural input from different sources, the co-existence of personal, professional, and institutional selection and amplification criteria, and interaction among different target audiences create enough complexity and uncertainty that the final effect of the communication process can hardly be measured at all. For this reason, guidelines for effective risk management can only partially rely on empirical evidence. Studies on risk perception, on marketing of products, on cultural symbols in risk communication, and others can indeed provide clues for designing communication programs, but neither prove nor guarentee the desired effects. Normative advice for risk communication is inevitably a mixture of knowledge, educated guesses, and common sense.

For the purpose of designing a set of guidelines, we assume that our risk communication activity is targeted towards the general public with the objective to change previously held beliefs about the object or the communicating institution. We also suppose that the message will be sent to transmitters, in particular the media, and that we have only limited resources as well as opportunities to collect feedback from the final receiver. Under these assumptions we have to find solutions for the following problems in risk communication:

- to tailor the information to the needs of the final receiver
- to design the message in such a form that it will likely pass the attention filters of the transmitters and that it will not lose its basic content in the recoding procedure
- to include only factual information that can be successfully

defended if challenged by other interest groups

- to design the information in such a way that it draws attention to familiar and non-dreaded risks and places unfamiliar and dreaded risks in the appropriate proportion

- to put risks into perspective and present probabilities in an accurate, but comprehensible and contextual format

- to find the right balance between conflicting goals such as simplification versus accuracy, security against human intrusion versus open information policy, arousal of fear and overreactions versus honesty about catastrophic potential, macro-level safety versus micro-level concerns, efficiency versus equity, and others

- to convey the impression of trustworthiness and competence, the two prerequesites for credibility

- to design serveral messages for different segments of the audience and for different transmitters and select several channels for sending the message to the transmitters

- to select the right timing for the communication program

- to design feedback loops whenever possible

In the literature additional problem areas have been identified such as assuring two-way communication or complying with ethical standards (14). But these problems are more relevant for other objectives of risk communication, for example conflict resolution, and are difficult or almost impossible to overcome in a normal communication situation with unknown transmitters and an uncertain fate of the message during the stages of transmission.

How can we address the above problems and how could an ideal communication program be designed? The following guidelines may assist agencies or other institutions in designing and tailoring their risk information (15).

- Be clear about your intentions and make them the central message of your communication effort

  As obvious as this may sound, many risk information attempts are clear violations of this principle. Many agencies have not made up their mind about an issue, but are already forced to react. In other instances, different departments voice different opinions and the text of the information constitutes a poor compromise between the different viewpoints. If a fast reaction is required, the message of the first response may be that there is still too much uncertainty about risk to produce sound judgments and that the institution needs more time to assess the data. Although those message may not be very attractive, they

still are better than pretending to have a degree of certainty which is actually unjustified and may need correction later. This embarassing experience made most West-European countries in the aftermath of Chernobyl.

- Simplify your message as drastically as you think you can do without being inaccurate

  Messages will be simplified regardless how well written the text may be. Rather than have the transmitters and final receivers simplify the text their way, the sender may perform a more accurate simplification which is also in accordance with his/her original intentions. Simplification is a very delicate job and needs careful editing and reediting. Factual information should be made as simple as possible, but inferences or even value statements should be more complex.

- Place your simple messages in the beginning of a text and add the more complex issues at the end

  Although simplicity is a virtue for the whole information process, it is advisable to start with the simple and easily understandable messages first and add more complex and detailed information at the end. This structuring of the information serves two purposes: gaining the attention of transmitters and pleasing the well-educated as well as less educated receiver. The well-educated receiver wants more detailed information including background information and technical analyses. The less educated or only marginally interested receivers want to be informed about the basic effects and how they may affect them personally, their primary groups or society in general. The only way to please both audiences (aside from splitting the information) is to to give the general information first and add the specific one later.

- Anticipate the interests of your target audiences and design your communication program in accordance with the needs of your potential receivers

  This guideline is the most often violated rule in risk communication. Experts in institutions have the irresistible tendency to package a whole education program in each attempt to communicate with the public. But most people have neither the desire nor the time to become nuclear engineers, immune system specialists, or experts on radon daughters. Most people care for the consequences of a risk, the circumstances of its occurence, the possibilities to mitigate the risk and the management efforts by the respective institutions. Their major concern is their own health, but also risks to society in general or inequity in risk bearing are often subjects of interest to them.

Depending on the risk category, they want to know more about accident management and emergency planning if low-probability, high consequence technologies are involved; they look for information on, risk distribution and potential health effects for human-made, but routine risk events (such as pollution), and are concerned about consequences of diffuse risk for future generation such as the gree house effect or radioactive waste disposal.

- Devise different communication programs for different target audiences

  In addition to structuring texts, a communication program can operate with different packages containing the same message, but using different channels for transmission. A message to the national wire services should only contain the basic facts and some general conclusions, a press release to daily newspaper may also incorporate some discussion of the results, anecdotal evidence if suitable and reference to actual events (otherwise it will not pass the selection filters of these transmitters). Manuscripts for science supplements in newspapers or specialized journals should br more problem oriented and offer a novel or interesting perspective in the analysis of the issue.

- Allocate enough time for packaging your message, but do not change your message in order to make the package more attractive

  The package of the message is an important component for the success of the communication effort. A good package implies that the formal requirements for a news story are met and that the message contains the relevant stylistic elements that are typical for the selected transmitters. This way the message is more attractive for the transmitter and the demand for recoding is reduced and with it the probability of misconceptions. So important packages are, they are not ends in themselves. If the message has been simplified and tailored to the needs of the receiver, it should not be further compromised by adjusting it to the most attractive package. This is the major difference to advertisement where people do not expect truthful information, but entertaining persuasion. Risk communication is based on different expectations: transmitters and receivers expect honest, clear, and complete information. They may be entertained by effective packages, but they will not appreciate the message, and certainly not change their beliefs as a result of this communication activity.

- Compose a well-tuned balance between factual information, inferences, evaluations and symbolic associations

Risk communication should emphasize factual information and present all the relevant evidence. The procedure and rationale of reaching a conclusion on the basis of the presented evidence is often more important than the inference itself. If people disagree with the conclusion, they may still accept the decision as long as the decision making process appears reasonable and sensitive to counterevidence. Evaluation of information should contain a specification of the underlying values. Contrary to the commonly shared request for value free analysis in science, reference to values are important and almost inevitable components of any risk communication strategy because the selection of management strategies and the priority setting for dealing with specific risks require trade-offs between conflicting values. People are much more sensitive to latent value decisions than overt value commitments. Honesty about trade-offs is the best way to avoid accusations of hidden agendas or biases. Symbolic associations may be included to increase identification with the source and to generate an atmosphere of familiarity with either the institution or the risk.

- Be honest, complete, and responsive in the composition of your message

Although it may hurt in the beginning of a communication program, honesty is a vital condition for gaining credibility. In a pluralistic society it is almost impossible to cover up a failure of the initiating institution over a longer period of time. Unless time is such a decisive factor that the embarassement of being caught lying is overcompensated, honesty is the best strategy to avoid more drastic responses. Honesty will not automatically be rewarded, but dishonesty will certainly create negative repercussions among transmitters and final receivers. The same effect will take place when sources withhold relevant information or tell only one side of the story. The goals of honesty and completeness include another, often overlooked aspect. Institutions with vested interests should not bashfully hide their interests, but put their cards on the table and justify their position. Nobody expects industries to be unselfish benefactors of society. Thus, industrial spokespersons should not try to convey this image, as most people are not inclined to believe it. Rather the argumentation should emphasize the dependence of economic prosperity from a satisfactory risk reduction program or low occupational health risk record. In addition to honesty and completeness, information should be responsive to public demand and inquiries. Transmitters expect fast responses and the public likes to be informed immediately after a hazardous event has occured or a new study with provoking results has been published. It is better to communicate at least something, be it only fact that one is still undecided.

- Place risk in social context and report numerical probabilities only in conjunction with verbal equivalents

First, risk comparisons which are aimed at explaining the seriousness of impacts of a novel risk in terms of the known impacts of a familiar risk are necessary, but problematic. Risk comparison should only rely on risks which are perceived as comparable in public understanding. Risks with identical benefits are certainky better suited to risk comparisons than risk with divergent benefits. It has also been suggested to compare only risks with identical consequences or base comparisons on the situation with and without the risk source (16). If comparisons serve the sole purpose of illustrating the meaning of abstract probabilities, a confinement within the same category or understanding of risk is sufficient. Risk comparisons for the purpose of deducting judgments about acceptability should be avoided in any case since they are neither logically defendable nor in the eyes of the public convincing.

Second, risk communication must address the basic qualitative properties of different risks and explain how deficiencies in those qualities have been compensated or will still be compensated. Third, it may be useful to insert anecdotal evidence or report about identifiable victims when communicating about familiar and unspectacular risks, such as radon or high blood pressure. Attention is almost guarenteed if the receivers perceives the risk as a potential threat to themselves or their primary group. Dramatic, unfamiliar, and technological risks with high catastrophic potential are likely to be overestimated. Instead of emphasizing the low probabily of severe accidents, communication should focus on the technical and organizational barriers to prevent such accidents and demonstrate the preparadness of the community in the unlikely, but not impossible event of an accident.

Last, it seems advisable to link numerical probabilities with verbal expressions of likelihood or risk comparisons. The perception of probabilities is characterized by so many biases that it is almost impossible to convey their meaning in risk analysis and risk management to a larger audience. Still they should be mentioned because they are the most accurate indicators for the relatve seriousness of the risk, thus a vital component of all risk policies. In addition, the public should be slowly familiarized with the concept of probability. As of now most people cannot comprehend the meaning of probabilities and need additional, contextual information to get a feeling of the chances involved.

- Try to escape from role expectations by using a personal approach and by framing the communication to the personal experience of the addressed receiver

  Transmitters are more inclined to select information that contains surprises or unexpected insights. Even if the material of the message does not offer anything new, a communicator can attract attention by avoiding the stereotypes of his or her role and by personalizing the message. This is particularly effective in face to face interactions, press conferences or talk shows. Without denying their home institution, communicators may talk or report about their personal feelings when they first heard about the risk source and what kind of actions they took to protect themselves. They even may convey their own feelings and show compassion for the anxieties and fears of the addressed audience. But honesty is an absolute condition for such an attempt as most people have developed a good sensitivity for acting and fake feelings.

- Messages should be distributed on different channels and feedback communication should be stimulated and encouraged as much as possible

  A good communcation program should not only address different audiences by using different transmitters, but should also take advantage of the different available channels. Press releases are one major medium for communication, but press conferences, participation in talk shows, appearance in hearings and public events, open letters, letters to the publisher, and direct mailings are other often superior ways of conveying a message. Press conferences and talk shows allow immediate feedback from the transmitter so that the information can better be tailored to the needs of the receiver. Sending out brochures with reply envelopes is another method of collecting information about the communication needs of the public and bypassing the transmitters. Models for public involvement have been proposed and tested to assure constant feedback from the risk bearers or bystanders (17). Such models rely, however, on the willingness of the communicator to learn from the involved public and revise decisions in accordance with publically expressed preferences. In addition, monitoring the process of recoding (through content analysis of media messages) and of receiver's responses (through evaluating letters to the editor or direct survey methods) provide valuable information about the comprehensibility of the original information and its effects on the receiver.

The outlined guidelines should not be regarded as recipies, but as normative directions of what to take into account when approaching the public with risk-related information. For different hazards and risks the guidelines must be modified and specified.

CONCLUSIONS

The objective of this paper was to describe the process of risk communication in theoretical terms, collect empirical evidence about people's perception of risk and articulate guidelines for the risk communication activities aimed at informing the public and inducing changes in opinion and attitudes.

The most outstanding result was that the effects of risk communication are in general invisible and almost impossible to measure. The communication process includes many stages with different actors, rules of coding and decoding signals, and dynamic feedbacks. All guidelines rest therefore on a mixture of knowledge, educated guesses, and common sense. A second insight from the risk perception and communication studies was the existence of different meanings of risk in public perception, among risk sources as well as among different segments of the public. Risk communication needs to address the specific risk attributes that are associatd with different classes of risk and to provide tailored material for audiences with diverging expectations.

Finally, biases in risk perception and a strong preoccupation with qualitative aspects of risks, such as voluntariness or personal control, govern the perception of risk as well as the evaluation of risk managemnt options. As a result, risk communication cannot confine its informational content to the classical components magnitude and probability, but should also include information about equity, institutional substituten for the lack of personal influence (licensing, regulating, monitoring, controlling), and the efforts to manage and mitigate the risk.

Thus risk communication must incorporate a broad concept of risk and operate under the assumptions that communication is a two-way process where both sides are able to learn from each other. By carefully framing the information, by tailoring the content to the needs of the final receivers and by conveying a clear, honest, and appealing message, risk communication can convey a basic understanding for the problems and choices of risk management and thus create the foundations for gaining trust and credibility. Although many receivers of risk information may not agree with the actual decisions institutions have made in setting priorities or selecting management options, they may realize that these decisions are results of open discussions and painful trade-off assignments.

Effective strategies to design communication programs for conveying complex risk concepts and enhancing understanding of involved institutions and actors are certainly not easy to develop, but first proposals are available. More research is needed to test alternative framing of risk information and different models and channels of communicating with target audiences. So far, the share of educated guesses prevail the amount of confirmed knowledge.

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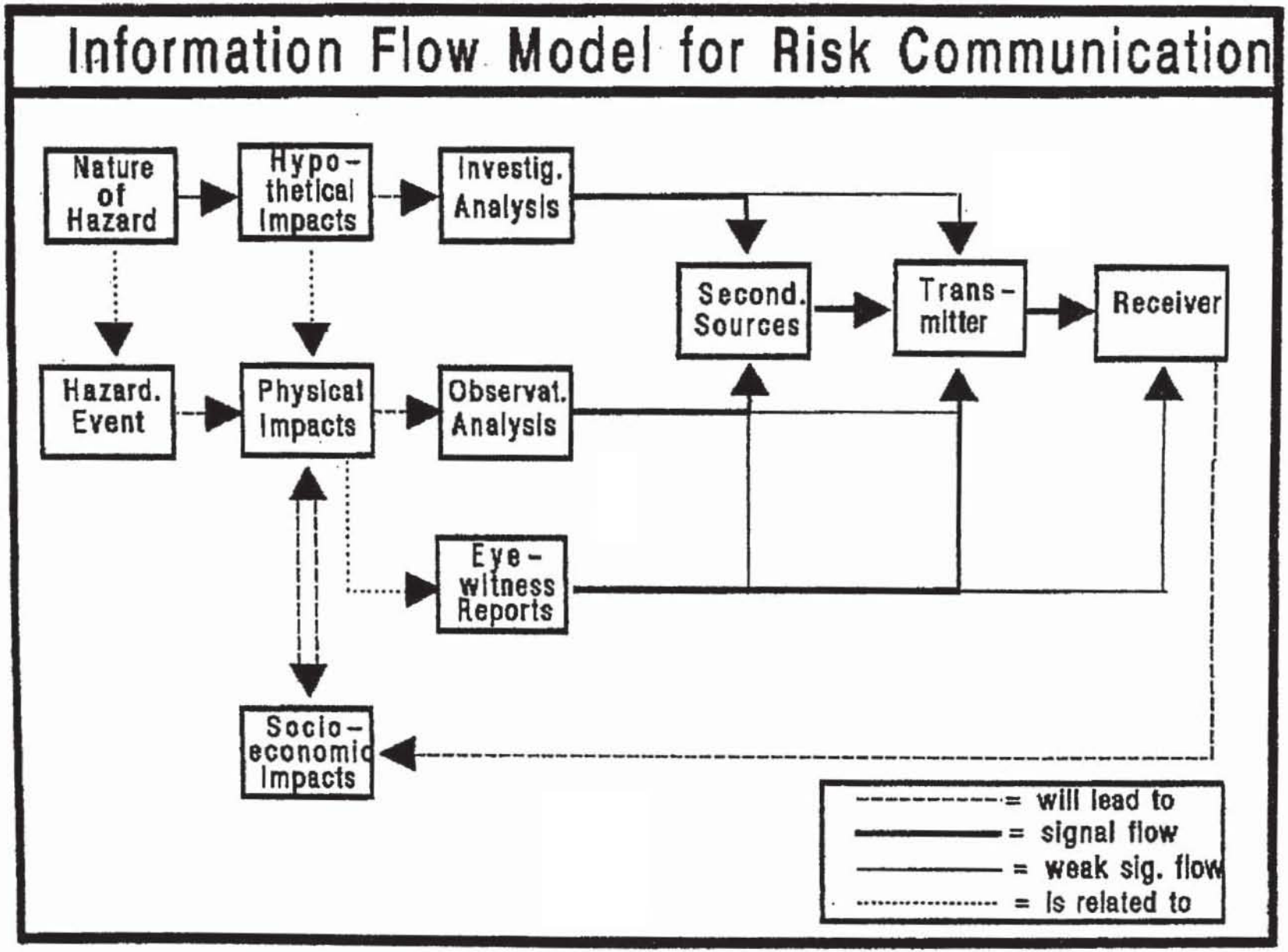
Table 1: Summary of Risk Perception Studies

Perception is a function of:
1. intuitive heuristics, such as availibility, anchoring, overconfidence, and others
2. perceived average lossses over time
3. situational characteristics of the risk
4. associatons with the risk source
5. credibility and trust in risk handling insttutions and agencies
6. media coverage (social amplification of risk-related information)
7. judgement of others (reference groups)
8. personal experiences with risk (familiarity)
Perception is influenced by:
1. voluntariness
2. personal controllability
3. catastrophic potential
4. delay of consequences
5. tendency to kill rather than to injure
6. perceived threat to future generations
8. equal exposure to risk
9. equal risk-benefit distribution
10. familiarity with risk
11. perception and exclusiveness of benefits


Information Flow Model for Risk Communication
Nature of Hazard
Hypo-thetical Impacts
Investig. Analysis
Second. Sources
Trans-mitter
Receiver
Hazard. Event
Physical Impacts
Observat. Analysis
Eye-witness Reports
Socio-economic Impacts
= will lead to
= signal flow
= weak sig. flow
= is related to