

# Communicating about risk issues<sup>1</sup>

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Risk communication is a specialist area of technical communication where the information content of the communication is broader than purely scientific. Organisations often see communication about risk issues as a process of the organisation providing information to its stakeholders – this is often viewed simply as an education process, with the (unstated) assumption that if they are ‘educated’ they will know better, and will align with the organisation’s viewpoint. In practise this often leads to frustration (on both sides) and general distrust.

Increasingly organisations are recognising two additional factors (a) that communication within the organisation is critical to assisting the organisation to understand its appetite for risk, and (b) that communication with external stakeholders is a learning process for the organisation, and can be used to develop an on-going relationship with the community of interest. Internal and external communication are closely linked and can support each other; where an organisation has strong internal communication processes supporting a recognised risk management culture then it will be more confident about using external risk communication as a means of supporting its objectives and helping the community to articulate its concerns.

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<sup>1</sup> This paper is based on Janet Gough’s introduction and overview paper in “Sharing the Future: Risk Communication in Practice”, CAE 2003.

Effective risk communication should be seen as a process rather than an outcome. It may not necessarily resolve all issues but should explore all feasible options and aim to improve understanding. For communication to be effective the organisation must establish credibility with the relevant community of interest, and develop a trusting relationship. Risk communication is an intrinsic part of risk management and an essential element in the determination of acceptable levels of risk. CAE is undertaking a project to develop frameworks for risk communication for New Zealand as a means of upskilling organisations and supporting institutional processes for improved science/society dialogue to enable agreed risk outcomes.

## **Introduction**

In recent years the public has become much more aware of, and concerned about environmental hazards. Part of this concern has arisen because of changing attitudes to the environment, reflecting changes in people's value systems, and a greater awareness of the importance of environmental, or ecosystem, health to our own well-being.

Environmental risk management is an important tool that can be used to analyse risks to the environment, and to make decisions based on predetermined objectives. Risk communication is an essential part of environmental risk management and more particularly part of defining and articulating the objectives and goals of the process.

People's perceptions of risks provide a valid and required input to both formal and informal risk assessment and risk management procedures, including risks to people and their physical and social environment (health and welfare) as well as the environment itself. Perceptions are important because they are founded in experience, and often reflect community's knowledge and awareness of their surroundings.

One of the early drivers of risk perception research was the recognition that individuals and particular groups in the community view risk in a very different way to technical experts and scientists who use scientific models and tools to analyse and measure risk. Early researchers examined the different factors and characteristics of situations and specified risks that individuals take into account when they are making their own estimates of risk (and benefit).

Some researchers were initially motivated by the expectation that if it were possible to understand why people perceived risk in different ways to experts then it would be comparatively straightforward to 'educate' people so that they would 'understand' risk better and would therefore accept the advice being given by technical and scientific experts. However, greater understanding of both the factors affecting public perceptions and the reasons why expert predictions and lay perceptions differ has shown that this may not necessarily be the appropriate outcome. Over time, more emphasis has been given to understanding risk perceptions and including consideration of them in making

decisions involving risk. Rohrman (1999) provides a useful review that illustrates the breadth of the area, and the range of disciplines that have been involved in research.

Perceived risk research has provided improved understanding of how individuals think about risk, with the key outcomes being the identification of the main factors affecting people's perceptions of risk, the recognition that the technical concept of risk as a compound of probability and magnitude is inadequate in terms of the way most people think about risk, and a greater comprehension of the heuristics that people use in their efforts to estimate risk (e.g. Starr, 1969; Tversky and Kahneman 1982; Fischhoff et al. 1981; Fischhoff et al. 1978; Slovic, 1987; Renn *et al*, 1985).

### **What is risk communication?**

Risk conflicts arise when experts and the public differ in their views about risks associated with an activity, and are due to many causes. Research into perceived risk has provided considerable insight, and has highlighted a major social problem that derives from risk conflicts; the lack of confidence that the public has in the technical expert. The credibility of the expert is now a key issue of risk research reflecting on the credibility of the public-sector decision-making processes.

The concept of acceptable risk is linked to perceived risk. Acceptable risk is best seen as the result of a decision process where risks are analysed and according to the particular decision criteria, specified as being either 'acceptable' or 'unacceptable'<sup>2</sup>. In public decision processes, the criteria for determining acceptability or tolerability<sup>3</sup> should include consideration of public opinion or public perceptions of the risk, though how this 'consideration' is included in the decision process may vary widely. The concept of 'accepted' risk, referring to that which people choose to accept even if they don't like it<sup>4</sup>, is also relevant.

One important result of early perceived risk and acceptable risk research was that people's perceptions are not simply 'irrational', and that people use a wide variety of input information including expert predictions to make their own social evaluations of risk (Fischhoff *et al.*, 1982, Kraus *et al.*, 1992). Essentially, individual and community

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<sup>2</sup> Needless to say it isn't as simple as this, and in many cases three categories are defined, such that there is a group between 'unacceptable' and 'unacceptable' that consists of those risks that require further attention.

<sup>3</sup> Tolerable risk depends primarily on the idea of the benefits outweighing the risks. The risk will never be accepted, but it will be tolerated for a particular activity or for a specified time period. Moore (1988) describes the term 'tolerable risk' as originating from the Sizewell B Inquiry in Britain. "A tolerable risk is not the same as an acceptable risk as people may tolerate a certain level of danger associated with a particular risk but that does not mean they will ever accept it." The term derives from comments by Sir Frank Layfield Q.C. (1987) that "although acceptable risk is often used in balancing risks and benefits, it does not adequately convey the reluctance with which possible substantial risks and benefits may be tolerated".

<sup>4</sup> Accepted risk differs from tolerable risk in people accept it voluntarily, for example, smoking.

perceptions are a valid input into decision processes, particularly the perceptions of groups likely to be affected by decisions. As a result, and also as a by-product of a certain amount of soul searching as to the purpose of research into perceived risk, the emphasis in risk research in the late 1980s switched towards designing ways of communicating risk information, as a means of (a) capturing public knowledge, and (b) avoiding costly risk conflicts that have the potential to slow or even halt some development activities. There is also a considerable body of work directed towards exploring the differences between expert and lay perceptions of risk (e.g. Lazo *et al.* 2000; Flynn and Slovic, 1999).

An important driver for finding better ways of communicating on risk issues, and incorporating public knowledge into decision making is that in many environmental decision processes there can be no absolute right answer because of the existence of uncertainty<sup>5</sup>. Therefore, the most acceptable solution to all parties must intuitively be reached by a process of trade-off between them (Renn, 1989; Renn and Levine, 1991)

For this to be successful, all parties must be prepared to negotiate and to establish a framework for this negotiation that will include the areas in which they are prepared to negotiate. Risk conflicts typically include elements of value conflicts as well as interest conflicts and risk communication seeks to clarify ways in which these can be defined and properly described.

#### *Some principles of risk communication*

The National Research Council (1989) defined risk communication by stating that the risk communication approach

“is an interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions or reactions to risk messages or to legal and institutional arrangements for risk management”.

There are two important concepts outlined in this definition. Firstly, risk communication is an exchange of information, or an interactive process requiring the establishment of two-way communication channels. Secondly, at times the communication channels will process messages that are not strictly related to risk. Risk concerns are often used as a surrogate for other issues in public-sector decision processes. This aspect of risk communication can be very important, as long as it is used judiciously and does not result either in ‘information overload’ or in a loss of confidence in the channel.

There are many manuals written on the ‘how to’ of risk communication. A number of consultants have taken the results from risk perception research as well as communications research and participatory research and have used this to specify sets of ‘principles’ or rules to be applied in communicating with the general public on risk issues. Two early examples were published by Rutgers University (Hance *et al.* 1988;

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<sup>5</sup> Other important issues to be mentioned here include the Precautionary Approach and decision maker’s approach to risk.

Chess *et al.* 1989). The Environmental Research Communication Program based at Rutgers University has continued to be at the forefront of the development of good practice risk communication, both in theoretical and applied arenas.

The literature provides some key messages as what should and should not be done. The following list is a useful set of aims for a programme.

- Start early
- Identify stakeholders and be inclusive rather than exclusive – communicate broadly
- Always involve the community in the decision-making process if appropriate representatives can be identified
- Address community concerns when explaining risk (try to consider their perspective), and be very careful when making comparisons with other risks
- Present material clearly and simply (but not condescendingly), give people time to assimilate and familiarise complex issues, and remember that there are no 'dumb' questions
- Pay as much attention to the community's intuitive perception of the risk, and to the community's concerns, as to scientific variables (provide the information that the community wants as well as what it 'needs')
- Don't avoid negative information, and admit when you simply don't know
- Focus on building trust as well as generating good data, and only make promises that you know you can keep

All of these aims are directed towards building trust and credibility which are essential elements of a good risk communication programme.

#### *What risk communication can't achieve*

When risk communication processes were initially promoted some experts believed that it would be possible to solve all conflict simply by providing the public with 'better' information. This has indeed been the case in some instances, however, there have also been a number of studies of conflicts where the public is not prepared to accept that the experts' viewpoint is 'better' and, with hindsight, most experts who have been involved in risk communication processes now have a greater understanding of the public's attitudes and concerns.

Attitudes are based on values and beliefs. Communication is associated with flow of information (and knowledge). Therefore while risk communication can provide all parties with a better general understanding of the issue it cannot (and should not) attempt to change basic values and beliefs. However, risk communication can help by identifying points of commonality and points of difference, and also why these arise.

#### *Uncertainty*

"Learning to say 'I don't know' may be one of the most important communication lessons" Hance *et al.*, 1989.

Risk communication must take account of uncertainty. Experts are often loath to admit that they simply don't know what some of the possible outcomes may be on the grounds that the remainder of the information they present may be discredited. There is an historical belief (common still in the medical profession) that people are not willing to accept a 'don't know' answer. This has led to the use of jargon to disguise areas of uncertainty. On the other hand, as scientists, risk analysts implicitly recognise uncertainty in their modelling approaches by making assumptions. The difficulty appears to be in communicating these assumptions in a way that does not (apparently) negate the validity of the remainder of the analysis.

Analysts and scientists are beginning to recognise that the public is more discerning than previously believed, and that in the present day, the public is more prepared to accept an answer that admits areas of uncertainty than they are prepared to accept the paternalistic 'trust me, I know what I am doing'. Members of the medical profession are slowly beginning to acknowledge this and reject the mantle of infallibility forced on them by a frightened public by recommending that patients should look for a second opinion.

Hansson (1989) points out that the public often considers reliance on inaccessible technological and scientific knowledge as a factor of uncertainty when judging technological projects. On the other hand, experts see this type of selective release of information as the appropriate way of informing the public (too much technical information could be misunderstood). However, open disclosure of all information including areas of uncertainty is more likely to gain credibility and to bring the public 'on-side' than the past processes of not admitting a lack of knowledge.

## **Risk communication and risk management**

The Australian and New Zealand risk management standard AS/NZS 4360: risk management was first published in 1995. This first version of the standard did not include explicit consideration of risk communication. However, when the revised version was republished in 1999,<sup>6</sup> risk communication had become a fundamental component of all steps of the process.<sup>7</sup>

The standard promotes the development of a risk communication programme as an essential part of risk management, where elements of such a programme include determining –

**why** communication and consultation is required,

**who** is going to be involved (the 'actors'),

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<sup>6</sup> AS/NZS 4360 is currently (2003) under revision again. In the 2004 version of the Standard the role of risk communication has been further reinforced. Reference: Standards Australia and Standards New Zealand, 1999.

<sup>7</sup> The development of the Environmental Risk Management Handbook (Standards Australia and Standards New Zealand, 2000) was a positive driver in ensuring the recognition of risk communication.

**when** are the different parties going to be involved,  
**what** is to be the subject of the communication and consultation, and  
**how** is the process to be undertaken throughout the risk management cycle.

One of the benefits of embedding risk communication within the risk management process is seen as being improved stakeholder relationships, allowing an organisation to explicitly identify its internal and external stakeholders and to develop a conversation between the stakeholders and the organisation. One important element may be assigning responsibilities for internal and external communication, whilst keeping in mind that communication, as well as risk management, must be part of everyone's responsibility.

The actors involved in risk communication include analysts (technical and non-technical), managers, representatives of the public, specific community interest groups and decision makers. They may also include the media and public relations agencies since the media provides the most common and accessible communication channel. Identifying the relevant interested parties and stakeholders is a crucial component of good risk management, and helps to anchor risk communication as a fundamental element of risk management.

Timing will depend on the risk communication and risk management objectives, but a simple rule is that the risk communication plan should be developed as early as possible in the risk management development process, and that communication should not be delayed for the purpose of getting more information.

The objectives and subject of communication and consultation need to be consistent with the risk management objectives, but may be broader.

Communicating and consulting on risk issues requires knowledge and consideration of the varying factors that affect all stakeholder perceptions. Individuals and communities respond to risk according to their perceptions of the risk, and perceptions are influenced by a range of factors that goes beyond the simple two-dimensional model of likelihood and magnitude of effect should the event occur.

When designing risk communication programmes as part of risk management, the distribution of risk across the population is highly relevant, since in many cases, external stakeholders believe that they are being asked to bear the risk while the organisation garners the benefits. Directly involving stakeholders and convincing them that the organisation has an interest in ensuring that stakeholders are not unnecessarily disadvantaged can help to allay these concerns. Trust and respect are crucial concepts in helping to meet risk management objectives (for examples see Peters *et al*, 1997).

## **Internal and external risk communication**

While much of the risk communication literature concentrates on communication between an organisation and its stakeholder, it is important to remember that communication about risks within an organisation can be critical. A classic and dramatic example of where poor internal communication about risks led to a tragic outcome is the case of the Challenger Shuttle disaster. The details how this occurred are well described in Feynman (1988). In this instance it was lack of communication between engineers (analysts) and managers that resulted in poor decisions. Another more recent example from the medical field relates to an instance in the United States information from gene therapy trials was not sent to the central registry, thus resulting in incomplete information being given to patients (New Scientist 2000).

Internal risk communication ensures that those who are responsible for implementing the risk management framework understand why certain actions are required. It can be used to encourage internal staff to keep a watchful eye for activities or situations that may lead to risk. Good internal communication about risk should be part of an organisation's risk culture, and embedded into risk management profiles and programmes.

### *Risk appetite*

'Risk appetite' refers to the decision maker's attitude to risk. Decision makers are often faced with comparing risks when considering the outcomes of alternative actions where these outcomes are not certain. In most cases the outcomes will be a complex mixture of positive and negative elements, and part of the decision process will involve weighing up these effects to reach a decision.

Risk-based decision making is concerned with the decision-maker deciding whether the estimated levels of risk are deemed to be 'acceptable' or not. The criteria that the decision maker uses to decide whether risks are acceptable or not reflect the decision maker's approach to risk or risk appetite. The context in which the decision is being made also determines acceptability. For example, public sector decision makers are acting on behalf of the whole of society but within this there are inevitably different societal groups, and therefore it is important that they understand and take account of the factors that affect the attitudes towards risk of these different groups.

In formal decision analysis a decision maker may adopt an approach to risk based on the calculation of expected values and a weighing up of risks (costs) and benefits. This concept of an approach to risk depends on putting different weights on the adverse and beneficial effects depending on how much risk of an adverse outcome the decision maker is prepared to accept.

Risk neutral decision makers are simply concerned with minimising costs or maximising benefits and will therefore make decisions based on the expected value of each alternative action (defined in economic terms). Decision makers may also be:

- *risk averse*: willing to accept only a low likelihood of adverse outcomes, irrespective of level of potential benefit (minimising the loss irrespective of the potential benefit); or
- *risk prone*: willing to accept a relatively high likelihood of adverse outcomes in the expectation of a greater benefit (maximising the benefit irrespective of the potential loss)

This approach does not specifically consider uncertainty, and assumes that the information available to the decision maker about the likelihood and magnitude of effects is statistically sound. Uncertainty may be addressed by calculating standard deviations (where the major issue is sampling error), or in other ways constructing a range of values. These ranges may be applied to estimates of both likelihood and magnitude, and these may be combined, to estimate bounds on the level of risk.

A second approach addresses uncertainty explicitly, and considers how the decision maker should address risk in the face of uncertainty. There are many circumstances, particularly in environmental decision making, where there may be very little information available, or the information may be recognised as being statistically unreliable. In these circumstances the decision maker may choose to be cautious or adopt 'precaution'.

Decisions made within an organisation make the implicit assumption that the organisation has a consistent risk appetite, however studies have shown that this is not necessarily the case (Sparrow, 2003). These inconsistencies may lead to incompatible decision making. This illustrates the importance of ensuring that the organisation's risk management policy is effectively communicated within the organisation.

### *Learning*

Risk communication can be viewed as a mutual or common learning process, where different participants provide their own world views as input to the decision process. This may or may not involve shared decision making. While the parameters of the decision process should be established before the risk communication process is undertaken so that participants do not have unrealistic expectations, in some circumstances these parameters may change as the process evolves.

### **Process and outcome**

Good practice risk communication does not necessarily lead to consensus. There is, at times, a good faith belief in the causal sequence that providing information to stakeholders and interest parties will lead to greater awareness and understanding of the issues which will in turn lead to changed behaviour. However, as pointed out by Sims and Bauman (1983), there is considerable evidence for the breakdown of this causal sequence. They replace it with a more cautious statement that "sometimes, under highly specified conditions, and if properly executed, with certain target publics, information

may lead to awareness and awareness may lead to behaviour". Therefore, providing information is not sufficient to affect behaviour.

It must also be remembered that there are two major types of conflict, interest-conflicts and value-conflicts, and that conflict resolution techniques of all types have been shown to be ineffective where value conflicts are concerned. Unfortunately, public sector decision-making problems in particular tend to be problems of inconsistent values (i.e. values of public and proponents). The only hope in this situation is to attempt to change attitudes. Whilst there is evidence of considerable attitude change in areas such as smoking, alcohol consumption and the place of women, these changes require long-term education. Attitudes towards perceived risk, acceptable risk and the role of risk communication have changed noticeably in the past decade and it is important that this process be continued for the sake of long-term gain.

Therefore, risk communication that is successful in terms of the communication process may not achieve the objectives of the particular application (resolution of conflict, and happiness all around).

### **Risk communication in New Zealand**

New Zealand has not yet faced the major risk conflict situations that have concerned Europe and the United States over the past two decades. One reason is that these have focused largely on large scale questions such as nuclear power generation and hazardous waste disposal. The second area is of concern to a number of groups and agencies, but it has not yet surfaced as a major focus of the general public.

In the past few years, however, there have been significant areas where differing perceptions of risks have led to conflict. These include the siting of microwave and cellular phone towers, genetic modification and biotechnology, and large scale spraying of residential areas to eradicate pest species.

Risk communication techniques have been applied in New Zealand to natural hazard management and flood control. There are a number of circumstances where councils have applied successful risk communication programmes that have used community knowledge and experience to help design appropriate systems. These include flood control (Kingsbury, 2000), and general natural hazard management (McSaveney *et al.* 1996; Gough *et al.* 2001).

Since the implementation of the Resource Management Act (RMA), communities have become accustomed to being consulted on the development of District and City Plans. Along with this, the notification requirements of the RMA have resulted in community groups becoming more active about engaging with planning authorities in a number of areas, many of which involve risk.

The health sector in New Zealand has also become more aware of the importance of risk communication, though in a number of recent examples the emphasis has been on informing the public, rather than consulting the public. Part of this is the result of current legislation; proposals for changes to the Health Act may result in better recognition of the benefits of properly designed risk communication programmes. At a clinical level, a great deal of emphasis has been given to improving doctors and clinicians communication skills in recent years.

Two areas where long term risk communication channels have been established in New Zealand are the Ministry of Agriculture and Forestry (MAF) Farm Advisory Service, and the Civil Defence Service. The Farm Advisory Service has for many years operated as a communication channel between farmers and the scientific and technical researchers of MAF. This has proved to be an effective two-way communication channel with farm advisors acting as communicators. One of the features of the service is that the communicators have been trained primarily as farmers rather than as communicators so they have used their own professional judgement to determine what the message should be and how it should be communicated. Unfortunately institutional change has resulted in the downgrading of the service. The Civil Defence service has largely been a one-way communication system with Civil Defence providing the public with information on what to do in cases of emergency. The efficacy of this communication channel is hard to judge since Civil Defence situations do not occur often. The new Civil Defence and Emergency Management Act (2002) aims to strengthen the role of risk communication in managing for emergencies, and communities and councils will be more directly involved in all aspects of planning for emergencies.

New Zealand needs to place emphasis on: encouraging institutions and agencies currently involved in risk assessment to recognise the validity and utility of their procedures, enhancing the credibility of agencies and institutions likely to be involved in risk communication exercises, considering ways of providing comprehensive and comprehensible technical information to the media and the public, and exploring imaginatively the establishment of communication channels (either as institutional arrangements or flexible processes).<sup>8</sup>

## **A way forward**

In 1997, the United States Presidential/Congress Commission on Risk Assessment and Risk Management published a document entitled *Framework for Health Risk Management*.

The importance of this document to proponents of risk communication was that the central element of the diagram illustrating the relationship of risk assessment and risk management was 'engage stakeholders'. It discusses the need for better communication

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<sup>8</sup> This statement derives from Gough, 1991. It remains appropriate today.

between regulators and the public and concludes that “The practice of risk communication is moving from trying to explain risk information to citizens toward building partnerships between plant managers and nearby residents, between companies and consumers, and between agency risk managers and the public. Although our air, water, and food are measurably cleaner and therefore less risky than they were 30 years ago, the fact that many citizens believe that they are at greater risk indicates that risk communication has a long way to go.”

In November 2002, the United Kingdom Cabinet Office published a document entitled *Risk: Improving Government’s capability to handle risk and uncertainty*. In it they refer to the importance of risk communication and note the following –

“Three specific concerns were raised in our study in relation to communication with the public about risks they face:

- communication needs to start earlier in the policy development and decision process, wherever possible when framing decisions are being made. A number of NGO<sup>9</sup>s
- told us that they were frequently approached for comments on a narrowly defined solution to risk issues, rather than being involved early on in analysing the problem and the range of options available for tackling it;
- communication with the public on risks that affect them needs to be a genuinely two-way process. NGOs have suggested that a one-way approach to risk communication is more likely to increase public anxiety about risks than to provide reassurance; and
- involvement of the public in decisions about risks, both formal and informal, needs to be as widespread and balanced as possible. Stakeholders we spoke to suggested that, by restricting formal consultation to their usual list of contacts, Departments were more vulnerable to “group think” and as a result key risks were sometimes missed. Similar concerns were voiced about informal soundings such as public attitude surveys, with one politician we spoke to suggesting that Departments sometimes confuse market research with genuine involvement in the decision process.”

The importance of these conclusions is not so much their content, which will be well recognised by people familiar with risk communication literature and practise, but that they are presented in high level government documents.

In the New Zealand context, the public participation elements of our environmental legislation (Resource Management Act 1991, Hazardous Substances and New Organisms Act, 1996, Civil Defence and Emergency Management Act, 2002) provide a legislative foundation for the development of better practise in communicating about risk issues.

The goal of the proposed CAE risk communication project is –

To develop approaches and techniques for enabling risk communication suitable for New Zealand organisations, *by means of*

- An improved understanding of the psychology of risk taking and risk perceptions at

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<sup>9</sup> Non Governmental Organisations

an organisational level

- The development and promotion of a process within organisations for promoting a more general awareness and understanding of expectations regarding managing risk i.e. risk attitude
- The development and promotion of a process for assisting organisations to communicate risk to external stakeholders and interested parties both on a project basis and on a more general basis

It is important to note that the use of the term ‘approaches’ here includes notions of how, why, what, when, and why, so as to assist organisations to undertake ‘better’ communication about risks.

In order for New Zealand to manage risks better, there needs to be an open discussion on what risk management can and cannot do, and how and where it should be applied. An excellent start would be greater recognition of the importance and value of risk communication and stakeholder contributions to decision making.

## References

- Chess, C., Hance, B.J. and Sandman, P.M. (1989): *Planning dialogue with communities: a risk communication workbook*. Environmental Communication Research Programme. Rutgers University. New Brunswick. New Jersey.
- Feynman, R.P. (1988): What do you care what people think? Unwin.
- Fischhoff, B., Slovic, P., and Lichtenstein, S. (1975): Fault trees: sensitivity of estimated failure probabilities to problem representation. *Journal of Experimental Psychology - Human Perception and Performance*, 4 (2): 30-344
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., and Combs, B. (1978): How safe is safe enough? *Policy Sciences*, 9: 126-152
- Fischhoff, B., Lichtenstein, S., Slovic, P., Derby, S.L., and Keeney, R. (1981): *Acceptable risk*. Cambridge University Press, Cambridge.
- Fischhoff, B., Slovic, P., and Lichtenstein, S. (1982): Lay foibles and expert fables in judgements about risk. *American Statistician*, 36 (3): 240-255.
- Flynn, J., and Slovic, P. (1999): Expert and public evaluations of technological risks: Searching for common ground. *Risk Analysis* 19(2): 153-166
- Gough, J.D. (1991): Risk communication: the implications for risk management. *Information Paper No. 33*. Centre for Resource Management. Lincoln University. New Zealand.
- Gough, J.D. (2001): Changes in Understanding, awareness and preparedness for natural hazard risk - Franz Josef Glacier. Institute for Geological and Nuclear Sciences Science Report Institute for Geological and Nuclear Sciences Science Report 2001/22.
- Hance, B.J., Chess, C. and Sandman, P.M. (1988): *Improving dialogue with communities: a risk communication manual for Government*. Environmental

- Communication Research Programme. Rutgers University. New Brunswick. New Jersey.
- Hansson, S.O. (1989): Dimensions of risk, *Risk Analysis* 9(1): 107-112.
- Kingsbury, P. (2000). Presentation to World Bank Tour on risk communication processes for flood control in Ashburton (*pers. comm.*)
- Kraus, N, Malmfors, T., and Slovic, P. (1992): Intuitive toxicology: expert and lay judgments of chemical risks, *Risk Analysis* 12(2): 215-252
- Lazo, J.K., Kinnell, J.C., and Fisher, A. (2000): Expert and layperson perceptions of ecosystem risk, *Risk Analysis* 20(2): 179-193.
- McSaveney, M., Davies, T., and Gough, J.D. (1996): Natural hazard assessment for Mt Cook/Aoraki Village and environs. *Unpublished report to the Mount Cook Village Development Steering Group, and the Department of Conservation.*
- National Research Council (1989): *Improving risk communication.* National Academy Press. Washington D.C.
- New Scientist. (2000): Don't keep secrets. *New Scientist* Editorial 18 March 2000:3.
- Peters, R.G., Cavello, V.T., and McCallum, D.B. (1997): The determinants of trust and credibility in environmental risk communication: an empirical study, *Risk Analysis* 17(1), 43-54.
- Renn, O. (1989): Risk analysis: a need to communicate, *Forum for Applied Research and Public Policy.* Summer 1989.
- Renn, O., & Levine, D. (1991). Trust and credibility in risk communication. In R. E. Kasperson & P. J. Stallen (Eds.) *Communicating risks to the public: 175-218.* Dordrecht: Kluwer.
- Renn, O., and Swaton, E. (1985): Attitude studies by the IAEA/IIASA risk assessment group. In: Cavello, V.T., Mumpower, J.L., Stallen, P., and Uppuluri, V. *Environmental impact assessment, technology assessment and risk analysis*, 403-452. Springer-Verlag
- Rohrmann, B. (1999): *Risk perception research - Review and documentation*, Research Center Juelich: RC Studies # 68.
- Sims, J.H. and Baumann, D.D. (1983): Educational programs and human response to natural hazards. *Environment and Behaviour*, 15(2): 165-189.
- Slovic, P. (1987): Perception of Risk, *Science* 236: 280-285
- Slovic, P., Fischhoff, B., and Lichtenstein, S. (1985): Characterising perceived risk. In: Kates, R.W. et al. *Perilous progress: technology as hazard.* Westview. Boulder, Colorado.
- Sparrow, A. (2003): Risk Appetite. In :Gough, J.D. *Sharing the Future: Risk Communication in Practice.* CAE.
- Standards Australia and Standards New Zealand. (1999): AS/NZS 4360: 1999. *Risk Management.* Sydney and Wellington.
- Standards Australia and Standards New Zealand. (2000): HB-203: 2000. *Environmental Risk Management: principles and process.* Sydney and Wellington.
- Starr, C. (1969): Social benefit versus technological risk, *Science* 165: 1232.
- Tversky, A., and Kahneman, D. (1982): Judgement under uncertainty: heuristics and biases. In Kahneman, D., Slovic, P., and Tversky, A. *Judgement under uncertainty:*

*heuristics and biases*. Cambridge University Press. Cambridge

United States Presidential/Congress Commission on Risk Assessment and Risk Management. (1997): *Framework for Environmental Health Risk Management*. Presidential Commission. Washington.

United Kingdom Cabinet Office Strategic Unit. (2002): *Risk: Improving Government's capability to handle risk and uncertainty*. London.