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Judgement Strategies In Determining Risk Acceptability

Jo Ann Elizabeth Beckwith BSc(Dalhousie) MES(York)

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Declaration

I declare that this thesis is all my own work and has not been submitted previously, in whole or in part, in respect of any other academic award at this University or elsewhere.

Jo Ann Elizabeth Beckwith

Abstract

Most risk perception research has focused on how people view the riskiness or acceptability of particular hazards. Less attention has been paid to how people determine whether or not the decisions taken by other parties (e.g., politicians, government agencies, industry, etc.) to address risk issues are acceptable decisions.

After examining the structure of risk perception and acceptability, this study researched the judgement strategies which individuals employ when assessing the acceptability or unacceptability of risk related decisions. It also investigated whether or not individuals directly affected by risk related decisions utilise similar judgement strategies to those of individuals not directly affected by the same decisions. This provided insights as to the reasons why local communities often reject risk related decisions that others in the broader community consider acceptable.

Questionnaire data were collected relating to a number of risk scenarios based on real world risk issues and decisions. The survey included Curtin University students, residents of a Perth suburb, and members of a resident action group involved in a local risk issue at the time of the study.

Unlike previous studies of heterogeneous hazard sets, exploratory factor analyses of 8 hazard domains did not reveal a global factor structure that could represent the construct 'risk'. Instead, each of the hazard domains revealed a qualitatively different factor structure, highlighting the context specific nature of risk.

Through the use of correlation, linear regression, and path analysis the relationship between perceived riskiness, risk acceptability and other risk attributes or characteristics was explored. These analyses revealed that a relationship between perceived risk and risk acceptability exists to varying but significant degrees across different types of hazards. For a specific risk item, only a limited number of characteristics appear to significantly influence perceived risk or acceptability with some characteristics influencing both.

Respondents used a ranking and weighting procedure to indicate the relative importance of the various qualitative characteristics in determining the acceptability of risk related decisions. This analysis revealed that people utilise both the characteristics of a risk issue as well as aspects of the decision itself when assessing the acceptability of risk related decisions. The study suggests that individuals who are not directly affected by a specific decision employ simple judgement strategies not that dissimilar to those of the risk experts. This contrasts with directly affected individuals who appear to employ additional considerations, such as the trust worthiness of the decision makers, when assessing the acceptability of decisions.

The thesis identifies a number of areas of future research, such as the role of hazard prototypes, and explores the implications of the study's findings for future risk communication efforts.

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Chapter 1

Introduction

While risk taking is generally accepted as an inherent part of living, there is little agreement within society regarding what type and level of risk taking is acceptable. Increasingly over the past 20 years, policy dilemmas have been created when the public, or some sectors of the public, believe that an activity poses an unacceptably large risk while the risk 'experts' believe the risk to be acceptably small. Paradoxically, the apparent increase in public sensitivities toward risk issues comes at a time when health and safety risks in modern industrialised countries are lower than at any other time in history.

The list of controversial risk-related issues is ever growing. It seems as if one only has to open a newspaper or turn on a television or radio to learn of a new risk facing society. Nuclear power generation was an early subject of public debate regarding risk acceptability. Since then the list of risk issues has come to include DNA research, asbestos, AIDS, pesticide use, hazardous waste disposal, electromagnetic radiation, passive smoking, drug testing, medical research, the greenhouse effect, even cellular telephones, but to name a few. With further advances in technology, new risk controversies are inevitable. This means that the challenge facing decision makers of finding better means of addressing risk issues and involving the community in those decisions will increase rather than diminish in the future.

Some academics have expressed the opinion that Western societies have already become too risk averse for their own good. Harold Shapiro (1990) observed that as individuals become more risk averse in their own lives, they are becoming less and less tolerant of the risks being taken by their decision makers.

The past twenty years has seen industries such as the nuclear power industry virtually ground to a halt by the concerns of some sectors of the community over safety issues. In North America it has got to the point where, due to community opposition, it is virtually impossible to obtain government approval for sites for facilities that the public deem to be 'too risky' even when the technical experts document that the risks are 'acceptably' small and within established regulatory standards or criteria. There exists little trust among the parties in these risk debates. The community often shows little faith that either the risk experts or the decision makers will act in their best interest. On the other side, the community's concerns are often interpreted by project proponents as irresponsible, emotional and irrational; born of selfishness, hidden agendas and ignorance. Facility siting stalemates have lead to the term NIMBY (i.e., Not In My Backyard) becoming part of everyday English. Industry and government representatives are all too well aware of the problems they face when risk becomes an issue in the community. What they do not know, is what to do about them.

There exists an almost endless list of questions about how we perceive risk, how we as a society should make decisions about risk, and how we should communicate about risk. For example, why as a society are we prepared to pay inordinate amounts of money to reduce already low levels of risk yet invest relatively little to reduce other greater risks (e.g., car safety)? Should we introduce new technologies and products such as genetically engineered foods if the long term consequences are unknown? Do we want to reduce risks at any cost? When is a risk acceptable and acceptable to whom? How safe is safe enough and who should be making these decisions? If the community is to be involved, to whom, in what form, and through which channels should risk information be communicated? The list of questions appears endless with little hope that many will be easily answered in the short term.

This research study focuses on the question of risk acceptability. The impetus for the research is the apparent failure of many risk communication efforts to successfully address risk issues. But, before one can recommend ways of improving risk communication efforts, an understanding of how people judge the acceptability of risk related proposals or decisions is required. This study examines how people perceive both the riskiness and acceptability of hazards. It also investigates the process by which individuals and groups judge the acceptability of risk related decisions or proposals such as the siting of a hazardous waste facility. A particular focus of the study is the judgement strategies employed by individuals and groups directly affected by risk related decisions or proposals, the so-called NIMBY syndrome. There is no systematic body of literature on this topic. These NIMBY strategies are compared with those of non-affected individuals.

This thesis is organised into two parts. Part A documents the general review of the risk perception and risk communication literature which was conducted at the outset of the study. The literature review documented in Chapters 2 through 4 was used to assist the researcher in gaining a broad overview of the risk literature and provides a general backdrop to the research program set forth in Part B of the thesis. Gaining a broad perspective of the fields of risk perception and risk communication was important to the researcher as it allowed the research program documented in Part B to be set in a broad policy making context. This reflects the researcher's interest in how the outcomes of empirically based research efforts in risk perception, which are often narrowly focused, significantly constrained (e.g. limited sample size), and based on hypothetical situations, can be usefully applied by policy makers dealing with real world risk issues.

Chapter 2 focuses on the concept of risk as seen through the eyes of cognitive psychologists and cultural theorists. Chapter 3 examines the issue of risk acceptability, while Chapter 4 highlights the dominant messages from the risk communication literature.

In addition to helping to set the scene for the research program, the literature review in Part A was used to identify the key research topics which formed the basis of the research program documented in Part B of the thesis. The research topics, study objectives and the study design are presented in Chapter 5. The chapter includes a more in-depth analyses of the key research literature pertaining to the research questions identified as a result of the initial literature review. Chapters 6 through 9 discuss the results of the research program. Chapter 10 provides a summary of the key research findings, identifies areas for future research and discusses applications of the research findings to future risk communication efforts.

PART A - LITERATURE REVIEW

Chapter 2

Risk Perception

Introduction

This chapter commences with an examination of the many definitions which have been applied to the term 'risk', highlighting the differences between technical definitions of risk and those which give greater recognition to the non-technical or socio-political aspects of risk. The increasing emphasis on the socio-political and cultural aspects of risks has lead some to question the role of technical risk assessments in decision making and to advocate a 'participatory' model of decision making.

The question of what people mean when they say something is 'risky' has lead psychologists to attempt to identify the key dimensions of risk. Since the initial studies of Starr (1969), psychologists such as Slovic and Fischhoff have attempted to develop hazard taxonomies to assist risk decision makers. As other researchers have extended the research of Slovic and Fischhoff by examining other types of risks (e.g. health rather than technology hazards), the list of factors identified as being important to risk perception has continued to grow. While the number of risk characteristics has grown, the role of heuristics in simplifying the cognitive processes lay persons apply to complex probabilistic problems has also been highlighted. The work of Tversky and Kahneman (e.g. 1974) has been a focal point for risk research on heuristics.

Those who promote a cultural theory of risk (e.g. Douglas & Wildavsky 1982) have been critical of psychological risk research for focusing on the individual while ignoring the importance of the interaction between the individual and his or her social environment (e.g. influence of family or social groups, media influences, institutions, etc.) in shaping a person's perception of a risk issue. Over the past 10 years an increasingly multi-disciplinary approach has been taken to risk research. This had lead to conceptual risk frameworks which have attempted to reconcile the various psychological and sociological perspectives. The best known of these frameworks being the 'social amplification of risk' (Kasperson et al. 1988).

It would be nice if a person's behaviour in response to a risk accurately reflected their attitudes towards that risk. Unfortunately we know that people's attitudes or perceptions about a risk often do not match their behaviour. This is an important issue for risk managers such as those involved in emergency response planning and preventative medicine. The most influential research on this issue has been that of Fishbein and Ajzen (1975) whose 'theory of reasoned action' attempts to demonstrate the relationship among beliefs, attitudes and intentions in predicting individual behaviour. The literature on the effect of stress on behaviour in response to natural or man-made disasters is also examined because it is an area of research which may provide some useful insights as to the reasons why people react the way they do when faced with hazardous situations.

What Do The Terms 'Risk' and 'Hazard' Mean?

When 'experts' and the lay public use the terms 'risk' or 'hazard', they are often talking about quite different things. Throughout the risk literature a plethora of meanings is given to these terms. From the expert or technical perspective, 'risk' is conventionally defined as something that can be given a numerical value or reduced to a unidimensional format (e.g., annual number of fatalities). Typically, the probability of a risk is multiplied by its severity to give an expected value which is then used to compare risks (Hansson 1989). Sometimes the expected value is called 'the risk'. A weakness of this definition is that it does not distinguish between risks that involve a large probability of minor consequences and those that involve a small probability of a major catastrophe.

Western Australia's Environmental Protection Authority (EPA) uses the term 'hazard' to describe a set of conditions that could lead to a harmful accident. 'Risk' is defined in terms of both the likelihood of a hazard, and the consequences of that hazard (EPA 1987).

Kates (1978) used the term 'environmental hazard' to describe the threat potential posed to man or nature by events originating in, or transmitted by, the natural or built environment. The term risk assessment is applied to an appraisal of both the kinds and degrees of threat posed by an environmental hazard.

Other definitions of risk include:

- a threat to life or health (Fischhoff et al. 1981);
- to hazard, endanger; to expose to the chance of injury or loss (Oxford English Dictionary);
- the probability of either financial or physical damage (Starr & Whipple 1980);
- the possibility of some adverse effect resulting from a hazard (Lowrance 1976);

- an uncertain situation in which a number of possible outcomes might occur, one or more of which is undesirable. The hazard is the source of the risk (Merkhofer 1987);
- expected damage;
- probability; and
- the cost associated with the probability of failure (Massmann & Freeze 1987).

One thing that is clear from the literature is that the public defines risk more broadly than do risk assessment professionals. Sandman (1988) defined risk as Risk = Hazard + Outrage, where the death rate is called 'hazard' and everything else that the public considers part of risk is collectively labelled 'outrage. For Sandman, risk, if properly conceived by decision makers, includes both hazard and outrage.

Defining the term risk as the quantification of a hazard is a very modern application of the word taken from the work of mathematicians concerned with the expression of probabilities. Ingles (1991) contended that the statistical use of the term risk should not be confused with the popular sense of voluntary venture which distinguishes risk from hazard.

Dake (1992) also examined the concept of risk from an historical perspective. In the 17th century, risk was defined as the probability of an event occurring, combined with an accounting for the losses and gains that the event would represent if it occurred. The interesting aspect is that, in this period, as much attention was paid to benefits as was to losses. This is a perspective that has effectively been lost in the 20th century.

In a popular sense, the term risk now carries largely negative connotations of loss or harm.

Von Winterfeldt, John and Borcherding (1981) view risk as a general and abstract construct that gains specific meaning only in the context of particular stimulus sets. Along similar lines, Fischhoff, Watson and Hope (1984) have argued that no single definition of risk can be correct since no definition can be suitable for all problems. They view the choice of a definition as a political one, expressing someone's views regarding the importance of different adverse effects in a particular situation. Defining risk is viewed as a policy issue, not a technical one. Cvetkovich and Earle (1992) view risk not as an inherent quality of the physical world but as a representation of the interaction between physical and psychosocial characteristics. The assessment of risk involves judgements about what is valued.

Does it really matter if experts and lay people have different definitions of risks? The answer is yes. If all parties involved in a risk communication are not working from the same definition of risk, there is a good chance they will be talking at cross purposes. At a minimum, it would seem essential that all parties to a risk issue have some appreciation of how others are defining the term 'risk' if a risk communication is to have any chance of success.

Risk Assessments

Many risk communication programs are efforts to convey the findings of technical risk assessments to the lay public. Over the past 20 years, technical or 'expert' risk assessments have come to play a significant role in risk decision making processes such as in the approval of new drugs and foods by regulatory agencies and in the siting of hazardous facilities. In recent times, risk assessments and the experts who produce them have increasingly come under attack from the public during risk debates. The risk assessments provide not only the substantive basis for risk communication efforts but often themselves necessitate the need for risk communication efforts.

Some people do not even consider risk assessment to be science, referring to it as 'art' or even 'hocus pocus' (Gregory 1989). Jackson (1989) has asked what is so technical about the assessments of risk experts and argues that risk assessments are so full of unknowns and value-laden assumptions that to put their conclusions on a plane higher than the citizens who live in an area and may experience the impacts is completely unfair.

Konheim (1988) observed that to the public the very act of undertaking a risk assessment validates its initial concerns about the seriousness of the threat. While risk assessments talk about the probabilities of events occurring they do not provide a clear answer to the question that potentially impacted members of the public are often asking: What will happen to me and my family if something goes wrong? Konheim has even suggested that the term 'risk assessment' be dropped in site specific applications in favour of 'health impact statement' or some other title with less provocative connotations.

Risk experts are often incredulous to the fact that many in the public simply do not believe what they have to say. In an effort to rationalise negative public reaction, they often fall back on their portrayals of the public as ignorant, irrational, emotional and selfish. Yet it is not just the public who are asking questions about the validity and usefulness of risk assessments in the policy making arena.

While risk assessments have a place in risk decision making, it is increasingly difficult to argue that they should be the sole basis for decision making. Freudenburg and Pastor (1992) have found risk analysts guilty of evoking 'the tyranny of illusionary precision', by conveying an impression of a higher level of accuracy and confidence than is actually warranted. There is a growing body of evidence which suggests that scientists may be subject to some of the same foibles and judgmental errors that affect the general public, and to a few more beside (e.g., Freudenburg 1988; Freudenburg & Pastor 1992; Hyman & Stiftel 1988; National Research Council 1989; Kahneman & Tversky 1972; Tversky & Kahneman 1971). These errors by researchers include:

- Failure to see the ways system components are interrelated;
- Failure to predict the cumulative impact of individually minor problems;
- Overlooking 'nontechnical' aspects of a technological system or those aspects outside their area of expertise;
- Insufficient attention paid to the sensitivity of assumptions and the problems of small sample size;
- Conscious decisions to simplify analysis by excluding low-probability events from consideration;

- Drawing conclusions from small samples that are only justified with much larger samples;
- A tendency to see meaning even when events are random;
- A tendency to fit ambiguous evidence into predispositions;
- Overlooking the ways that human errors or deliberate human interventions can affect technological systems; and
- Over-confidence in the reliability of analyses.

Rushefsky (1982) rejected the argument that policy disputes about risk can be minimised by separating them into two stages. The first stage focusing on the measurement of risk and the second stage on the normative process of evaluation or judging safety. Thereby creating something of an objective/subjective dichotomy. Rushefsky viewed this position as flawed because he believed the measurement of risk (i.e., the scientific stage) is not objective.

Rushefsky argued that epistemological differences are a key reason why experts disagree among themselves over risk issues. He has identified three dichotomies: the acute/chronic perspective (i.e., short term versus long term effects); the chemical/biological perspective; and the classical/romantic perspective (i.e., analysis of components versus interrelationships). He contended that scientists who advocate a certain technology lean toward the acute, chemical, classical perspectives, while their opponents lean toward the chronic, biological and romantic perspectives. He concluded that opposing scientists are really talking past each other. The much sought after objectivity of science is less realisable in practice than in theory, with judgement and politics playing a strong role even in the early stages of risk assessment.

Like Rushefsky, Fiorino (1989) rejected the separation of the scientific assessment of risk from its political evaluation but for different reasons. He identified two models for making decisions about risk. One is the 'technical' model which determines risk acceptability through the application of formal quantitative models, probabilistic methods, and expert judgement. Institutionally it takes forms such as science advisory panels. The risk communicator's role is to present the judgements of the experts to the public. Drawing on Bachrach's "elite theory" of modern democracy, Fiorino views the technical model of risk analysis as elitist in nature since implicit in elite theory is the notion that citizens are not capable of judging what is in their own interests, and that such judgement is best left in the hands of elites, subject to electoral and interest group control. The general interest is realised when government policy is in accordance with the judgement of the elites.

The second model is the 'democratic' or 'participatory' model which views risk conceptually on the basis of its social and cultural context. The democratic model accepts the legitimacy of lay risk judgements and the socio-political values they reflect. Fiorino highlighted the need to reconcile the two models by synthesising the technical and democratic values they represent explicitly within the analytical risk assessment. This would require acceptance of the legitimacy of lay judgements, the development of two way communication between the lay public and elites, and assessing policy processes and institutions not only by their end results, but by their compatibility with substantive and procedural values. Negotiation and mediation processes, and the use of citizen review panels or policy juries are put forward by Fiorino as possible mechanisms for achieving synthesis of technical and democratic values.

Risk Perception

The Psychometric Paradigm

Much of today's risk communication efforts attempt to operationalize what psychologists have learned about risk perception. Researchers in the field of risk perception seek to determine what people mean when they say that something is risky and what factors contribute to that perception. The most cited research on the role of risk characteristics or dimensions in risk perception is that of Slovic, Fischhoff, and their Decision Research team.

Slovic (1962) noted that people are often described either as risk takers or risk avoiders but he found no consistency in a person's propensity for taking risks in different risk contexts. People who may be daring in one context may be risk adverse in another. Slovic, Fischhoff and Lichtenstein (1979) also found that when experts and lay people were asked to estimate frequency of death for a particular activity, the experts' judgements were close to the statistical frequencies while the estimates of the lay group showed only a moderate relationship to the annual frequencies of death. They noted that lay people's risk perceptions were no more closely related to their own fatality estimates than they were to the calculated fatality estimates. For lay people it appeared that risk may not be synonymous with fatalities.

Since then Slovic and his colleagues have attempted to develop a taxonomy for hazards that can be used to understand and predict people's responses to different types of risks. It was hoped that this would explain people's extreme aversion to some hazards, their indifference to others, and the discrepancies between these reactions and the opinions of risk experts (Slovic 1987).

There has been debate regarding the exact nature and importance of the characteristics which lay people employ in assessing risk. A review of the risk perception literature indicates that the psychometric paradigm, through the application of psychophysical scaling and multivariate analysis techniques, has been most commonly employed to develop hazard taxonomies. These techniques have produced maps of risk attitudes and perceptions. Although it has received considerable criticism, Starr's (1969) 'revealed preference' approach, which weighed technological risks against benefits in order to determine 'how safe is safe enough', was pioneering in this area. Starr contended that 'voluntariness of exposure' was the key mediating characteristic. According to Starr, society is assumed to have achieved a balance between risks and benefits, so that more risky activities produce greater benefits in compensation.

Other researchers have found little support for this claim. Eiser and Hoepfner (1991) found that subjects' ratings of the seriousness of different hazards tended to be inversely related to their opinions concerning whether the risks were justified by the associated benefits. The work of Fischhoff, Slovic and others, which followed that of Starr, also applied the psychometric paradigm. Fischhoff, Slovic, Lichtenstein, Read, and Combs (1978) developed their 'expressed preferences' approach as an alternative to Starr's 'revealed preference' method. A major difference between the two approaches was that Starr's analysis dealt with public behaviour whereas the work of Fischhoff et al. dealt with attitudes.

The results of these studies indicate that not only is perceived risk both quantifiable and predictable, but the concept of risk means different things to different people. This is particularly true of 'experts' versus the 'lay public' (Slovic et al. 1979). While experts tend to assess risks in a mathematical context (e.g., annual fatalities), the lay public's risk judgements relate more to other characteristics of risk (e.g., catastrophic potential). As a result the risk judgements of experts often differ from those of the lay populace.

Popper (1983) pointed out that unlike the risk analysts, the public is unwilling to multiply the probability of an event times the consequence to obtain a risk value. He suggests that in refusing to do so the public are more realistic than the risk experts because the multiplication neglects the uncertainties inevitable in both the probabilities and the consequences it is manipulating. It ignores the fear, ignorance, and hostility that surround any low probability / high consequence (LP/HC) risk. Rather than do the multiplication, Popper believed the public operates on the basis of consequences.

Using psychometric questionnaires, Fischhoff et al. (1978) asked respondents to rate each of 30 risk items on a seven-point scale for nine risk characteristics. The nine risk characteristics were those that they and earlier authors had hypothesised as influencing risk perceptions. The risk characteristics were: voluntariness of risk; immediacy of effect; knowledge of risk (on the part of persons exposed); scientific knowledge; control over risk; newness; chronic-catastrophic; common-dread; and severity of consequences. As a separate exercise, half of the respondents were asked to make a global estimate of the gross benefits to society, tangible and intangible, associated with each risk item. The other half of the sample population were asked to rate the risk items in terms of the "risk of dying as a consequence of this activity or technology" (p.131).

Fischhoff et al. found that most respondents indicated that current risk levels were too high for most items. This was interpreted as meaning that respondents were not satisfied with the way that market and other regulatory mechanisms have balanced risks and benefits.

The existing risk level was considered more acceptable by those respondents who had considered the benefits than by those who had previously dwelt on risks indicating a relationship between perceived benefit and acceptable level of risk which is compatible with Starr's (1969) findings (Fischhoff et al. 1978). Respondents believed that more risk was acceptable for more beneficial activities. However there was no such relationship between perceived existing risks and benefits.

None of the nine dimensions or characteristics of risk correlated significantly with perceived benefit. Perceived risk did correlate with dread and severity but not with the other characteristics such as voluntariness. For any given level of benefit, greater risk was acceptable if that risk had the following characteristics: voluntary, immediate, known precisely, controllable, and familiar.

The nine risk dimensions were found to be highly intercorrelated, leading Fischhoff et al. (1978) to conclude through factor analysis that the dimensions could be reduced to two dimensions. One dimension which they labelled 'Technology Risk' discriminates between high and low technology activities. The high end is characterised by new, involuntary, poorly known activities, often with delayed consequences. The other dimension reflected the certainty of death which they labelled as 'Severity'.

Since then, a number of authors (eg. Slovic et al 1980, Kraus & Slovic 1988, Mullet et al 1993, Bishop & Syme 1992) have used factor analysis in efforts to identify a small number of higher order characteristics or factors. The most cited of these studies is that of Slovic et al (1980). In an expanded version of their earlier study (Fischhoff et al. 1978), two higher order characteristics or dimensions, 'dread' and 'familiarity', were identified. The dimension 'Dread' is defined by the characteristics: perceived lack of control, dread, catastrophic potential, fatal consequences, and the inequitable distribution of risks and benefits. The dimension 'Familiarity' encompasses characteristics such as unobservable, unknown, new, and delayed in their manifestation of harm. Fischhoff, Watson and Hope (1984) interpret the familiarity dimension as an expression of aversion to uncertainty, and thus represents cognitive (or intellectual) aspects of concern, whereas the dread dimension captures a risk's ability to evoke a visceral response. Slovic et al (1980) also reported that one characteristic, the number of people exposed, was relatively independent of the other risk characteristics.

Slovic, Fischhoff and Lichtenstein (1980) contended that, for lay people, the higher a particular hazard scored on the dread risk factor, the higher its perceived risk, the more people want to see its current risks reduced, and the more they want to see strict regulation employed to achieve the desired risk reduction. Experts' perceptions of risk however were not closely related to the characteristics applied by lay people, leading to their view that experts employ a different concept of risk, one that is synonymous with expected annual mortality.

Kraus and Slovic (1988) conducted a study to assess whether the relationships among the various risk characteristics and factor structures reported for a heterogeneous set of hazards (Slovic et al., 1980), would also pertain to a single hazard domain. They constructed a diverse set of 49 railroad hazard scenarios and asked 48 paid subjects to rate each scenario using the same risk characteristics applied in the studies of heterogeneous hazard domains. In addition, subjects rated each hazard on its overall level of risk.

Using Principal Components Factors Analysis, Kraus and Slovic reported that the characteristics could be represented by 2 factors which accounted for 78% of the total variance among the risk characteristics. Factor 1 was associated with the characteristics of voluntariness, control, and knowledge. Factor 2 was most strongly defined by the characteristics catastrophic potential, newness, and equity. The effects of dread were split between the 2 factors.

The resulting factor structures bore a number of similarities with previous research findings for heterogeneous sets of hazards but there were also some differences. One similarity being that the qualitative risk characteristics could be well represented by a smaller set of higher order factors. As in earlier studies, the characteristics knowledge and catastrophic potential were both found to be major components of the factor space, each loading onto different factors. Similarly, overall risk was highly correlated with the characteristics catastrophic potential and dread.

However the inter-relationships among a number of the risk characteristics were quite different to those reported by studies of heterogeneous hazard sets. Characteristics such as catastrophic potential and newness which had loaded onto the same factor in previous studies, loaded onto different factors in the railroad study. Similarly the characteristic control loaded differently in this study. Kraus and Slovic believed these unexpected results were a function of the specific set of railroad hazards presented to the respondents. Another unexpected finding was that the characteristic dread, which had been a primary component of the "dread" factor in previous studies did not play a strong role in the railroad study. The researchers speculated that this result was due to respondents not viewing railroad hazards as being particularly dreaded. Kraus and Slovic (1989) concluded that "the dimensions of any hazard space are likely to be dependent on the nature of the set of hazards being described" (p. 454).

Over the years the list of influential risk characteristics has grown. Otway and von Winterfeldt (1992) and Covello (1989) identified from the psychology literature the following 21 factors as important to risk perception:

- Catastrophic potential - fatalities that are grouped in time (e.g., airline crash) create greater concern than those which are scattered or random (e.g., automobile accidents).

- Severity of consequences - risks that can generate large numbers of fatalities or injuries create greater concern than those with small numbers of fatalities or injuries per event.

- Familiarity - people are more concerned about unfamiliar risks (e.g., nuclear power accident) than familiar ones (e.g., household accidents).

- Understanding - risks that are associated with poorly understood exposure mechanisms or processes (e.g., low level toxic substances) create greater concern than those with apparently well understood exposure mechanisms or processes.

- Delayed effects - Risks that are associated with somatic effects that are delayed in time (e.g., cancer) create more concern than those whose effects are immediate.

- Uncertainty - people are more concerned about risks that are scientifically unknown or uncertain than those which are relatively known to science.

- Controllability - risks that are perceived as not being under the person's control (e.g., industrial accidents) create more concern than those that are perceived to be under the person's control (e.g., riding a bike).

- Volition - risks that are perceived as involuntary (e.g., exposure to industrial emissions) create more concern than risks perceived as voluntary (e.g., sun tanning).

- Effects on children - activities that specifically put children at risk (e.g., Alar on apples) create more concern than those which do not put children specifically at risk (e.g., adult smoking).

- Effects on future generations - those activities which pose a threat to future generations (e.g., genetic effects due to radiation) create more concern than those which pose no special risks to future generations.

- Victim identity - risks to identifiable victims generate more concern than risks to statistical victims.

- Dread - those risks which evoke a response of fear, terror, or anxiety (e.g., radiation exposure) generate more concern than risks which do not evoke such a response (e.g., the common cold).

- Trust in institutions - a perceived lack of trust and credibility in the responsible risk management institution (e.g., US Dept. of Energy) creates more concern than situations where the responsible institution is perceived to be trustworthy and credible (e.g., Atlanta Centre For Disease Control).

- Media attention - people are more concerned about risks that receive much media attention (e.g., airline crashes) than those that receive little media attention.

- Accident history - activities associated with a history of major and sometimes minor accidents (e.g., nuclear power plants) create more concern than those with no track record of major or minor accidents (e.g., recombinant DNA research).

- Equity and fairness - perceived inequities or unfairness in the distribution of risks and benefits (e.g., the siting of locally unwanted land uses or LULUs) will generate more concern than activities characterised by a perceived equitable or fair distribution of risks and benefits (e.g., vaccination).

- Benefits - activities perceived as having unclear or questionable benefits (e.g., nuclear power generation of electricity) generate more concern than activities perceived as having clear benefits (e.g., automobile driving).

- Reversibility - activities with potentially irreversible negative affects (e.g., acid rain) create more concern than those characterised by reversible adverse effects (e.g., sports injuries).

- Personal stake - activities believed to place an individual or their family personally and directly at risk (e.g., living next to a hazardous waste site) create more concern than those that are not believed to do so (e.g., remote siting of waste sites).

- Evidence - risks based on evidence from human studies (e.g., epidemiological studies of occupational exposures) create more concern than risks based on evidence from animal studies (e.g., exposure studies using rats).

- Origin or attributability - people are more concerned about risks caused by human actions and failures (e.g., accidents caused by negligence) than those caused by nature (e.g., hurricanes).

Heuristics

Fischhoff, Slovic and Lichtenstein (1981) contend that, while people's risk perceptions may sometimes be erroneous, seldom are they stupid or irrational. Rather, they believe that people lack the intuition and cognitive capacity to deal with complex, probabilistic problems. To overcome these limitations lay people rely on 'heuristics', or judgmental rules of thumb, that allow them to reduce the complex problems to simpler, more familiar terms. It also provides a means of coming to conclusions in the face of uncertainty (Cvetkovich & Earle 1992).

Tversky and Kahneman (1974) have identified a number of heuristics that people apply when assessing the probability of an uncertain event including representativeness, availability, and anchoring. For example, the 'representativeness bias' is the tendency to think of particularly memorable examples as representative of a class of events, whether they are or not. Tversky and Kahneman (1981) also found that people's choices among risky options could be affected by the frame of reference provided for the outcomes (e.g., in terms of gains and losses). This is referred to as the 'framing bias'.

Slovic et al. (1979) found that people were moderately accurate in assessing which are the most and least lethal events in a global sense. However, rare causes of death generally tended to be overestimated, while common causes of death were underestimated. The inaccuracy in assessing the mathematical risk was attributed at least in part to the 'availability' heuristic. Those individuals who employ this heuristic judge events as likely if they are easy to imagine or recall.

Tversky and Kahneman (1974) found that many people make estimates of probability by starting at an initial value which is then adjusted to produce a final value. The initial value may have been given to the individual through the formulation of the problem or may be the result of a partial computation by the person. Regardless of the source of the initial value, Tversky and Kahneman found that when different initial values are used, individuals give different estimates to the same problem, and these estimates are biased toward the initial value. They referred to this phenomenon as 'anchoring'.

Weinstein (1989) acknowledged the 'optimistic bias' in self-other risk comparisons. When asked about their own chances, people claim that they are less likely to be affected by a risk than their peers. While optimistic biases appear for positive events; pessimistic biases are rare. Optimistic bias occurs in situations: when people compare themselves with an incorrect norm; when ambiguous risk factors are interpreted in a biased manner; and when people in high-risk groups downplay the risk or refer to risk-countering practices of little value. Optimism is greatest for hazards with which the person has little personal experience; for hazards with low probability; and where the hazard is considered controllable by personal action.

Bellrose and Pilisuk (1991) examined the role of risk familiarity in people's perceptions of the risks they face at work and their attitudes toward other environmental hazards. Having compared the risk perceptions of fire-fighters, radiation protection specialists and insurance agents, they suggested from their findings that as people become less familiar with the environmental hazard in question, their attitudes become more consistent with those of the general population. When subjects from these three groups were asked to determine the seriousness of 18 environmental hazards, the less familiar they were with the hazard item, the more consistent were their perceptions with those of the general population. They also found evidence of the 'availability bias', particularly among radiation protection specialists and fire-fighters. Occupational health and safety literature appeared to be used selectively to substantiate preconceived attitudes toward the risks of their vocation. During interviews, the fire-fighters quoted statistics regarding high fire-fighter mortality rates, which supported their perception of their vocation as extremely risky. The radiation specialists had expressed the lowest concern for the risks posed by their vocation, perceiving the harmfulness of nuclear emissions to be less than that of fluorescent lighting or copying machines. They tended to quote from sources provided by the nuclear industry which claimed that risks of exposure were very low, unsubstantiated, or low relative to other types of risks.

McClelland, Schulze and Hurd (1990) noted the potential importance of perceptual cues, such as odour, which may serve as a signal of more ominous events. In the case of people's fear about the hazards of a landfill, their research suggested that perceptual cues have strong signal value leading to higher risk judgements.

A review of the heuristics literature by Freudenburg and Pastor (1992) revealed that biases and logical errors characterise the decisions of experts as well as the lay public. In fact, experts may have additional biases, such as the 'influencing bias', introduced when experts work for organisations involved with a particular technology. This influencing bias will tend to result in underestimating rather than overestimating risks.

Researchers in the area of risk heuristics have received criticism of their work from a number of sources. Otway and Thomas (1982), in their review of literature on risk heuristics, stated that authors in this area have missed the main point and questioned how their research can in any way help to solve the political issues which initiated the research in the first place. They believed that risk perception research is too often used as " a panacea with which to attempt to remedy what are essentially societal and political matters" (p.69).

Cultural Aspects of Risk Perception

One group which has attacked the psychological research approach to risk perception is the sociologists and anthropologists led by Douglas and Wildavsky. They view risk as a 'collective construct' (Douglas & Wildavsky 1982) and have developed a cultural theory of risk. Douglas (1985) indicated that it would be a long time before psychological research could contribute to understanding highly socialised cognitive processes such as risk perception. Her complaint was that cognitive psychologists take the individual as its decision making unit and thereby excludes any moral or political feedback that the individual may be receiving from his or her surrounding society. Along similar lines, Wynne (1982) accused Slovic and Fischhoff of promoting the "positivist myth of scientific rationality."

The past 10 years has seen an increasing focus on the social or cultural aspects of risk perception. The dominance of the cognitive psychology approach of focusing on the dimensions of risk (e.g., dread, familiarity, etc.) to explain individual perceptions of risk has diminished. While still considered as legitimate, its narrow focus on the individual is increasingly viewed as telling only part of the story. Even some of those who were the early advocates of the psychometric paradigm such as Slovic and Fischhoff are increasingly embracing concepts of risk perception which embrace both the cognitive psychology and cultural theory of risk. The development of the concept of risk amplification (Kasperson et al. 1988; Renn, Burns, Kasperson, Kasperson, & Slovic 1992) is an example of this trend.

Douglas (1985) highlighted the role of culture in shaping the individual's perception of risk. She defined culture as the publicly shared collection of principles and values used at any one time to justify behaviour and viewed it as the 'coding principle' by which hazards are recognised. She contended that the cultural standards of what constitute appropriate and improper risks emerge as part of the assignment of responsibility. When asked about the risks he or she takes, an individual will start his or her answer from some culturally established norm of due carefulness.

A study by Bastide, Moatti, Pages and Fagnani (1989) highlighted the role of culture in risk perception. Their research found that the perception of nuclear technology risks held by the French was very similar to that held by U.S. citizens. Yet in France, unlike in the United States, there has been little public controversy about the development of nuclear power facilities. These national differences are accounted for by the differing social contexts resulting from the perceived level of security produced within each society and the perceived social legitimacy of activities involving risk. Rohrmann (1994) also reported crossnational differences in the risk judgements of Australians and Germans. He reported that Australian subjects were more accepting of sport-related risks (e.g., car racing) and unhealthy private behaviours (e.g., smoking) and gave lower risk ratings for technologies such as airports and coal power plants than did their German counterparts. Other studies have also found cultural differences in the risk perceptions of various nationalities. For example, a study by Hinman, Rosa, Kleinhesselink, and Lowinger (1993) comparing American and Japanese risk perceptions on the issue of nuclear power found some differences which they attributed to cultural influences. When Carlson and Davis (1971) examined the role of cultural values in the risk perceptions of Ugandan and American student subjects, they found that the African subjects were more conservative with respect to risk taking than their American counterparts.

Rather than defining groups by nationality, Borcherding et al (1986) examined the effect of social groups on evaluations and interpretations of risk. respondents were assigned to social groups by their value orientations. The study found that most group differences were related to 'technological' versus 'ecological' value orientations with all risk sources being accepted to a higher extent by technologically oriented respondents.

Douglas (1985) wrote about the existence of a general safety first principle which sets a lower limit for acceptable outcomes. This idea was formalised within Simon's

(1955) concept of bounded rationality. Simon argued that rather than maximising profits which is assumed by utility theory, individuals simplified complex choices through 'satisficing' which sets upper and lower bounds for making rational choices which are set semi-independently. In selecting among options possessing varying degrees of risk, an individual may select conservative (i.e., safety first) strategies until his lower bound is assured and then be prepared to adopt riskier options in an attempt to increase profits. Douglas suggested that the lower bounds of risk acceptability may not be set by the individual but communally.

Douglas (1985) contended that due to cultural or societal influences people tended to focus their attention on the middle range of risk probabilities. As a result, high probability dangers get overlooked (e.g., the difficulties in getting people to wear seat-belts in cars) and risks that combine heavy consequences with low probability, such as floods and earthquakes, get ignored. She attributed this tendency to public moral judgements which powerfully advertise certain risks, with the well-advertised risk generally having a connection to legitimating moral principles.

Some researchers noticed what came to be labelled the 'risky-shift' phenomenon; that groups make riskier decisions than the individuals that make up the group (Wallach, Kogan & Bem 1962, 1964). The 'diffusion of responsibility theory' argues that groups tend to make riskier decisions than individuals because there is someone with whom to share the responsibility for the decision. There is also the suggestion that high risk takers might exert more influence in a group causing the group to move toward greater risk taking.

Fraser, Gouge and Billig (1970) were among the first to raise the idea of a value for risk. They also identified the possibility that there was something even more general than a value for risk, namely a preference for positives. They described the group risk taking phenomena as 'group polarisation' which suggests that if subjects are inclined toward one pole of a scale then group discussion will increase that inclination. This held true regardless of whether or not the inclination was toward risk or toward caution. Group polarisation was not a content bound concept and thus was not unique to risk items.

Since the early 1970s researchers have questioned the risky shift literature both on conceptual and methodological grounds (e.g., Myers & Lamm 1976; Pruitt 1971). There is now consensus that the risky-shift phenomenon was a misnomer having little to do with risk per se. The risky-shift research has been relabelled as 'group choice shifts' or 'group polarisation of attitudes'.

Rather than construct a culturally based theory of risk, Plough and Krimsky (1987) argued that psychologists have isolated the cultural factors and treated them as just another variable in an experimentally derived framework. They were critical of psychologists for preserving the dichotomy between expert judgement and lay perception of risk and for categorising irrationalities rather than exploring the cultural underpinnings of risk perceptions. Plough and Krimsky felt that cognitive psychologists have treated the cultural inputs to risk perception as deviant but comprehensible. This approach is often reflected in risk communication efforts which apply the research findings of cognitive psychologists to convince lay persons that their risk perceptions are incorrect and that the risks, as judged by the experts, are acceptable.

They supported a cultural model based on the notion that expert and popular approaches to a risk event can be logical and coherent on their own terms (Plough & Krimsky 1987). They attacked the work of Slovic and Fischhoff for attempting to codify public attitudes about risk by measuring people's responses to hypothetical questions. Arguing instead that cultural rationality can only be understood when people's cognitive behaviour is observed as they are threatened by a real risk event. Because people's perceptions of risks are socially embedded and strongly influenced by a mixture of social, economic, and political considerations, public attention and resources can become focused on risks that are among the least likely to affect people (Covello 1988).

Thompson and Wildavsky (1982) believed that people who subscribe to contradictory cosmologies will operate contradictory rationalities and thus conflict between these parties may ensue. According to cultural theory, individuals behave in a manner which will justify and maintain the pattern of social relationships from which they have come (Thompson et al. 1990). However individual identify is shaped not only by ones relationship with others but by the extent of social prescriptions which constrain the individual's behaviour. The social perscriptions and group identity collectively result in distinctive myths of nature, specific forms of rationality, and particular risk management strategies. Dake (1992) wrote that " risk perception is socially constructed and culturally biased in the sense, and to the degree, that individuals respond to and reshape the prevailing opinions in their own social circles" (p. 32).

Dake (1992) viewed the cultural theory of risk advocated by researchers such as Douglas, Thompson and Wildavsky as a functional interpretation of myths of nature in which risk perceptions are explained in terms of their contribution to maintaining a particular way of life. Cultural theory accounts for the social construction of risk with respect to three linked domains that constitute a way of life: cultural biases, social relations, and behavioural strategies.

Cultural biases are defined as worldviews (i.e., shared beliefs and values that justify different ways of behaving) corresponding to different patterns of social relations (Dake 1992). Worldviews act as "powerful cultural lenses" which influence our risk perceptions by magnifying one danger, obscuring another, and selecting others for minimal attention or even disregard (Dake 1992). Worldviews and social relations are functionally interdependent. Social relations fall into one of five possible categories: hierarchical, individualistic, egalitarian, fatalist, and autonomous. These relational forms, along with the cultural biases or worldviews which underpin them, lead to shared perspectives among individuals as to what constitutes a risk and what does not (Douglas 1970, 1982). As described by Dake (1992), each category of social relation fosters a different myth of nature and correspondingly a different preferred rational environmental strategy:

- Hierarchical groups - foster the myth that nature is perverse or tolerant. Nature is viewed as robust but only up to a point. Sustainable development would be a compatible strategy for this group.

- Egalitarian groups - espouse the myth that nature is fragile. Members of this group typically frame risk issues in ethical terms. They prefer approaches that foster equality of outcomes and strategies that encourage strict preservation of the environment.

- Individualists - hold the myth of nature as benign. Deregulation is the rational strategy for this group because individualists value decisions stemming from personal judgement rather than collective control.

- Fatalism - hold the myth of nature as capricious. They construct a cultural bias that rationalises isolation and resignation to stringent controls on behaviour. "Why bother?" is their rational risk management measure.

- Autonomy - defined as a largely asocial way of life.

According to cultural theory, social conflict over issues such as environmental hazards are the result of clashing worldviews and social relations. Dake and Wildavsky (1990) suggested that those who hold an egalitarian bias perceive the dangers of most technologies as great and their associated benefits as small. They found that as predicted by cultural theory, it is not that members of the hierarchical or individualist groups perceive no dangers, but they disagree with those who favour egalitarianism about how the dangers should be ranked.

Risk Attitudes and Behaviour

Kates (1978) observed that people survive, and in some cases even prosper, when faced with an environmental hazard because they adopt coping strategies, either in the form of adaptations or adjustments. Adaptations are long-term responses to a hazard that are embedded in human biology or culture such as humans adapting to high altitudes or severe cold. Adjustments are short-term responses to a hazard which may take three forms: measures that accept consequences by bearing, sharing or distributing the effects; measures that modify events or reduce society's vulnerability to loss; and, on rare occasion, changes in basic location, livelihood or productive systems. Adaptations and adjustments work together to reduce the hazard consequences to some level of general tolerance or acceptability.

Kates found that many individuals will take some positive action to reduce losses but few will take preventative action much in advance of the risk event and few choose a large number of adjustments. As a general rule more individuals bear losses than share losses, and more accept losses than reduce damages. Of those that reduce damages more seem to try to modify events than to prevent consequences, while many more seek to reduce damages rather than change their livelihood, productive technique or land use. Fewer still move their residence or change location, even when the hazard is severe.

Bell, Fisher, Baum and Greene (1990) described another aspect of adaptation noting that we can hear so much about a risk that it no longer is frightening. Large populations who lived in earthquake prone areas such as California were seen as an example of this adaptation phenomenon. The people who face such a threat on an on going basis learn to live with it, and in the process of doing so discount the possibility that they may themselves become victims. If a person's well being is closely related to the source of the threat they will remain more aware of the danger rather than adapting. For example farmers would be more aware of drought hazards than nonfarmers in the same area.

Resolving attitude-behaviour inconsistency has attracted considerable attention from cognitive psychologists since the 1960s. Research efforts have focused on developing models which explain the other variables which affect attitude-behaviour consistency. The most prominent and influential of these models is that developed by Fishbein and Ajzen. Their 'theory of reasoned action' (Fishbein and Ajzen 1975) attempted to demonstrate the relationship among beliefs, attitudes, and intentions in predicting individual behaviour. They contended that behavioural intentions are closely linked to volitional actions and can predict them with a high degree of accuracy, although the degree of accuracy would decline with the amount of time between the measurement of behavioural intention and any observations of actual behaviour. Fishbein and Ajzen contended that the predictive ability of intentions is significantly greater than that of attitudes toward a particular behaviour. However, this position has been criticised by Liska (1984), who pointed to studies which suggested that attitudes are better predictors of behaviour than are behavioural intentions.

According to the theory of reasoned action, behavioural intentions are a function of attitudes toward the behaviour and subjective norms. The assumption is that intentions mediate the effect of attitudes on behaviour. The attitude is the individual's positive or negative evaluation of performing the behaviour of interest, while the subjective norm is the person's perception of social pressure to perform or not perform the particular behaviour. The relative importance of these two determinants, attitude toward behaviour and subjective norm, depends on part in the behavioural intention in question. In addition, the relative weights of the two determinants may vary from person to person. Fishbein and Ajzen's theory of reasoned action explains attitudes and subjective norms in terms of behavioural and normative beliefs respectively. A person's attitude toward a behaviour is the result of their evaluation of the outcomes associated with the behaviour. In general, a person who believes that performing a particular behaviour will lead to mostly positive outcomes will hold a favourable attitude toward performing that behaviour, and vice versa. Subjective norms are a function of a person's beliefs (i.e., normative beliefs) that specific individuals or groups, labelled as 'referents', approve or disapprove of performing the behaviour. Fishbein and Ajzen believed that in the final analysis a person's behaviour could be explained by his or her beliefs.

The work of Fishbein and Ajzen was criticised by Liska (1984) for creating a false dichotomy of volitional and involitional categories. The theory of reasoned action was later revised by Ajzen (1988) to incorporate behaviours that are not purely volitional in nature. This gave recognition to Liska's point that many behaviours may not be fully under volitional control and that control over behaviour can best be viewed as a continuum. In this context, behavioural intentions are best considered as goals whose attainment is subject to some degree of uncertainty (Ajzen 1988). There are various factors, both external and internal, which can affect a person's control over attainment of behavioural goals. Internal factors include having needed information, skills, or abilities, as well as other factors such as intense emotions, stress or compulsions. Situational or environmental factors external to the person might include lack of opportunity and dependence on the actions of others to successfully perform a behaviour.

Ajzen's (1988) 'theory of planned behaviour', an extension of the theory of reasoned action, attempted to address the problem of incomplete volitional control by adding a third independent determinant - the degree of perceived behavioural control. This determinant refers to the perceived ease or difficulty of performing the behaviour and reflects past experience as well as anticipated impediments and obstacles (Ajzen 1988). According to the revised theory, the more favourable the attitude and subjective norm with respect to a behaviour, and the greater the perceived behavioural control, the stronger the person's intention to perform the particular behaviour. Figure 1 shows a structural model of Ajzen's theory of planned behaviour. The model distinguishes three types of beliefs: behavioural, normative, and control beliefs. As with the theory of reasoned action, behavioural beliefs influence attitudes toward the behaviour; while normative beliefs are the underlying determinants of subjective norms. The new addition is control beliefs which provide the basis for perceptions of behavioural control.

Liska (1984) made additional criticisms of the theory of reasoned action which have not been addressed by Ajzen's revised model. These included that:

- The effect of attitudes on behaviour is not completely mediated by behavioural intentions. Behavioural intentions may in fact be less stable than attitudes due to greater dependence on social situations and contingencies. As the interval between the measurement of attitudes/intentions and behaviour increases, the predictive ability of attitudes, relative to that of intentions, will increase. At a certain point in time, attitudes may become the better predictor of behaviour. Beliefs and attitudes may vary independently and may independently affect intentions and behaviour. This is because human information processing, linking beliefs to attitudes, is inexact and inefficient.

- The Fishbein/Ajzen model demonstrates a recursive-chain causal structure and does not give recognition to reciprocal effects. The causal structure should be shown as nonrecursive in nature; with behaviour directly affecting attitudes, attitudes directly affecting intentions and behaviour, and intentions directly affecting behaviour.

- Contrary to the model, attitudes and subjective norms are not causally independent. They reflect similar beliefs and may influence one another. Some portion of their combined effects on intentions and behaviour may not be additive.

Weinstein and Sandman (1992) examined the linkages between risk perception, mitigation intentions, and actual actions. This research was done in the context of predicting home owners mitigation responses to radon test data. They tested the hypothesis that decisions about home mitigation should closely parallel the risk indicated by the tested level of radon in their homes. The assumption was that homeowners with levels considerably above the EPA guide-line would act promptly in adopting mitigation measures, while those with low levels should not undertake costly and futile attempts to reduce their risk levels to zero.

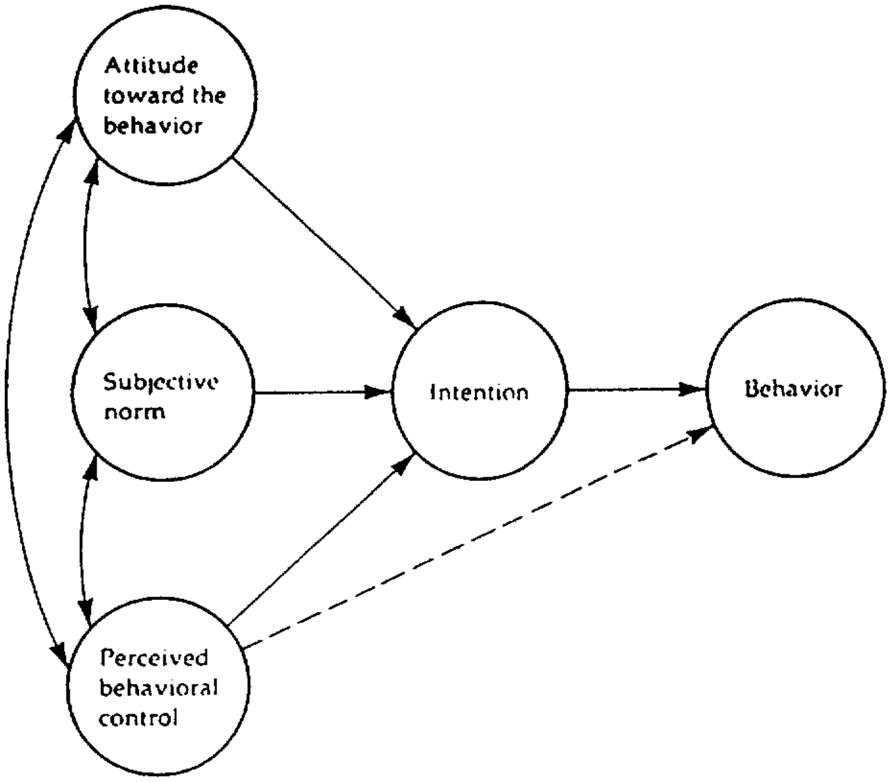

Figure 1. Ajzen's Theory of Planned Behaviour

Previous research (e.g., Akerman 1988; Doyle, McClelland, Schulze, Elliott, and Russell 1991; Mazur & Hall 1990; Sjoberg 1989) had found that mitigation usually increased with the radon level, but even at high levels there were many homeowners who did not act. Weinstein and Sandman (1992) postulated that people may respond to hazards in distinct stages by applying different variables at different points. The variables that determine whether or not a person decides he will take an action may be different from those used to determine whether these individuals actually do take the action. They found that a person's global appraisal of danger or seriousness and the actual radon level were the best predictors of mitigation intentions and actions. An individual's appraisal of danger or seriousness was in turn primarily a product of the perceived likelihood of illness and the belief that their level of risk was greater than that of others in their community. Variables that were found to have little relationship to mitigation were: general radon knowledge, beliefs about the need to act quickly, beliefs about the cost and effectiveness of mitigation, knowing others who had taken mitigation actions, and demographic factors (i.e., age, sex, education, income, number of children, length of residence).

The variables examined in their study explained far more of the variance in mitigation intentions than they did for mitigation action. They interpreted their results to mean that other factors not examined in their study were more important in determining action. Possible factors include: ready access to radon mitigation companies, reminders to act, interaction with a helpful neighbour who had already mitigated, and available free time. They suggested that lowering barriers to mitigation action might be more effective than publicising carefully constructed informational messages or issuing appeals to act.

Weinstein and Sandman (1992) also postulated that if only information about the risks of radon produced cancer were provided, without any recommended mitigation actions, the correlation between radon concentration and mitigation actions would be near zero. They believed that an effective radon reduction program would require three essential components: convincing information about the seriousness of the risk; clear action recommendations; and steps to minimise barriers to action. The authors posed an interesting, if unresolved, question when they ask if we cannot assume that, when presented with data on the magnitude of a risk, people will inevitably reach proper conclusions about risks on their own, then what limits of government intrusion in individual behaviour is warranted (e.g., prescribing obligatory action)?

Appeals to emotion (e.g., fear, pride, guilt, parental concerns) are sometimes used by risk communicators to influence the behaviour of the recipients of their risk message. However, they are not always more effective in inducing behavioural change than less emotional appeals and while they are widely accepted, they often are considered manipulative and irresponsible (National Research Council 1988).

To explain the relationship between fear appeals and attitude change, Rogers (1975) developed the 'Protection Motivation Theory of Fear Appeals'. According to this theory, individuals appraise the severity and likelihood of exposure to a depicted noxious (i.e., dangerous) event, evaluate their ability to cope with it, and alter their attitudes accordingly. Rogers' theory is based on three crucial stimulus variables in a fear appeal: the magnitude of noxiousness of the event; the probability of its occurrence if no adaptive behaviour is performed; and the efficacy of the recommended response. According to this theory, if an individual did not assess an event to be severe, likely to occur, or if nothing could be done about the event, protection motivation would not be aroused, and in turn there would be no change in behavioural intentions. No motivation would be aroused if any of these three variables equalled zero.

Manipulation of the magnitude and probability of occurrence components of fear in communication efforts can affect the perceived seriousness of a threat (magnitude manipulation) and feelings of susceptibility to a threat (probability manipulation), thereby facilitating attitude change. The relationship between efficacy and attitude change is less clear, although some empirical studies report that increases in efficacy of a coping response increased compliance with the recommended response to the hazard.

Although not included in his Protection Motivation model, Rogers postulated that other environmental and cognitive variables may be important determinants of attitude change. Variables put forward include: duration of the noxious stimulus; the time between presentation of information and the onset of the event; a response-cost factor (i.e., the painfulness of the amount of work involved in implementing the recommendation); and dispositional factors (e.g., personality variables such as anxiety and defensive style).

Much of the recent research relating attitudes to behaviour take the perspective of the individual as a nonrational actor. Rather than making rational choices among alternatives, people often behave in response to automatically activated attitudes or on the basis of how information is framed. Ronis and Kaiser's (1989) work in the health area, suggests that attitudes may in some instances, such as for repeated behaviours (e.g., smoking), be irrelevant in guiding behaviour. Only when the individual is confronted with adversity or novelty would attitudes be applied in a decision making context and determine behaviour.

With reference to the work of Timothy Wilson on reasons analysis, Tesser and Shaffer (1990) suggested that when people are encouraged to think about their attitudes, the relationship between attitudes and behaviour may diminish. Forcing people to be analytical about their attitudes could, in some but not all cases, result in an uncoupling of attitudes and behaviour (Tesser and Shaffer 1990). They saw this as one means of stopping undesirable behaviours such as smoking. They believed that by having an individual analyse their attitudes and make their values salient, and then comparing them with the values of other reference groups, could lead to lasting and desirable behavioural change. They also acknowledged that people often lack a well developed set of conscious reasons for their attitudes.

Social Amplification of Risk

Kasperson et al. (1988) examined why apparently minor risks often lead to extraordinary public concern and social and economic impacts, with rippling effects across time, space, and social institutions. They have put forward a conceptual framework for this phenomenon which they called the 'social amplification of risk'. It attempts to integrate the different and sometimes conflicting theories of risk perception that have emerged from the fields of psychology, anthropology, and sociology.

Like many other authors, Kasperson et al. felt that the technical concept of risk (i.e., the probability of events and the magnitude of consequences) was too narrow and ambiguous for the purposes of policy making since most people have a much more comprehensive conception of risk. Risk is conceptualised partly as a social construct and partly as an objective property of a hazard or event (Renn et al. 1992). They saw the challenge facing society as the need to use risk analysis in formulating public policies while recognising the inability of the current risk analysis to anticipate and explain the nature of public responses to risk (Kasperson et al. 1988).

They described social amplification as the phenomenon by which information processes, institutional structures, social group behaviour, and individual responses shape the social experience of risk, thereby contributing to risk consequences. When hazard events interact with psychological, social, institutional, and cultural processes they can amplify (i.e., either heighten or attenuate) individual and social perceptions of risk as well as shaping risk behaviour (Renn et al. 1992). As shown in Figure 2, these behavioural patterns can, in turn, create a rippling affect by generating secondary social or economic impacts (e.g., insurance costs, loss of trust in institutions). These may trigger third order impacts such as demands for additional institutional responses and protective actions, or conversely place impediments in the path of needed protective actions. Thus there is no such thing as true (absolute) risk or distorted (socially determined) risk. Risk has meaning only to the extent that it treats how people think about the world and its relationships.

Renn et al. (1992) believed that components of the decoded message which are inconsistent with previous beliefs or values of the receiver will be ignored or attenuated, while those components which are in agreement will be intensified. They are critical of the risk perception research which focuses only on the individual, for failing to explain why individuals attend to certain risk characteristics and ignore others. Consistent with the cultural theory of risk (e.g., Douglas & Wildavsky 1982), they see the role of the individual as only part of the story since individuals also act as members of larger social units that codetermine the dynamics and social processing of risk.

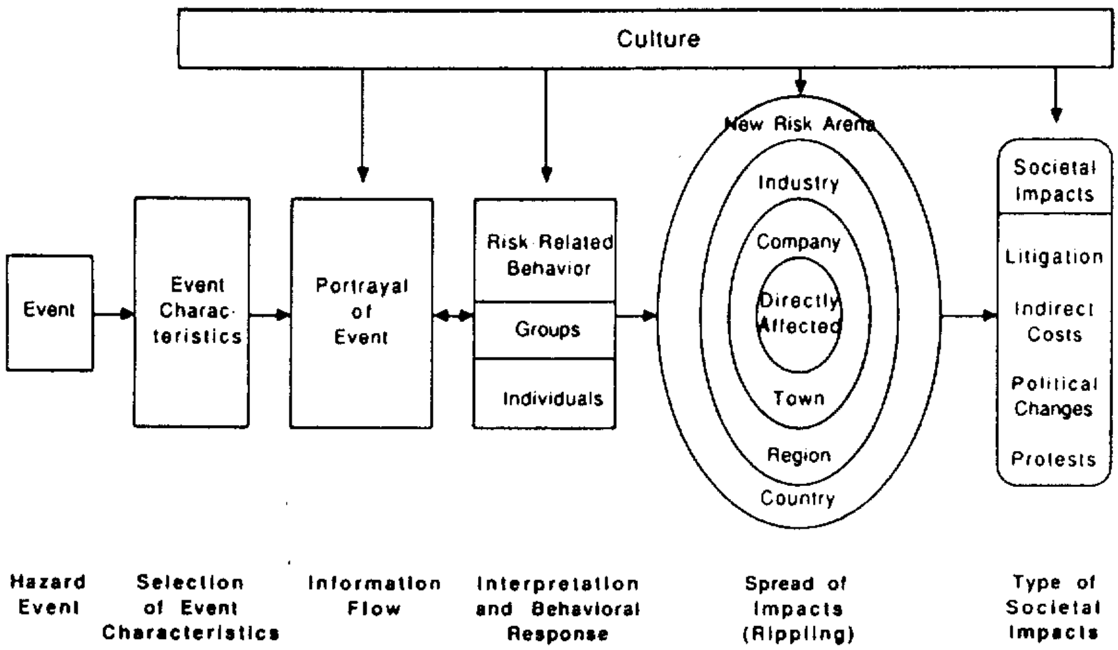

Figure 2. The Social Amplification of Risk (Renn et al. 1992)

Renn et al. (1992) noted that individual and societal risk experience appears more strongly related to exposure than the actual number of casualties. Yet it is the latter on which most risk assessments are based. This means that an exposure of a few people resulting in several casualties is likely to be less influential than an exposure of many people that results in minor injuries or only a few casualties. They postulated that the gap between expert and lay risk perceptions may be an expression of a different strategy for determining the seriousness of a hazard. Rather than use the magnitude of the risk as a yardstick for risk evaluation as experts do, lay persons may use exposure to risk as their yardstick for assessing the seriousness of a risk. They also found little support for the hypotheses put forward by Peltu (1988) that risk perception is merely a mirror of media coverage. Although their work indicated that dread was clearly related to media coverage, most of this effect could be explained by the intervening variable of exposure.

Hazards and Stress

The literature on the stress experienced by persons following or facing the prospect of a natural or man-made disaster or threat reveals striking similarities with the risk perception literature. The stress literature provides a link between people's perceptions of possible risks and how people actually react when they are faced with or experience the risk first hand. Messages found in the stress literature include the tendency for individuals to overestimate the amount of personal control they can exert (Thompson & Spacapan 1991). The parallel in the risk literature is that, in general, individuals believe themselves to be less vulnerable to risks than the average person (e.g., Covello 1989). For example, most people rate themselves as better than average car drivers.

Similar to the risk perception literature, the stress literature distinguishes between natural and technological disasters (e.g., Baum, Fleming & Davidson 1992). Bell et al (1990) found that while they may be stressful in the short term, chronic stress or psychiatric impairment due to natural disasters is rare. By comparison, technological disasters can generate chronic stress as was the case with the discovery of contamination at Love Canal in New York State and the nuclear accident at Three Mile Island (TMI) in Pennsylvania. Research by Baum, Fleming, and Davidson (1983) identified stress effects among some TMI area residents 15 to 22 months after the accident.

It appears that technological risks threaten our sense of control more than do natural disasters, despite the fact that natural disasters are inherently uncontrollable while technological disasters represent an occasional loss of the control humans usually have. Bell et al. (1990) suggested that technological disasters are more disquieting because they shake our confidence in our ability to control events in the future. Technological disasters can reduce general perceptions of control and lead to chronic stress (Davidson, Baum, & Collins 1982). Baum et al. (1992) suggested that the loss of control associated with technological disasters may generate more lasting feelings of helplessness than for an event such as a natural disaster for which no control existed to lose.

Rochford and Blocker (1991) described the past typologies and comparisons of natural and technological disasters by authors such as Baum, Fleming and Davidson as overly simplistic and conceptually imprecise. They demonstrated that in the case of some flood disasters, which are typically viewed as natural and uncontrollable, they may be interpreted by victims as unnatural and controllable. During the 1986

Oklahoma floods, unprecedented rainfall exceeded the capacity of the U.S. Army Corps of Engineers flood control lakes creating extensive flooding. Although such flooding would technically be classified as a natural disaster, residents believed that the flooding could have been avoided or reduced had the Corps of Engineers made better decisions regarding reservoir releases, predictions, and communications with other agencies. Thus, researchers should not assume that individuals will interpret natural events as uncontrollable. Rochford and Blocker (1991) argued that there is an increasing tendency for disaster events which were previously viewed as natural and uncontrollable (e.g., floods, earthquakes, volcanic eruptions) to now be interpreted as within the bounds of scientific prediction, if not control.

Studies by Steinglass and Gerrity (1990) of post-traumatic stress disorder in communities hit by natural disasters revealed substantial levels of short-term stress symptoms which diminished significantly within 16 months of the disaster. Women experienced higher levels of both short and long-term stress. Surprisingly, they found that psychological recovery and community recovery appeared to be unrelated in the two communities they studied.

Warheit (1988) has reviewed the posttraumatic stress disorder literature and revealed an ambiguous set of conclusions. He found that some studies reported widespread stress-related symptoms for indefinite periods of time following a disaster. But a second group of studies found some evidence of acute stress reactions which were usually mild and short term in nature. A third group of studies found evidence of both short and long term stress, however most of the affected individuals already had a history of psychological problems. There were also a number of studies which suggested that disasters may actually reduce levels of psychological distress because the communities in these studies typically display higher than normal levels of cohesiveness and altruism which enhanced a sense of stability and well-being.

Hallman and Wandersman (1992) found that a variety of sources can generate stress when dealing with a hazard. Some sources stem from the hazard itself, such as: worrying about potential health problems; dealing with uncertainty due to the fact that many threats are invisible to our senses; and feelings of lack of control over the hazard. Other sources of stress come from the social interactions typically associated with risk conflicts such as: dealing with the actions of others, including those who are officially responsible for solving the problem, those who caused the problem, and those from the community involved in efforts to do something about the hazard. Additional sources of stress can result from efforts to help others cope with their stress; the attentions of the government and media; and the stigma sometimes attached to individuals and communities involved in contentious risk debates.

Environmental threats can create stress in communities and in some cases it is severe enough to create measurable psychological problems. When people are faced with a threat they respond both individually and collectively in ways that are identifiable. Lazarus and Folkman (1984) found that individuals respond to threatening situations by adopting one of two coping strategies: problem focused coping or emotion focused coping. Problem focused coping attempts to change the situation to make it less threatening, while emotion focused coping attempts to manage emotions that arise in response to the threat.

While it has been postulated that individuals may in fact use both coping strategies simultaneously, an individual's primary coping strategy is usually determined by whether they assess the situation to be alterable (Hallman & Wandersman 1992). Researchers have found that the greater the distance a person lives from a threatening industry the less they perceive the risk. Yet people who live very close to a 'risky' facility, and who are presumably exposed to the greatest risk, often do not perceive the risk to be great (Covello 1988). One factor that may contribute to this is cognitive dissonance (Festinger 1957). Those living closest to the facility are likely to experience cognitive dissonance if they believe the facility to be dangerous. To cope they revise their judgement about the facility's level of safety.

Uncertainty denial could be an additional factor (Fischhoff et al. 1981, McClelland, Schulze & Hurd 1990). Many people have difficulty grappling with the uncertainty associated with risk estimates and one way of coping with uncertainty is to deny its existence. In doing so they make the risk seem so small as to be ignored or so large that it clearly should be avoided.

When faced with a perceived threat community members turn to social groups in an attempt to cope with a threat. This may take the form of turning to their established social network (e.g., friends, relatives, co-workers) or to institutional networks (e.g., government agencies). Unfortunately social networks often prove inadequate in the face of threats, resulting in victim blaming, ridicule, and stigmatization. Hallman and Wandersman (1992) contended that government responses rarely prove satisfactory and their actions frequently disable citizens by failing to keep them fully informed and excluding them from decision making. This limits people's sense of control over their fate and a loss of trust in government officials (e.g., Creen 1984). When existing social networks and institutional networks prove inadequate, people often form a new network by forming a citizen action group.

Media Influences

Much has been written about the media's role in risk communication (e.g., Peltu 1988; Sandman 1987; Tyler & Cook 1984) since it is from the media that most lay people receive their information about risks. A 1984 survey conducted for the Canadian Department of National Health and Welfare found that the news media was the main source of health risk information. It was consulted by the public three times as often as any other single source. Interestingly, it rated lowest in terms of credibility.

The Decision Research team concluded that the media affects people's judgements of risk not only because of what they don't report (successful plane trips or reactor operations), but because of what they do report to a disproportionate extent (Lichtenstein et al. 1978). It is sometimes the case that disasters and accidents with the greatest severity do not receive the greatest amount of coverage. Sandman (1987, 1988) believes that the media give greater coverage to dramatic and sensational events because they are more interested in outrages than hazards. The characteristics of outrage are: something exotic; memorable; dreaded; unfair; highly focused in time and space; and imposed on people against their will often by treacherous officials. These characteristics closely match those described by Fischhoff et al. (1981) as those applied by people when developing their perception of a risk. Fischhoff et al. found that, when reporting on health and environmental risk issues, the media focused on the same concerns as the public (e.g., catastrophic potential, voluntariness, etc.). They also tend to focus on disputes among experts and authorities in coping with disasters and crises and to events with the greatest signal value. The media is also influenced by factors such as photographability and "human interest".

There are many factors which come into play when assessing how the media affects our perceptions of risk. It has been suggested that those who are regularly exposed to media are not inclined to accept the reality portrayed in the media when it conflicts with information obtained through a personal source (Cozzens & Contractor 1987). Research by Cook et al. (1983) on the effect of news reports on the views of the general public, policy makers, and interest groups indicated that these groups were impacted differently by the same news stories. Tyler and Cook (1984) examined the impact of the media on individual's attitudes toward firearms and drunk driving at both an individual and societal level. They found that the media coverage changed people's beliefs about the importance of these risks to society at large, but not on the individual's estimated risk of being personally affected.

Mazur (1981) reported that the quantity of coverage, as opposed to its quality or content, is of more importance in influencing perceptions toward controversial technologies such as nuclear reactors. People with an anti attitude toward nuclear energy for example will become more anti when the volume of media coverage increases regardless of whether or not the coverage is about nuclear power or bombs, or highlights the benefits more than the disadvantages.

Sometimes incidents which receive widespread media coverage, such as Three Mile Island, Bhopal, Chernobyl, Love Canal, or Wittenoon, become cognitive markers of danger (National Research Council 1989). They reach out beyond the media coverage they receive to become part of the cultural consciousness of many people, even those who know little of, or paid little attention to, the original incidents (Slovic 1987). McDaniel's (1988) comparative study of risk perceptions of nuclear power prior to and shortly after the accident at Chernobyl indicates that a single event can alter risk perceptions, at least in the short term. However another study of the impact of the Chernobyl accident indicated that experience with a major accident can decrease rather than increase perceptions of threat (Lindell & Perry 1990).

Chapter 3

Acceptable Risk

Introduction

Whereas Chapter 2 focused on the factors which play a role in determining our perceptions of risks, this chapter examines the risk literature pertaining to risk acceptability. What makes a particular risk 'acceptable' and acceptable to whom? The failure of decision makers in many Western countries to be able to resolve issues of risk acceptability has lead to a shift away from sole reliance on technical risk assessments toward decision making strategies which also focus on the socio-political aspects of risk such as trust, equity and control. For example the findings of procedural justice research are increasingly being applied in facility siting exercises. Yet in a society which is increasingly losing confidence in its governments, these approaches have met with only limited success to date.

Risk framing is discussed in some depth in this chapter since resolving a social conflict over risk may not be possible unless the various parties adopt a similar or compatible framing of the risk issue. Most risk communication efforts fail to examine or respond to differences in the manner in which people frame a risk issue yet this is at the core of many risk disputes.

This chapter introduces the relationship between risk communication and risk management. The literature review highlights that risk communication efforts which focus on the technical presentation of risk information while ignoring the socio-political processes are inadequate and typically reflect a very narrow definition of risk communication.

While the majority of decision making literature examines how people should make decisions, far less of the literature evaluates how people do make their decisions in the real world. Yet it is the second question which is of particular interest in this thesis. Janis and Mann's (1977) 'conflict theory of decision making' is highlighted and leads into a discussion of NIMBY disputes which display many of the decision making characteristics described by Janis and Mann.

The final section of this chapter examines the NIMBY syndrome, its characteristics and the various responses which decision makers have adopted. While some decision makers have chosen to place greater reliance on quantitative technical risk assessments which can be portrayed as value-free, even though they are not, others have adopted more participatory approaches.

A Question of Values

Many risk communication efforts attempt to educate the public so that their risk perceptions are in agreement with those of the experts. In fact they want to go one step further. They want the public not only to agree on the degree of risk posed by a technology or activity but to agree that the degree of risk is acceptable. This is a different issue since one may agree on the consequences and probability of an event but not as to its acceptability. While debates over acceptable risks are often characterised as interest groups versus technical risk experts, it is not uncommon for the technical experts to end up debating one another. When this situation arises it creates confusion within the public who are left not knowing which experts they should believe.

MacLean (1982) argued that activities which involve great risks, and decisions that impose risks on other people, demand justification. The traditional technical approach to determining or justifying acceptable risks is the use of risk comparisons to help distinguish acceptable from unacceptable risks. This approach has been promoted by researchers such as Cohen and Lee (1979), Wilson (1979), and Crouch and Wilson (1982). These researchers developed a variety of tables, using a range of scales, which displayed the risk attached to a diverse set of activities. Their position was that the meaning of any new risk can best be established when presented in a comparative context. Cohen and Lee (1979) argued that the ordering of the risks in these risk tables is an approximation of society's ordering of priorities and thus provided a basis for making decisions regarding the acceptability of a new risk. Such decision making was viewed as justified because the public has implicitly accepted the new risk by having implicitly consented to identical levels of risk in other areas. This technical approach has steadily lost favour in the face of criticism that consent in one area of risk cannot be taken to justify a choice on another area (MacLean 1982). The issue of acceptability cannot be reduced to the probability that one will be harmed or killed by a specific cause.

Increasingly, risk issues are viewed as questions of values (Conrad 1980). Yet quantitative models of risk, including comparative risk assessment, disregard the many value issues embedded in risk analysis. Hyman and Stiftel (1988) argued that in environmental impact assessments, the probabilities of significant hazardous impacts should be quantified to the extent feasible but value judgements regarding risk acceptability should be left to decision makers who are in contact with the full range of public opinion.

Ruckelshaus (1983) believed that in societies in which democratic principles dominate, the perceptions of the public must be weighed. Instead of objective and subjective risks the experts sometimes refer to real and imaginary risks. He pointed out that there is a certain arrogance in this - an elitism that has ill served us in the past. Rather than decry the ignorance of the public and seek to ignore their concerns, governmental processes must accommodate the will of the people and recognise its occasional wisdom.

The phrase 'acceptable risk' poses a fundamental question: Acceptable to whom?. Decisions to impose a given risk are often taken by those who find the risk acceptable, at least in part, because they will not have to bear the consequences. Douglas (1985) saw the question of acceptable standards of risk as part of the question of acceptable standards of morality and decency.

Since Fischhoff et al. (1981) viewed acceptable risk as the risk associated with the most acceptable solution to a particular decision problem, they felt the term connoted contingent acceptability rather than absolute acceptability. Decision makers using different decision rules, believing different information, or considering different options could make quite different decisions regarding what options and associated risks to accept. As a result there are no universally acceptable options or risks. In particular, no level of risk can be specified such that risks less than that level are acceptable and risks greater than that level are unacceptable. Yet many environmental regulatory agencies have done just that. The Environmental Protection Authority of Western Australia (EPA) has defined as acceptable a risk that can be reduced to a level that the community is prepared to tolerate (EPA 1987). For proposed industry, an individual risk of fatality in residential zones of less than 1 in a million per year is so small as to be considered acceptable by the EPA.

This approach of assigning a 'magic number' to denote an acceptable level of risk for a whole range of activities is somewhat at odds with the position of Otway (1990) and others who believe that the acceptability of a risk cannot be judged apart from its economic, psychological, social and political effects. Debates about acceptable levels of risk are sometimes really a proxy or surrogate for other social, political, or economic issues and concerns. Covello (1984) gave the example of nuclear power which was less a debate about the specific risks of power generation than about other fears and concerns such as the proliferation of nuclear weapons, the adverse affect of nuclear waste disposal, the value of large scale technological progress, and the centralisation of political and economic power in the hands of the technological elite. Conrad (1980) contended that questions of individual and public risk acceptance should be discussed only against the background of the role of technologies in their respective societal context. For better decisions to be made, the usual form of decision-making by technocratic elites has to be changed.

Rather than acceptable risks, O'Riordan, Jungermann, Kasperson, and Wiedemann (1989) talked about 'tolerable' risks. The concept implied that people will never accept some risks, but they may tolerate them provided the following conditions are met: (1) that they believe the risks are reduced, and shown to be reduced, to levels as low as practical; (2) that the benefits are clearly in the public interest; and (3) that appropriate measures are at hand to cope with post-accident effects on health, well-being, and community image.

An increasing number of authors are viewing questions of risk acceptability as deeply connected to perceptions of fairness and justice, from both process and institutional perspectives (e.g., Plough & Krimsky 1984; Armour 1993). Many articles have been written on the reasons for community opposition to proposed facilities such as hazardous waste facilities and much of this literature has, over the last 5 years in particular, focused on the issues of trust and fairness in decision making (e.g., Armour 1993). Three factors that explain the public's level of trust with governmental and scientific risk assessments are: the acceptability of the procedures used to obtain collective consent; the acceptability of how the liabilities / risks are to be distributed; and the level of trust in the institutions that will manage and regulate the technology. While Fischhoff et al. (1978) ask "How safe is safe enough?", Pijawka and Mushkatel (1991) ask "How fair is safe?" Again highlighting the importance of establishing organisational legitimacy in the eyes of the community when trying to either site risky facilities or implement risk management measures. Pijawka et al. (1991) have written about the 'risk shadow' effect on proposed projects which results from public perceptions of an agency's mismanagement of past projects.

Along similar lines, Syme and Nancarrow (1991) contended that issues of trust and fairness of process play an important role in community perceptions of acceptability. Studies by Williams and Syme found that trust in authorities was as, or more, important to perceived satisfaction with water quality than the actual physical quality of the water (1989). Treating the community in a way that is seen by them to be fair may provide a measurable criterion for judging the 'social legitimisation' of risk decisions (Syme & Nancarrow 1991).

Although there may be good, valid, and functional reasons for gaps between expert and lay risk perceptions, the reasonableness of the different perspectives often gets lost during the adversarial contests typically associated with risk issues (Fisher & Ury 1981). Dake and Wildavsky (1990) see the adversarial context as distracting adversarial parties from seeing that their respective perspectives may represent some part of the larger truth about hazards. They concluded that knowledge about physical dangers made no difference to risk perceptions, not even those held by the risk experts. More important are factors relating to the adversarial nature of risk issues such as trust in institutions, cultural values, and one's own political orientation. Wildavsky (1991) asked what will become of a country (i.e. the USA) and people who base decisions involving hundreds of billions if not trillions of dollars, not on the best risk comparisons, but rather on confusion over whether they are hearing science or ideology or both.

Fischhoff et al (1981) identified five complexities that characterise decisions regarding risk acceptability:

(a) uncertainty about how to define the decision problem;
(b) difficulties in assessing the facts of the matter;
(c) difficulties in assessing the relevant values;
(d) uncertainties about the human element in the decision making process; and
(e) difficulties in assessing the quality of the decisions that are produced.

Persistent debates about environmental or health risks stem from different belief and value systems and often demonstrate difficulties in: how to define risk and related concepts; how heavily to weight the various factors (e.g., economic, social, environmental) considered in risk acceptability decisions; and how to frame the risk issue (Vaughan & Seifert 1992). The difficulty for the risk communicator is that there is no consensus in society regarding any of these themes.

The courts in the United States have, on occasion, acted as a decision maker with respect to risk acceptability. Vig and Bruer's (1982) review of the court's role in risk policy in the United States, found the judiciary to be unclear as to its role in the decision making process. The U.S. judiciary has struggled with many of the same problems faced by policy makers. The courts have also been asked to rule on hazard communication rules established by the US federal Occupational Safety and Health Administration which requires that certain standard forms of communication be used to provide workers with risk information (Baram 1988).

Despite hesitation on the part of the judiciary to become involved in resolving risk policy issues, it is hard to imagine that they will not increasingly be asked to do so as they become a favourite avenue of recourse for those who view themselves to be on the losing end of risk decision making.

Trust and Procedural Justice

Is it actually the case that society is increasingly unwilling to accept new risks or is it merely a symptom of another problem - mistrust in decision-makers and more specifically mistrust in government? The asbestos debacle, both in Australia and in North America, is but one example of why citizen confidence that government will protect their interests over those of industry has been eroded (Twight 1990). Although the health risks associated with asbestos were documented in US Government reports as early as 1918, it was not until the 1980s that the federal government shifted from the role of promoter to regulator of asbestos. A prime reason is that by the 1980s the media had lifted the public profile of the asbestos issue, making it more worthwhile for legislators to seek votes as environmental purists than to cater to asbestos industry interests as had been the case up to that point. If the public is now unwilling to accept information from industry and government about new risks, it is not surprising, as by their past actions, that they have earned public mistrust.

It has been said that risk analysts are distrusted, appear to distrust one another and inspire little public confidence (Popper 1983). This may be putting it mildly. It is not just the risk analysts, it's the decision makers, the regulators, and even the public.

After all trust is a two way street. While the public may distrust those who have influence in the decision making process, these same parties do not trust the public and in particular interest groups. The inter-related issues of trust and procedural justice in relation to risk have attracted considerable attention in the risk literature in recent times (e.g., Sandman 1988; Armour 1991; Pijawka & Mushkatel 1991; Bishop & Syme 1992).

Covello, Sandman and Slovic (1988) contended that almost any accurate risk comparison will work if the agency making the comparison has established trust and credibility with the people in the community. However even the best risk comparison will fail if the agency has low credibility, inspires no trust, or has no relationship with the community.

Fessendon-Radon, Fitchen and Heath (1987) found that when residents trusted local public and corporate officials, they were more likely to accept official risk communications about hazards. However, if trust was low, residents appeared sceptical of risk communications from these sources and were more likely to seek information from other sources.

Fiorino (1989) contended that to cope with the complexity and uncertainty of risk issues, the lay public ties their confidence in risk assessments and risk management proposals to their trust in institutions. He viewed this as analogous to the surgical patient who evaluates competing medical advice based in part on evaluations of the perceived competence and professional integrity of the surgeons. Konheim (1988) distinguished between trust in institutions and trust in individuals. At a time when trust in institutions, both public and private, is at an all time low, she contended that the conscientiousness and expertise of an individual is more important to the public in building credibility than the credentials or experience of the individual's agency.

Risk management and risk communication are closely linked. As Renn and Levine (1988) noted, a bad management record cannot be compensated by an excellent communication effort. They also highlighted the important role of trust in the communication process distinguishing between message, person, institution, and social climate. They proposed a number of principles for gaining trust in risk communication programs by applying the findings of the relevant psychological and sociological literature on trust and credibility in communication. First, the credibility of an institution will be closely linked to its perceived past performance and its openness toward public demands. Unfortunately for many organisations, it is not just the past trustworthiness and credibility of their organisation that is important. A company wanting to establish a new facility will pay, in terms of public trust and credibility, for the sins of any of their predecessors even if they have no relationship to the other organisations. The issue of trust in institutions may be global in scale. Vogel (1986) argued that the apparent heightening of public sensitivities about environmental health issues in the U.S.A. are related to a loss of confidence in major social and political institutions and hostility toward big corporations such as multinationals.

Renn and Levine (1988) recommended that in a climate of general distrust toward social organisations, the provision of public access to all relevant information and acceptance of some public control can counteract public suspicions of hidden agendas and create a microclimate of trust and credibility. In order to make the message attractive it is important to match the message to the concerns of the targeted audience. They divided risk debates into three types: technical debates which focus on good science; institutional debates; and value debates.

Bord and O'Connor (1990) examined risk communication with respect to the issue of food irradiation, a technology often perceived as risky. The variables in their experiment were risk message characteristics, respondent background characteristics, knowledge, and attitudes. They wanted to find out which factors have the greatest influence on ordinary citizens when making risk decisions. They found that people appeared to be willing to take personal risks that they would not want imposed on their family or the wider public. Technical information had little impact on acceptability while information about users and prestigious endorsers increased favorability. Regression analysis revealed a strong relationship between trust and acceptability: trust in industry, in the food irradiation industry, in government regulatory agencies, and in science itself. Bord and O'Connor suggested that effective risk communication may be more a problem of ensuring trust than it is an issue of explaining risk/benefit analysis in lay terms. Along similar lines, Otway (1990) believed that the main product of risk communication is not information but, rather, the social relationship it supports.

There is no doubt that many risk experts in their dealings with the public, carry a visible aura of arrogance that says "Trust me, I'm an expert." It also conveys other messages to the public - that they are perceived as irrational, naive, and not capable of learning. They are told they should not worry about such complex issues but leave them to the risk experts. Yet risk debate after risk debate has shown that while a local community may have no expertise or limited understanding at the commencement of a risk debate, citizen groups are very good about doing their homework when it comes to risk debates affecting their communities. Either they will educate themselves or they will bring in their own experts to support their assessment of the situation. In addition, it isn't true to say that the public are not experts, for they are. They are experts on their community. There have been innumerable cases in which risk experts have been embarrassed when a local community member points out an important missing factor simply because the experts do not know the community. Risk experts like to use models and sometimes do not even use local data to run these models, simply assuming what is applicable in one context is applicable in another. When they are "caught out" by the community, their credibility is doubly hit because their error was obvious to anyone living in the local community.

Otway and Wynne (1989) have referred to risk communication guides such as Covello, Sandman and Slovic's (1988) as etiquette books for risk communicators. This is an appropriate comment given the omission from the handbook of any reference to, or guidance on how to respond to, the types of questions that proponents and consultants repeatedly get asked by residents living in the vicinity of a proposed site for a risky facility. These questions typically relate to issues of trust and equity, often taking the form of "Would you live here?"

Kasperson, Golding and Tuler (1992) embraced a broad based, multidimensional concept of trust. They viewed trust as a person's expectation that other persons and institutions in a social relationship can be relied upon to act in ways that are competent, predictable, and caring. Trust operates simultaneously at cognitive, emotional, and behavioural levels. It is a social phenomenon that is probably never completely or permanently attained and requiring continuous maintenance and reinforcement. Four key dimensions of trust are: commitment, competence, caring and predictability.

They noted the paradox that risk communicators typically face when dealing with the issue of trust. Actions to build trust on one level or dimension may result in a corresponding loss of trust on another dimension or level. They give the example of an agency which decides to open up its decision making processes and information. Yet since research often proceeds through incomplete results, false starts, and gradually developing data bases, a decision to provide information to the public during the early stages of a decision making process could increase public perceptions of a lack of credibility and competence in the research, leading to decreased levels of social trust. They contend that substantial uncertainty exists as to whether improvements along one dimension or level of trust will outweigh decreases in trust along another. They do note, however, that while the early release of developing information can lead to diminished trust, on balance, the damage associated with openness is easier to address than the damage associated with concealment.

Controversies over contentious risk issues, such as hazardous facility sitings, are less about risk than they are social trust crises about institutions. Unlike other authors who have encouraged efforts on the part of decision makers to re-establish trust, Kasperson et al. (1992) take a more pessimistic outlook. They describe attempts to communicate about controversial risks which are predicated upon efforts to regain social trust as naive at best and self defeating at worst. Once trust is lost, it may require a lengthy process of confirmatory experience along multiple dimensions of performance to re-establish. The unfortunate reality is that the recovery of trust is probably not achievable within the time frame of most risk communication efforts. They contended that the key to designing processes to overcome social distrust is extending the sharing of power in the management of the risk to the risk bearers.

They viewed narrow conceptions of risk communication as inadequate in situations of high social distrust. Yet their recommended solutions would appear to do little to overcome the problem of insufficient time to re-establish a trust relationship. They advocated that risk communicators: seek broad, early public participation; develop a strong listening capacity; establish two way communication; be sensitive to the social fabrics of participants and the symbolic meaning of their language; recognise the limitations and uncertainties of studies; remain open to criticism; incorporate indigenous and independent expertise; use a variety of communication strategies to reach the full spectrum of publics; and implement a program of participatory evaluation that begins before the initiation of the communication program. They viewed the role of the risk communicator as not one of passing judgement on public perceptions but of recognising the reasons for the divergence and acting on them.

Lind and Tyler's (1988) procedural justice research identified a number of relations of importance to the social conflict arena:

- In most situations procedural justice judgements lead to enhanced satisfaction. This effect is especially strong if the outcomes of the process are negative.
- Procedural justice is one of the most important factors applied in determining which processes will be preferred by those affected by a decision.
- Procedures are viewed as fairer when they vest process control or voice in those affected by a decision.
- Judgements of procedural justice (i.e., fairness) enhance the evaluation of authorities and institutions.
- Procedural justice affects behaviours (including disputing behaviour, compliance with decisions, and task performance) as well as attitudes and beliefs.
- Procedural justice involves more than questions of how decisions are made. It also involves questions of how people are treated by authorities and other parties.
- The opportunity to express one's point of view, in itself, enhances procedural justice judgements.

It seems logical that risk communication efforts would be more acceptable to people if they meet their criteria of procedural fairness. A number of procedural fairness criteria have been established: consistency, bias suppression, accuracy, correctability, representativeness, and ethicality (Leventhal 1980). The literature suggests that the meaning of fairness changes in accordance with the nature of the problem, however, for a particular problem setting, people can generally agree on the criteria that should be applied to determine procedural fairness (Tyler 1990). Tyler (1988) suggested that the meaning of procedural fairness within a particular setting will reflect shared social beliefs.

Studies by Lipkus (1992) indicated that subjects are sensitive to issues of betrayal (e.g., breaking promises, violations of trust) whether they be matters of personal ethics or explicitly stated codes of conduct (e.g., accepted procedures or standards). Violations of this type result in a person's loss of faith in those parties who have committed the violation. Individuals also perceived an event as unjust if they feel they have been falsely accused or blamed for the misdeeds of others or if a person's sense of control is threatened.

Approaches to resolving risk and social conflicts that rely heavily on procedural justice processes are currently receiving strong support in the risk management and facility siting literature. Facility siting approaches in North America currently embrace procedural justice processes. In many respects such approaches which include extensive public involvement throughout all stages of decision making and implementation are considered to be the best means of breaking the facility siting gridlock that has occurred in North America (e.g., Siting Task Force 1990).

Framing Risk Issues

A major difficulty with risk communication efforts is that the public and experts are often talking at cross purposes. For instance, the experts may be attempting to convey the risks associated with a technology and the best location for it while the public often wants to talk about the more fundamental issue of the need for the technology in the first place. As Popper (1983) pointed out, the basic question of whether or not a technology or facility should be produced at all never gets a fair hearing in risk analysis. The issue of need is often glossed over with generalised statements about the proposal being for the public good. Whether or not it truly constitutes a public good is rarely seriously investigated.

Weterings and Van Eijndhoven (1989) found in their risk communication research that while data uncertainty and the complexity of information in risk assessments were problems, the problems of communication would not be simply solved by better presentation. They have found, as have other researchers (e.g., Wynne 1982,1983; Renn and Levine 1988), that although a dispute may be about a certain type of risk such as a health risk, the core of the dispute is often not the assessment of risks but other issues such as power in decision making. Public reactions to technological risks are more a reaction to the institutional relationships that are part and parcel of the technologies. Weterings and Van Eijndhoven contended that the manner in which residents react to an authority's interpretation of a risk assessment will depend significantly on the degree to which the interpretation accommodates their specific problems and concerns.

Wynne (1983) contended that most conflicts over technological risks reflect different assumptions about the nature of technology. The technical experts, policy analysts and decision makers viewing technology as a physical entity whose risks are separate effects which can in principle be controlled if the necessary arrangements and commitments are made. In contrast, those with a social view of technology view the social relationships which embody the technology as the most relevant aspects. Wynne argues that the social model corresponds with a rational rejection of the technical agenda of risk and policy making that restricts itself to the matters of physical risks and effects. Opposition arises in response to a feeling of lack of control and yielding of people's fate to decision making elites.

To date there is relatively little discussion in the risk perception or communication literature on how to tackle value debates although there is acknowledgement that they are the most difficult. What has typically happened is to try via the risk communication program to skirt around the value issues by focusing the attention on the technical and institutional aspects of the risk issue although at the end of the day the value issues may be at the core of the problem.

Multiattribute utility measurement has been used as a tool for clarifying public values in risk debates (Edwards & von Winterfeldt 1987). For a given problem, the values of the various stakeholders were arranged in a hierarchical fashion into a values tree, with general values at the top and specific criteria at the bottom. They identified three uses for such an approach: helping to structure criteria and assess trade-offs in the process of evaluating options; aiding in diagnosing the nature and extent of a value controversy about a risk related decision; and assisting in the resolution of value conflicts.

The foundation for conflicts about risks may lie in the different ways that individuals initially frame risk problems (Vaughan & Seifert 1992). The risk framework has implications for risk evaluation, but also for which solutions eventually will be seen as viable in policy disputes, what information is considered useful in reaching a decision, and how legitimate opposing views are judged to be. How we frame a risk issue can influence, by amplifying certain situations and beliefs, how we filter or process a risk communication as well as our choices and preferences in situations of uncertainty (Nelkin 1989; Fischhoff 1983; Tversky & Kahneman 1981). Resolving a social conflict over risk may not be possible unless individuals adopt a similar or compatible framing of the issue or reach some negotiated common framework (e.g., Snow et al. 1986).

Differences in the language used by experts and lay persons reflect the gap created by framing risk differently. For instance lay persons talk about 'accidents' while experts use the neutral term 'events'. The language used by experts to label risk perceptions is also symptomatic of the gap between expert and lay views of risks. The expert's assessment of a particular risk is often referred to as the 'real' or 'technical' risk, while the lay person's assessment is typically deemed the 'perceived' risk, a term which automatically devalues their position. This also ignores the fact that even if risk beliefs are not accurate in a technical sense, they can still result in impacts which are very real (e.g., loss of property values) (McClelland 1990).

Within a society, individual differences in the framing of risk issues will exist. The way an individual frames a risk issue will be influenced by factors such as: the format of presented information (e.g., Levin, Johnson, & Davis 1987); social norms; personal characteristics including a priori beliefs and values, past experiences; and the sociocultural context (e.g., Tversky & Kahneman 1981; Nelkin 1989). While each individual will frame the issue in their own way, how risk issues are publicly framed in risk debates often reflects the values, worldviews, or institutional affiliations of the decision makers (Vaughan & Seifert 1992). Social conflict is likely when groups differ in how they frame the risk issue. When such differences exist in an atmosphere of mistrust the conflict will be heightened with accusations of hidden agendas and narrow self interests.

Difficulties with issue framing are often at the core of facility siting disputes. Lidskog (1993) examined the role of risk issue framing in the successful siting of a centralised facility for hazardous waste in Sweden. From the facility siting literature, he identified six general views or perspectives commonly applied in facility siting exercises:

1. As a rational and scientific planning exercise (e.g., national interests take precedence over local interests);
2. As an intergovernmental tussle between local self-government and central government.
3. To view the siting as a question of spatial concentration and distribution of risk.
4. As a conflict between private rights and public interest.
5. As planning in a domain of uncertainty.
6. As a problem of production rather than as a problem of location (e.g., Freudenberg & Steinsapir, 1991).

Lidskog concluded that locational conflicts arise when different actors hold different definitions and perceptions of the issue at hand. He argues that merely having the right to express one's opinion does not make a person a legitimate actor in the siting process. Equally important is the extent to which the actor's perspectives of the issue are viewed as legitimate and integrated in the planning process which precedes a decision. In the case of the Swedish hazardous waste facility, the local opponents to the siting were largely ineffective because they held different perspectives on the siting issue than the proponents of the facility (i.e., company, federal government agencies, local government) which held the rational and scientific planning perspective. In contrast the local opponents focused on the perspective of spatial concentration and distribution of risk, by highlighting concerns regarding the impact of emissions on the health of nearby residents and on the local environment. They also focused on the issue of private rights versus public interest and the issue of distributive justice. The proponents of the site were successful because they were able to have their perspective of the issue dominate that of their opponents. As a result the local opposition's perception of the facility as threatening to their health and environment, received no serious consideration from the decision making authorities.

A frustrating aspect of risk framing is the fact that it represents a dynamic process which means that over time individuals may change how they frame an issue (Heimer 1988). This can lead to situations in which after initially accepting a solution (e.g., a policy, plan, or management strategy) that was compatible with their original framing, stakeholders subsequently reject the solution because it is no longer compatible with their new framing of the issue.

The framing issue has significant ramifications for risk communication efforts. If those receiving a risk message hold a dissimilar frame to those producing the message, the information provided in the risk communication, regardless of its quality, may do little to narrow differences (Vaughan & Seifert 1992). This is because information that is compatible with one framework may well be judged as useless by those holding another conceptualisation of the risk issue.

An example is risk experts presenting aggregate risk estimates to affected community members. This will often frustrate individuals who have framed the issue in terms of personal risk. The presentation of risk data can increase conflict if those receiving the information possess a different perspective on the question of who are the victims or at-risk population, or if the data is presented as societal risk as opposed to individual risk. Nelkin (1989) has observed that formal risk assessments generally fail to provide risk statistics for vulnerable groups (e.g., children, elderly, disabled) and thus fail to address the concerns of members of the public. It can also result in the perception that those delivering the risk estimates are intentionally misleading them.

Decision Making

How people make decisions and how people should make decisions are two very different things. Most of the decision making literature examines how people should make decisions rather than how they do make decisions. The literature that exists on how people do make decisions pertains primarily to hypothetical decision making with little having been based on real world research.

McDaniel and Lawrence (1990) pointed out that the "distinction between the logical and psychological approaches to thinking is related to the contrast between formal logic and what others call everyday reasoning" (p.1). Formal or logical reasoning involves applying a set of rules within a bounded or self-contained problem. If the rules of logic are applied a correct and unambiguous solution is achieved. By comparison, everyday reasoning involves problems which are often ill defined for which there are no established procedures for their solution and no clearly correct answers. Pre-existing knowledge and broad concepts are used to perceive, define and support the point of view taken. Decisions are made so that they are consistent with one's values, attitudes and view of the way the world works.

Decision Making Strategies

Janis and Mann (1977) have examined the decision strategies people adopt when choosing among alternative courses of action. Drawing heavily from the field of administrative science, they have developed a conflict theory of decision making. They contend that individuals lack the capacity to employ truly optimising strategies for decision making. Humans do not make choices or decisions by employing the rational model assumed by economists. Such a strategy would require estimating the comparative value of all possible alternatives with respect to costs and benefits.

Janis and Mann (1977) contended that the "psychological laws of opinion and attitude change are not necessarily the same as the psychological laws of decision making, although there may be some overlap. ....principles governing consequential decision making probably are substantially different from those governing verbalised choices on non-consequential issues" (p.5). They identified procrastination and invented rationalisations as two ways in which decision makers cope with difficult decisions. Difficult decisions are those which will result in some costs and risks which ever course of action is chosen.

Janis and Mann's (1977) conflict theory of decision making seems very applicable to the style problems often associated with risk issues. When a person is faced with making a decision that directly affects their own vital interests or those of their organisation a state of internal conflict arises. Janis and Mann (1977) referred to these types of decisions which involve decisional conflict and associated psychological stress as 'hot' cognitions. These are in contrast to the cold cognitions of routine problem solving.

According to the conflict model, if a decision maker experiences little decisional conflict and stress they will be unmotivated to give the decision much thought. The decision maker becomes motivated to work out a good solution when a moderate degree of emotional stress is aroused by a problem decision. Under extreme conditions of decisional conflict and stress, decision makers are likely to resort to defensive avoidance (e.g., wishful rationalisations) or disruptive hypervigilance (e.g., panic) which interferes with cognitive processes. The best quality of decision making occurring under conditions where the decision maker's level of psychological stress is in the intermediate range.

"When a person is required to make a choice entailing potentially unfavourable consequences for himself or for significant others, his information processing behaviour will change markedly from that displayed when he is required to make essentially the same judgement on a purely hypothetical basis" (Janis & Mann 1977; p.69). Janis and Mann's conflict model is an extension of a conflict model of emergency decision making.

Underlying their theory is the belief that decision makers will continue to process information in the same manner after they have made a committing choice as they did in making that choice if the same conditions are present. In other words when conditions that foster vigilance rather than defensive avoidance are present both before and after a decision is made then the decision maker will continue to be open to new information and be relatively unbiased in its appraisal. However if conditions that foster defensive avoidance continue after a decision then decision makers will display bolstering and other distortions in information processing in light of new information.

When decision makers are experiencing high level of conflict then information processing may be negatively effected due to hypervigilance or defensive avoidance. Hypervigilance is very rare even in large scale disasters (Quarantelli & Dynes 1972) but defensive avoidance is common. Defensive avoidance may take the following forms: cognitive dissonance (Festinger 1957) and bolstering, procrastination, and shifting responsibility. Janis (1972) found that when neither buck passing or procrastination are possible, members of a policy making group tend to make decisions that are bolstered by shared rationalisations and a collective sense of invulnerability to threats of failure.

They labelled this collective pattern of defensive avoidance as 'groupthink'. It occurs in highly cohesive groups when members use their collective cognitive resources to develop rationalisations that bolster their decision or position. Janis and Mann (1977) have identified eight symptoms of groupthink:

1. an illusion of invulnerability which creates excessive optimism and encourages taking extreme action;

2. collective efforts to rationalise so as to discount warning that might lead to reconsideration of assumptions;

3. an unquestioned belief in the group's inherent morality;

4. stereotyped views of rivals and enemies as too evil, weak, or stupid to warrant attempts to negotiate;

5. direct pressure on any group member that strong contrary opinions will be viewed as a lack of loyalty to the group;

6. self-censorship of deviations from the groups position;

7. a shared illusion of unanimity reinforced by the false assumption that silence implies consent; and

8. the emergence of self-appointed "mindguards" who protect the group from information that might weaken their conviction in their position.

Other researchers have also concluded that individuals lack the ability to truly optimise in their decision making (e.g., Simon 1976). In attempting to do so they would be overcome by information overload (Miller & Starr 1967). A true optimising strategy would require that too many variables be kept in mind at the same time. "The number of crucially relevant categories usually far exceeds 7 plus or minus 2, the limits of man's capacity for processing information in immediate memory" (Janis & Mann 1977, p22). As a result of internal and external constraints (e.g., time to gather data on alternatives), a decision-maker who tries to use an optimising strategy will in fact resort to some form of sub-optimisation which will optimise some utilities at the expense of others.

But it appears that decision makers do not even attempt to use an optimising strategy. Simon (1976) argued that decision makers 'satisfices' rather than maximises, looking for a course of action that is "good enough". This is the 'bounded' or 'limited rationality' approach to decision making. This approach does not require decision makers to work with full information and thus fits the limited information processing capabilities of humans. The simplest form of the satisficing strategy is reliance on a single criterion or decision rule. Janis and Mann contended that this sort of strategy is often employed by individuals facing major health and welfare crisis. Another type of decision making strategy which uses a single decision rule is 'moral decision making'. The inherent danger in single rule decision making strategies is premature decisions which fail to consider important consequences.

A more complex form of decision making is one that uses a set of decision rules but still falls far short of a truly optimising strategy. An example is Tversky's (1972) 'elimination-by-aspects' approach to decision making. A combination of simple decision rules is used in a sequentially narrowing down process to select rapidly from a number of salient alternatives one that meets a set of minimal requirements.

Lindblom (1959) described an incrementalist approach to decision making which he referred to as "the art of muddling through". He noted that policy makers in government or other large organisations tend to make decisions which would result in only incremental change. This was a direct result of having considered only a narrow range of alternatives that differ only to a small degree from the existing policy. Incremental decision making is seen as an effective strategy for reaching consensus among many parties and interests within a large organisation. Janis and Mann (1977) hypothesised that an incrementalist approach may be used for personal decisions as a means of avoiding investing great time and energy in a problem that may appear insoluble. Such incremental decision making can over time lead to a series of small changes which collectively constitute major change perhaps in an unintended direction. They give the example of people locking themselves into certain career paths as a result on incremental decisions the collective implications of which are not anticipated by the individual until they are realised.

Etzioni's (1967) mixed scanning strategy combines features of the optimising strategy with the incrementalist approach. The intensiveness of scanning can vary over a wide range from the very superficial to the very intensive. For any given decision issue, the decision maker must decide how intensive the scanning will be. Intensive scanning is restricted to those problems that are most important or difficult while other problems are treated more superficially. Implicit in Etzioni's theory is the assumption that decision makers have the ability to draw upon a number of substrategies to meet the needs of a particular problem. If a low cost or low energy strategy cannot resolve a problem then a more costly and energy intensive strategy may be utilised.

Although individuals have limited information processing capacities they can adopt mental strategies that simplify the tasks of judgement and choice. Although such strategies may be effective they can lead to systematic biases. Hogarth (1980) noted that how information is presented (e.g., sequentially versus simultaneously) can influence what type of judgement strategy is used. The consequences of limited information processing capacity are: selective rather than comprehensive perception of information; the use of operations that simplify judgmental tasks and reduce mental effort; information is processed sequentially as opposed to simultaneously; and individuals have limited memory capacity (Hogarth 1980).

Payne (1976) found that people used different strategies depending upon the amount of information provided. For choice problems involving few attributes and alternatives, subjects would examine all available information and tended to use compensatory strategies. Compensatory strategies confront the conflicts inherent in the choice situation through the use of trade-offs (Hogarth 1980). For problems with increasing numbers of attributes and alternatives subjects tended to use non-compensatory strategies initially to screen out alternatives. Non-compensatory strategies avoid the conflicts inherent in choice situations by avoiding trade-offs. Instead the decision maker uses cut off points such that any alternative falling below a cut off point is dropped from further consideration. Compensatory strategies were then employed for the remaining smaller set of alternatives (Payne 1976). In other words the strategies employed by people reflected the structure of the choice or problem with which they are confronted particularly with respect to informational demands.

The Role of Attitudes in Decision Making

McDaniel and Lawrence (1991) viewed thinking in terms of information processing. Attitudes, strategies, concepts, and norms are seen as information processing structures which are used to differentiate the environment and integrate perceptions into beliefs and actions. Individuals with more complex cognitive structures can discriminate the environment into more parts. The level of integrative complexity is also seen as important. Even if one can make many distinctions within the environment, these elements may be combined in simplistic ways during decision making. The greater the individual's level of integrative complexity the less black and white becomes the decision making process and the more alternatives perspectives are generated and considered.

The attitude literature suggests that judgements are made either on-line as information on the particular issue is received or by retrieving existing individual beliefs about the issue from memory or a combination of these two processes. Whether or not an individual's response reflects an on-line or memory-based judgement may be affected by factors such as whether the respondent has a pre-existing judgement toward the issue, whether the existing judgement is accessible, and whether the existing judgement maps onto the specific issue question (Tourangeau, Rasinski & D'Andrade 1991).

Attitudes are viewed as memory structures consisting of related beliefs about an issue. Hastie and Park (1986) contended that many respondent judgements are based on material stored in long term memory such as general beliefs about the issue, visual images, related values, personal experience, etc. A number of researchers have examined the activation of attitudes from memory (e.g., Fazio et al. 1986; Fazio & Williams 1986; Tourangeau, Rasinski & D'Andrade 1991), testing whether attitudes are activated automatically when an individual encounters the attitude object or whether activation requires a more reflective process in which the individual actively considers their position or attitude toward the object. Their research suggests that attitudes can be automatically activated and that the strength of the object-evaluation association determines the likelihood of automatic activation.

Fazio et al. (1986) viewed attitudes as simple associations between a given object and a given evaluation which fall on an attitude/nonattitude continuum. Some respondents may draw upon their memory of pre-existing evaluations of the attitude issue while others will have no existing evaluation to draw upon. At one end of the continuum the individual has made no *a priori* evaluation of the attitude object. Moving along the continuum, an evaluation does exist and its accessibility from memory grows increasingly strong. At the other extreme of the continuum is a well learned attitude that is highly accessible from memory. Social issues, categories of situations, categories of people, specific individuals and physical objects are all viewed as possible attitude objects. The strength of the association between the object and the evaluation can vary and may determine the accessibility of the attitude from memory. Tourangeau, Rasinski and D'Andrade (1991) believed that it is more likely that individuals retrieve individual beliefs about the issue rather than retrieval of stored evaluations.

Only if the object-evaluation association is strong will attitudes be automatically activated from memory by the mere presentation of the attitude object (Fazio et al. 1986). Attitudes that are highly accessible from memory (i.e., strong object-evaluation associations) are more predictive of subsequent perceptions of the attitude object and behaviour toward that object. An American study of the effect of attitude accessibility on voter attitudes and behaviour toward presidential candidates found that both attitude-perception and attitude-behaviour relationships were moderated by attitude accessibility (Fazio & Williams 1986). Initial attitudes characterised by high accessibility appeared to have biased people's perceptions of any later information about the candidates that came to their attention during the course of the campaigns. This suggests that persuasive communications have the best chance of changing attitudes for those people who have less accessible attitudes for a particular attitude object.

Attitudes involving a strong association are less likely to be affected by counter influence (Fazio & Williams 1986). The stronger the object-evaluation association the more resistant the attitude is to change and the greater the stability of the attitude over time. If a strong object-evaluation association does not exist, the object is more likely to be evaluated on the basis of salient features of the immediate situation. This has significant implications for risk communication efforts.

Strong object-evaluation associations are highly functional in that they free the individual from the processing required for reflective thought and can guide the individual's behaviour in a fairly automatic manner (Fazio et al. 1986). The individual avoids the effort associated with deliberate reasoning processes. For instance in answering a survey question, due in part to time constraints, respondents typically base their answers on a quick sampling of relevant beliefs that does not reflect the complex structure of beliefs. This sampling of beliefs in making judgements may explain inconsistencies in the attitudes of individuals from one occasion to the next (Tourangeau, Rasinski & Bradburn 1989).

NIMBY Conflicts

Many risk conflicts lead to NIMBY stalemates. The NIMBY (Not-In-My-Backyard) syndrome has been defined as "an individual or community sentiment which expresses the undesirability of proximity to a particular land use" (Gleeson & Memon, 1994; p. 105). Over the past 15 years the NIMBY phenomena has affected a range of land use proposals including landfills, half-way homes, low income housing, prisons, airports, electrical transmission corridors, industrial parks, and hazardous waste facilities. Popper (1981) has referred to these undesirable land uses as LULUs (Locally Unwanted Land Uses). While the public may accept the broader social need for such facilities or land uses they do not necessarily want them in their neighbourhoods. The NIMBY phenomena has been cited as a major cause of the policy stalemates that have occurred in many countries as attempts to find acceptable homes for these 'risky' land uses fail due to local community rejection of such proposals.

Fischer (1993) viewed NIMBY issues as types of "wicked problems". They are problems "with no solutions, only temporary and imperfect resolutions" (Harmon & Mayer 1986, p. 9). NIMBY responses are viewed by some as "an irrational response to problems that ordinary citizens are simply unable to understand" (Fischer 1991; p. 175). Amongst the toughest of the NIMBY problems are those dealing with environmental hazards such as hazardous chemical and waste facilities.

A common accusation thrown at NIMBY groups is that they would not hold the same viewpoint if the particular issue did not affect their backyards. Out of this reasoning comes the charge that NIMBY responses are simply the product of self-interest on the part of affected residents. Alternatively, NIMBY reactions may simply reflect the public acting in a "prudent" fashion (Freudenburg and Pastor 1992).

Risk assessments and the interpretation of their findings have been central to many NIMBY debates. Many risk experts view risk assessments as a communication vehicle for providing an ignorant public with objective information about a risk. Risk communications are designed to assist the lay-person to understand and accept the expert's findings that the risks are so small as to be acceptable. Despite this many risk assessments and their associated risk communication efforts are often rejected by community based NIMBY groups who often hire their own technical experts to produce counter positions.

The response of decision makers to NIMBY conflicts has been varied. Some have chosen to further reduce public participation in the decision making process. Instead they have chosen to place greater reliance on expert knowledge. The logic is that if the everyday citizen is not capable of understanding (i.e., agreeing with) the findings of the experts they should be removed from the decision making equation. In this manner risk assessments can be employed as a method of circumventing the participation of an 'irrational' public in an otherwise democratic process (Fischer 1993).

This position has been rejected by those who argue for a participatory alternative. Proponents of this approach note that today's bureaucracies reflect and reinforce top-down policy decision making processes which are antagonistic to authentic democratic participation because they are technocratic and elitist. They argue that more, rather than less, participation is needed. They point to examples of decision making processes which encourage a high level of public involvement, not just the provision of information, in decision making through a process of participatory negotiations among the major stakeholders (e.g., Fischer 1993; Armour 1991).

Common among NIMBY groups is a fear that their health and quality of life is under threat. Pillar (1991) reports that NIMBY groups typically reject the view that experts and technocrats should be the ultimate arbiters of technological risk. He likens NIMBY groups to right-wing religious movements because of their shared irreverence for the official versions of reality offered by scientists and technocrats. This implies that NIMBY responses are attributable to a small sector of the community which is philosophically out of step with mainstream society. However, it may be the case that NIMBY groups are as mainstream in their worldviews as other citizens and that it is the risk experts and technocrats who are out of step. Freudenburg and Pastor (1992, p. 50) have suggested that "technical experts' values and personality types tend not to be at all representative of the public at large".

Janis and Mann's (1977) research on "hot cognitions" suggests that as a result of stress individuals make decisions in a different manner when faced with affect-laden issues as opposed to the cold cognitions of everyday problem solving. NIMBY style issues would seem to fit into the category of "hot cognitions". This applies to both those affected by the decisions (e.g., residents) and the decision makers (e.g., project proponents, regulatory agencies). Typically in a NIMBY style conflict all parties (e.g., the formal decision makers and the affected residents) are functioning in a stressful environment in that all understand that they have something to lose.

NIMBY conflicts typically result in the emergence of resident groups whose sole focus or raison d'être is the NIMBY issue affecting their community. Such conflicts are usually characterised by polarised positions with the decision makers on one side of the risk issue and the affected community on the other. The literature on "groupthink" is relevant to this discussion. Often both sides in a NIMBY debate, decision-makers and residents, demonstrate many of the characteristics of groupthink identified by Janis and Mann (1977). Groupthinking often makes it very difficult for groups on either side of an issue to move from their initial position.

Much of the NIMBY literature pertains to facility siting and has increasingly focused on the issues of procedural justice, trust and public perceptions of the trustworthiness and credibility of risk managers and decision makers (e.g., Bord & O'Connor 1992; Mitchell 1992; Hunter & Leyden 1995; and Pijawka & Mushkatel 1991). This is consistent with Armour's contention that "social discourse about risk is more often than not a discourse about trust, power and equity" (1993, p. 192). Other risk characteristics which appear to play a significant role in NIMBY disputes are equity, personal control, and the voluntary nature of exposure (Armour 1993).

The behaviours displayed in NIMBY style conflicts are also consistent with the concept of social amplification (Renn et al. 1992, Kasperson et al. 1988) (see Chapter 2). As discussed earlier, social amplification is the phenomenon by which information processes, institutional structures, social group behaviour, and individual responses shape the social experience of risk. The interaction of psychological, social, institutional and cultural processes in response to a risk issue can amplify individual and group perceptions of that risk. It can also lead to second order (e.g. loss of trust in institutions) and third order effects (e.g. demands for additional protective measures).

Chapter 4

Risk Communication

Introduction

Risk communication is, itself, a multidisciplinary area of study drawing from a diverse array of fields including cognitive and social psychology, anthropology, sociology, political science, law, decision science, philosophy, communication theory, linguistics, and consumer behaviour.

As with risk perception a decade ago, risk communication has become an 'in' topic for international conferences and research papers. It is a growth industry, albeit an industry that has had limited success to date. All too often risk communication efforts have been reduced to experiences in frustration for both the risk communicator and the recipient of the risk communication.

Risk communication has been described as any purposeful exchange of information about health or environmental risks between interested parties (Covello, von Winterfelt, & Slovic 1987). It also has been strongly condemned by some as an attempt to market unacceptable risk and has even been described as a code word for brain washing by experts or industry (Jasanoff 1989).

There are two basic approaches to risk communication which reflect different communication objectives and decision making processes. The technical approach was the first type of risk communication to emerge and reflects the basic goal of informing the public of a decision and applies an older communication model of 'message', 'source', 'channel' and 'receiver'. This contrasts with the integrated or process approach which views risk communication as an integral part of the risk management process. Since chapter 3 focused on process approaches to risk management and risk communication, this chapter concentrates on the technical aspects of risk communication.

The characteristics of the risk message are examined and the research on risk comparisons, message style and format is described. Many of the prominent authors in this area have identified a range of do's and don'ts for risk mangers in the design and implementation of their risk messages (e.g. Covello and Allen 1988). It is interesting that many of these recommendations are based on basic principles of public involvement and reflect little about risks per se (e.g. use simple, nontechnical language). A brief overview of the disaster and crisis communication literature is also provided in this chapter as it comprises its own extensive subset of the risk communication literature.

One of the major weaknesses in the field of risk communication is the fact that for most risk communication programs no empirical evaluation is conducted as to their effectiveness. This issue is examined in the concluding section of this chapter. While a number of researchers (e.g. Rohrmann 1990; O'Riordan 1988) have made strong cases for evaluation programs, a number of barriers must be overcome before evaluation of risk communication efforts becomes more commonplace. A principal barrier being the need to establish accepted criteria to assess risk communication effectiveness. Possible evaluation criteria which have been put forward by researchers such as Gregory (1989), Weinstein and Sandman (1993) and Rohrmann (1990) are described.

Risk Communication Objectives

The motives and objectives of risk communication efforts have attracted considerable criticism. The success of risk communication is typically measured by the degree to which popular attitudes reflect the technical rationality of risk and the extent to which popular behaviour conforms to technocratic values (Plough & Krimsky 1987). Where there is a lack of convergence, it is attributed to a failure of risk communication. Unfortunately this reflects the fact that many risk communication efforts have set out to bring the perceptions of the 'lay public' into line with those of the risk experts. As an objective it implies that the experts are correct and that the lay public is wrong and in some manner needs to be informed or educated on the facts so that their perceptions can be corrected.

Focusing on the role of risk communication in risk debates is seen by some as an intentional or unintentional attempt to avoid the real issues. Jungermann, Kasperson and Wiedmann (1988) argued that conflicts over risk are not in fact about risk but social values and such conflicts cannot be resolved through improved communication but by political arguments. There is little doubt that risk communication efforts have, at times, been used as a scapegoat for other problems in the planning or policy process. For instance, public opposition to new technologies or risky facilities is often viewed solely as a problem in effective risk communication, when invariably there are additional and sometimes more powerful factors at play.

That risk communication research has the potential to produce results which could be used for covert and unethical purposes seems obvious. Unfortunately the line between ethical and unethical can be hazy. Morgan and Lave (1990) saw ethical problems arising when there is a mismatch between the objectives of the communicator and recipient of a message. There is potential for such problems to be reduced when the intent of the communicator is altruistic rather than selfish and the intent is overt rather than covert. However, even if we are altruistic and overt with our communications, significant questions remain, such as the degree to which we should attempt to change behaviour in the face of certain types of risk.

Given all the problems associated with risk communication, why bother doing it? In large part there really isn't any choice in the matter. The public is demanding a greater role in decision making and greater accountability in its decision makers, having over the past twenty years increasingly lost faith in the ability of government agencies, industry, and experts to protect the public's interest. A response to these demands has been attempts in recent times to regulate the provision of information regarding environmental hazards to the public through Right-to-Know laws and other forms of sunshine legislation. Unfortunately in most cases these laws provide little guidance as to how to effectively communicate risks to the public (Nordenstam & Dimento 1990). These requirements also bring with them the spectre of legal liability, placing even more pressure on today's risk communicator (Otway 1990).

Approaches to Risk Communication

Two basic approaches to risk communication emerge from the literature. These approaches typically support their complimentary forms of decision making. The first is the technical or instrumental approach to risk information transfer or risk communication. The second approach is the integrated or process approach which views risk communication as an integral part of all phases of the risk decision making process (i.e., risk analysis, assessment and management) (e.g., Grima 1989).

Those holding the technical perspective define risk communication as any purposeful exchange of information about health or environmental risks between interested parties(Covello et al. 1987). It is the act of conveying or transmitting information between interested parties about levels of health or environmental risks; the significance or meaning of such risks; or decisions, actions, or policies aimed at managing or controlling such risks. The interested parties may include government agencies, corporations and industry groups, unions, the media, scientists, public-interest groups, and individual citizens.

The technical approach focuses on questions such as, "How can risk information be simplified for the lay person without losing its meaning? How do we improve the treatment of risk by the media? How do we obtain relevant information from the public without generating undue fear and suspicion?"

The technical approach of Covello et al. (1987) is reflected in the manner in which they separate risk communication problems into four basic categories: (1) "message" problems resulting from limitations of scientific methods, analyses, and assessments; (2) "source" problems resulting from limitations of risk communicators and risk assessments experts; (3) "channel" problems resulting from limitations of the means by which scientific and technical information about risks is transmitted; and (4) "receiver" problems stemming from certain characteristics of the intended communication recipient. This approach reflects models developed through communication theory.

In addition, they have organised risk communication tasks into four types on the basis of their primary objective or intended effect: (1) information and education; (2) behaviour change and protective action; (3) disaster warnings and emergency information; and (4) joint problem solving and conflict resolution. While conceptually different, the four types of tasks, in real world situations, overlap substantially.

They go on to describe the variety of problems associated with each of these types of risk communications and recommend steps to overcome the difficulties. Finally they boil all the risk communication literature down to four main messages for risk communicators:

- Know your risk communication problems.
- Know your risk communication objectives.
- Use simple and nontechnical language.
- Listen to your audience and know its concerns.

The appeal of the technical approach to risk communication is its practicality. It almost offers a 'cook book' or 'how to' guide for practitioners. Many of its leading authors have in fact produced risk communication manuals for industry (Covello, Sandman, & Slovic 1988; Covello & Allen 1988).

Despite its immediate and practical appeal the technical approach to risk communication has been challenged by those holding the process perspective. By focusing on components, the technical approach is seen as encouraging the tendency to view risk communication as a field separate from risk management. It is also criticised for its tendency to create dichotomies such as 'lay people versus expert', 'receiver versus source', 'message versus medium', and 'public versus regulator' (Grima 1989).

The integrated or process approach views risk communication as an integral part of the risk management process (e.g., Grima 1989; National Research Council 1989). Risk communication is seen as including all messages and interactions that have a bearing on risk decisions. Because risk communication is so tightly linked to the management of risks, solutions to the problems of risk communication often require changes in other aspects of risk management (National Research Council 1989).

From a process perspective risk communication has been defined as " 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" (National Research Council 1989, p.21).

Communication Theory

An Historical Perspective

Critical examination of communication has occurred from the time of the ancient Greeks and Romans. By the fifth century BC, Plato and Aristotle had developed the first recorded theories on communication. Their theories focused on persuasive argument and public communication which were highly valued skills in their society.

By the nineteenth century, the scientific method had become the preferred model for investigation both within the natural and physical sciences, and other disciplines. Within the social sciences, behavioural scientists were among the first to adopt the scientist model. The emergence of the scientific method lead to the division of the field of communication into two separate areas: (1) humanistic rhetorical study; and (2) social-scientific communication theory.

Another area of social science research which influenced communication theory was the study of attitude change. The rapid advancements in information technology lead to a mechanistic approach to communication theory. The development in the 1940s of a mathematical communication theory known as Information Theory lead to the division of communication into source, encoder, message, channel, decoder, and destination. This language has to a large extent been adopted by risk communication theorists such as Covello (1983).

However, the past decade has seen a questioning of the mechanistic approach and a search for new models. Today communication theorists are looking to rules theory, language philosophy, qualitative sociology, semiotic study, and critical theory as potential bases for a new communication theory (Trenholm, 1986).

Cognitive Consistency Theories

Cognitive consistency theories are based on the view that individuals attempt to simplify their cognition's of the world (i.e., individual beliefs or attitudes about self or objects in the world) in order to achieve consistency and predictability (Festinger 1957). Cognitions are dissonant if they are contradictory. A state of dissonance occurs when a person realises that they are simultaneously holding two dissonant cognition's. Since dissonance is an uncomfortable psychological state, individuals actively avoid dissonance producing situations and try to reduce dissonance when it occurs. The magnitude of dissonance is a function of both the importance and number of dissonant and consonant cognition's that are held with respect to the topic. Dissonance is greatest when the number of dissonant elements outweighs the number of consonant elements and when the dissonant elements are highly important.

Dissonance can affect our behaviour in response to a communication. If new information is presented which is inconsistent with existing cognitions, individuals may either avoid situations that will result in dissonance by rejecting dissonance producing ideas. In choosing among alternatives, individuals will avoid information extolling the virtues of unselected alternatives and prefer information that is consonant with their choice.

Social Judgement Theory

Within communication theory, there are two theories which try to predict the magnitude and direction of attitude change as a result of exposure to persuasive messages. Sherif's Social Judgement Theory argues that a receiver will evaluate a message by comparing the message with pre-existing attitudes and opinions which act as anchor or reference points. The anchors determine the degree of change that will occur in response to a message. Sherif (1967) found that receivers distort their judgements of messages in relation to their anchor points. When a speaker's position is similar to the receiver's anchor, an assimilation effect will occur, whereas when the message is judged to be divergent from the anchor a contrast effect will occur. The effectiveness of a persuasive message largely depends on how close the message is to the receivers anchor or reference point.

Sherif views a receiver's anchor as a point on a continuum of attitudes. Surrounding the anchor point are other positions which are acceptable to the receiver. This is known as the *latitude of acceptance*. Positions that are totally unacceptable to the receiver form the *latitude of rejection*. Between the two, are positions about which the receiver is undecided or ambiguous. This is known as the *latitude of noncommitment*.

If the speaker's message falls within the receiver's latitude of acceptance then assimilation occurs and the message will be favourably received. However if the message falls within the latitude of rejection, a contrast effect will occur and the message will appear more divergent than it is (i.e., a boomerang effect). The greatest potential for attitude change occurs when source messages fall within the latitude of noncommitment.

Individuals differ with respect to the relative size of their latitudes of acceptance and rejection. Ego-involvement has been identified as an influencing factor in this regard. Those who are ego-involved (e.g., those personally affected or whose family and friends are affected) poses stronger anchor points and wider latitudes of rejection, and display greater assimilation-contrast effects. Thus with a highly ego-involved receiver the communicator should use messages that contain moderate as opposed to extreme views. In terms of risk communications, situations that are commonly referred to as NIMBYs fall into the highly ego-involved category.

Congruity Theory contends that attitude change is a function of both the receiver's judgement of the source's advocated position and the source's credibility. When an admired source advocates a position that is not in accordance with the receiver's position, psychological discomfort will occur. Attitude change of some sort will occur to restore the loss in cognitive balance. Congruity Theory attempts to predict the magnitude and kind of change.

Persuasion Research

The cognitive research on the topic of persuasion could be useful to risk communicators. Persuasion research has put forward two possible approaches to how people influence each other's attitudes. One is the cognitive response approach, such as Petty and Cacioppo's 'central route to persuasion' (1986), which contends that individuals apply argument based thinking to interpret persuasive messages. The second is the heuristics processing or peripheral modes approach which emphasises factors other than argument based thinking (e.g., source attractiveness; message length) that may lead to attitude change. This approach assumes that individuals will expend only as much effort as is necessary to validate a persuasive message. The application of cognitive heuristics and other peripheral cues offers a relatively effortless means of doing this. It may not be an either or situation. It may be the case that both heuristic and systematic processing can occur simultaneously, leading to additive or interactive effects on message recipients' attitudes (Chaiken et al. 1989).

Tesser and Shaffer's (1990) review of the persuasion literature suggests that argument based or issue-relevant thinking is applied when message recipients are both motivated and able to scrutinise the message. On the other hand, recipients who are unmotivated or unable to scrutinise the message, will adopt opinions that are relatively insensitive to the quality of the message arguments. Research has been trying to determine what are the enabling and motivating variables for argument-based or systematic message processing. Enabling variables include: repeated exposures to persuasive arguments; absence of situational distractions; a neutral state of mind; extensive prior knowledge of the message topic; and direct experience with the attitude object. Motivating variables include: dispositional variables such as high self-acceptance; and situational variables such as high personal relevance of the message, high match between the persuasive context and the recipient's functional predisposition, use of interrogative (versus assertive) formats to assess opinions, and delivery of independent arguments by multiple spokespersons. While disagreement of opinion with the majority of important reference groups will induce issue-relevant thinking, consensus information from less important sources typically functions as a heuristic cue to the validity of the message.

The persuasion literature suggests, although it is not yet conclusive, that attitudes based on issue relevant thinking are stronger and more durable than those based on heuristic/peripheral mechanisms. They appear to be more temporally stable, more resistant to counter-attack, and more highly predictive of future behaviour. Although the reasons remain unclear, biased processing of messages, such as favourable elaborations of weak arguments or unfavourable reactions to strong arguments, appears to occur under certain conditions: when the message is highly involving; or when the recipients are knowledgeable about the message subject, disagree with an important reference group, or have been forewarned of the message's content or the communicator's intentions.

Presenting Risk Data To The Public

One of the difficulties that risk communicators continue to experience is one of public presentation of risk analyses and data. Popper (1983) observes that to the public, the risk analysis appears to be "bloodless, unrelated to real life and a complicated euphemism that fools no one." Part of the problem is the variety of dimensions and units that can be applied in describing risks. Possible dimensions include net benefit, morbidity, and acute (e.g., explosions) or chronic (e.g., long term toxicity), but to name a few. For instance, Ferguson and Valenti (1991) have demonstrated that describing the same risk to individuals in terms of child exposure rather than adult exposure can significantly increase perceptions of risk. To add to the confusion, each risk dimension may be expressed by a number of units such as: annual death toll; death per person per hour of exposure (e.g., Starr 1969); loss of life expectancy; and lost working days.

Fischhoff et al. (1981) believed that presentation and elicitation effects are inevitable because one has to pose a problem in some way, and the method used will affect the resulting message. An understanding of these effects can be used to manipulate the information people receive and influence the information which comes out of them. As they point out, by careful presentation of information it may be possible to exaggerate or minimise perceived risks in ways that could not be faulted in a court of law. When people lack strong prior opinions they are even more vulnerable to manipulation through the formulation of a risk problem (Slovic 1969). The ethics of such procedures are another matter entirely.

To assist risk communicators, Covello and Allen (1988) identified what they refer to as the 'seven cardinal rules of risk communication':

- Accept and involve the public as a legitimate partner.
- Plan carefully and evaluate your efforts.
- Listen to the public's specific concerns.
- Be honest, frank, and open.
- Co-ordinate and collaborate with other credible sources.
- Meet the needs of the media.
- Speak clearly and with compassion.

Interestingly, these seven rules have for many years been accepted as basic rules for any public involvement programme, irrespective of whether the issue is risk-related or not. This situation appears analogous to the 'risky-shift' debate. Much of the so called risk communication literature is not about risk per se but more about communication and public involvement in general.

In case after case it has been shown that even the most interested parties will not read further than the executive summary of an extensive risk assessment. As Konheim (1988) pointed out, even the executive summary will be read thoroughly by only the most dedicated citizens and elected officials. In a world dominated by electronic media and sound bites, where decision makers have little patience for more than a 5 to 10 minute presentation, risk communicators are under pressure to get the message of the risk assessments across to the public and decision makers. The absence of a spokesperson who is closely identified with the study and has the skills and talent to make an authoritative, concise, accurate, and informative presentation of the approach and findings of a risk assessment is a common weakness of the risk analysis process (Konheim 1988).

Risk Comparisons

It is generally accepted that framing individual risk in terms such as one in a million is not very useful to the lay public. As an alternative, the risk in question is often compared with other risks to give the public a better understanding. This is commonly achieved by comparing the risk with risks that people experience everyday or with which they are more comfortable. Covello (1989) described risk comparisons as providing a 'conceptual ruler' which is more intuitively meaningful than absolute numbers or numerical probabilities.

Many risk communication programmes will compare the risk in question with the probability of getting hit by lightning. Since individuals routinely accept the risk of being hit by lightening, which poses a risk of 1 death in a million per year, it has become a standard for an acceptable risk. Yet comparing a specific risk to that of getting struck by lightening often attracts criticism from the public for: reducing risks to a single dimension; persuading the listener regarding how large risks should be; and ignoring the fact that people perceive risks in multiattribute terms. The public often accuse risk communicators of comparing apples with oranges in the case of voluntary and involuntary risk comparisons. In other cases, there are accusations of trivialising the potential risk by comparing it with something like the risk of eating peanut butter. Gregory (1989) advocated that only one type of risk comparison is meaningful and fair, a comparison of the risks associated with different options for dealing with the same issue.

Criticisms of risk comparisons described in the risk communication literature include:

- failure to identify the uncertainties involved in risk calculations;
- failure to consider the broad set of quantitative consequences that define and measure risk;
- failure to recognise the multi-attribute nature in which people make judgements about risk acceptability;
-
- risk comparisons are often drawn from data sources that vary significantly in quality;
- most tables of risk comparisons do not provide data on the feasibility and costs of reducing the risks; and

- judgements about risks can not be separated from the decision making process.

Despite the frequent criticisms of risk comparisons, Slovic (1986) contended that risk comparisons are still more meaningful than providing the public with absolute numbers or probabilities, especially when the absolute values are quite small. While describing the provision of risk comparisons as one of the few 'principles' in risk communication that seems to be useful, he noted that some types of risk comparisons are better than others.

To assist the U.S. chemical industry in presenting risk data to the public, Covello et al. (1988) developed a manual advising plant managers on how to present risk comparisons. The authors acknowledged that since systematic empirical studies of the effectiveness of risk comparisons had not been conducted, their guidelines were based on logical analysis and experience. They identified 5 categories of risk comparisons and rated them in terms of their predicted acceptability to the public. The best comparisons were considered to be those which: compared the same risk at two different times; compared the risk with a standard; or comparisons which are different estimates of the same risk.

They contend that the more a risk comparison disregards the dimensions of risk that are most important to people (i.e., catastrophic potential, dread, voluntariness, newness, familiarity, and controllability) the more likely it will be ineffective and may prove to be inflammatory and damaging to the agency's credibility.

Roth et al. (1990) attempted to empirically test the predictive ability of Covello et al. (1988) ranking scheme by asking 4 diverse groups to judge the acceptability of 14 statements produced in the earlier study as examples of the 5 categories of risk comparisons. They found no correlation between the judgements of acceptability produced by their subjects and those predicted by Covello et al. (1988). For example, they found that comparisons of risks across domains (e.g., comparing ethylene oxide with lightning) fared better than expected, as did comparison of occupational with environmental risks. While comparisons with standards of acceptability and comparisons with different estimates of the same risk (e.g., worst-case and best-case estimates) fared worse than expected. Slovic, Kraus and Covello (1990) challenged the Roth et al. (1990) findings by questioning whether or not similar findings would occur in a context in which the community is angry or distrustful. Their contention is that comparisons of unrelated risks would prove less satisfactory as the context became more hostile.

Using the case of asbestos exposure in schools, Slovic et al. (1990) divided subjects into three groups. All received quantitative data on the risks associated with asbestos exposure in schools but one group received no further information. The other two groups received additional information comparing the asbestos risk with risks from smoking, peanut butter, x-rays, radon, etc. They were also given a statement from a fictitious expert witness explaining and interpreting the risk comparisons in a favourable light. One of these two groups also received a second statement by another expert witness criticising the risks comparison data. Subjects from the three groups were then asked on a scale of 1-7 to rate the risk of exposure to asbestos for students. They were also asked to find the company guilty or not guilty of exposing students to an unreasonable risk of disease from exposure to asbestos fibres.

Those who had received only quantitative data on the asbestos risk rated the level of risk similar to the third group that had received all the data including both testimonials, while the second group which only received the positive testimonial rated the risk significantly lower. Similar findings occurred with respect to guilt. The researchers were surprised that the risk comparison data and the favourable testimony were so easily offset by the negative critique, despite the fact that the information provided indicated that the asbestos risk was minuscule relative to other commonly accepted risks. The results of their study suggest that the analyses and opinions of technical experts may not be convincing to the public in adversarial contexts.

Message Characteristics, Styles And Formats

It appears that positive and negative messages may be processed differently, with people tending to react more strongly to options that are negative relative to their reference point than to options that are positive (Kahneman & Tversky 1979; Tversky & Kahneman 1981). Lichtenburg and MacLean (1988) gave the example that if people see a technology as possibly saving lives but also as risking some loss of life, they will weigh the losses more heavily than the gains in their decisions about whether to support or oppose the technology. Meyerowitz and Chaiken (1987) examined the topic of breast self-examination (BSE), which is a risky activity from the perspective that it might detect cancer. They found a greater increase in positive BSE attitudes, intentions, and behaviours as the result of a negative appeal (i.e., you may lose if you neglect BSE) than as a result of a positive appeal (i.e., you might gain from BSE). These findings indicate the importance of how people frame their options in drawing conclusions or making decisions and in communicating with the public.

It appears that people only selectively take notice of a small proportion of the total volume of information about risks that they encounter. It has been suggested that when processing the wealth of information on risks, people apply three types of screening factors: involvement, personal relevance, and ability (Earle, Cvetkovich, & Slovic 1990). The involvement factor asks the question " Is this an important issue to me as an individual?" Personal relevance concerns the question " Can this risk affect me?" If information recipients cannot relate to the way the risk information has been derived, in terms of time, place, and population, they are likely to discard it because they feel that "the statistics don't really pertain to me" (Slovic 1986). The ability factor pertains to the message recipient's capacity not only to process the information but to act on it.

One of the difficulties in risk communication is the fact that if people already possess strong beliefs on a certain subject it is very difficult to get them to modify those beliefs even in the face of contrary evidence (Slovic 1986). New information will be accepted if it is consistent with the person's initial beliefs while contrary evidence will tend to be dismissed as unreliable, erroneous, or unrepresentative. Lyndon and Zanna (1988) reported that a person's commitment to values, particularly central values, appears to increase in the face of adversity.

The opposite situation exists for people who do not hold a strong opinion prior to information having been provided. They are vulnerable to the various effects associated with different types of information presentation described earlier. The way in which we frame information can manipulate perceptions. This raises ethical considerations that must be addressed in the design of risk communication programs. Slovic (1986) suggested the use of multiple formats as a possible means of overcoming framing effects.

Using the example of household radon gas, Golding, Krimsky and Plough (1992) tested the hypothesis that people respond better to risk communications that reflect more closely the conditions of their social and cultural lives. They compared technical and normative styles of presenting written information about radon to the community. Their results, although inconclusive due to small sample size, indicated that both risk communication formats enhanced the levels of knowledge about radon, but neither encouraged a significant increase in testing and/or mitigation (i.e., change in behaviour). This means that risk communication may enhance public knowledge and encourage informed consent without necessarily resulting in desired changes in behaviour.

Slovic (1986) contended that since some misconceptions of risk are due to reliance on imaginability as a cue for riskiness, merely describing possible adverse affects of a product or activity could enhance their perceived likelihood and make them appear more frightening. Using a study by Morgan et al. (1985) of people's judgements of the risks of high voltage transmission lines, Slovic demonstrated that people's perceptions of risk shifted toward greater concern after they read a brief and "rather neutral" description of studies on the health effects due to such lines.

Johnson and Fisher (1989), also working on the radon issue, looked at the problem of motivating households to take remedial actions without generating undue anxiety. Their research focused on two issues. Do people respond better to risk information that is quantitative or qualitative? And, do they respond better to a directive format that provides explicit instructions about what measures should be taken (the 'command' tone) or to a format that encourages judgement and evaluation (the 'cajole' tone)? They found that quantitative information treatments were statistically significant in reducing discrepancies between 'objective' and 'perceived' risks. Subjects initially perceived their level of risk from radon as similar to another hazard (ie. hazardous wastes) but less than the hazard auto accident. After having been given additional information only about radon, the subjects' risk perception moved closer to the mathematical risk as might be expected. However, the perceived seriousness of the other two forms of risk also decreased in the follow-up survey although no additional information had been provided on these hazards. With respect to the effect of the information format, the cajole / qualitative brochure achieved the best improvement in responses to quiz questions. The quantitative brochures achieved better congruence between objective and subjective risks; while the command format brochures significantly reduced homeowners demand for additional information.

Eiser and Hoepfner (1991) examined the influence of response categories in questionnaires on people's estimates of risk. They found that subjects used the format of the response scale as a cue to the range of quantities within which they should make their estimates. This is consistent with Tversky and Kahneman's (1974) anchoring heuristic. In their experiment subjects were presented with a list of 20 possible causes of death and asked to estimate the number of people likely to die over the next 10 years from each risk item. The wording of the 5 category response scale, as either a low-frequency or high-frequency scale, was the only manipulation in the experiment. The low-frequency condition was presented as: 100 or less; 100-1,000; 1,000-10,000; 10,000-100,000; and 100,000 or more. The high-frequency scale was defined as: 10,000 or less; 10,000-100,000; 100,000-1 million; 1-10 million; and 10 million or more. Subjects consistently gave higher estimates for the high frequency condition although the relative ordering of the items remained very similar for both conditions.

In another experiment, Eiser and Hoepfner (1991) had subjects estimate the consequences of the greenhouse effect. Again the categories of the response scale were manipulated. In addition the order of two questions (i.e., "How much do you think the sea level will rise by the year 2050?" and "How much of the world's present land mass do you think will be flooded by the year 2050?") was reversed for half the subjects. Again estimates of future rise in sea levels and future flooding were higher when the response scales covered a high range rather than a low range of possible effects. The order of the questions also had an effect. When subjects were presented with the question on sea level first, their qualitative ratings of the seriousness of the threat of global warming and their support for a ban on CFCs was higher. Eiser and Hoepfer suggested that this result may be consistent with Tversky and Kahneman's belief that people tend to interpret associations in 'causal' rather than 'diagnostic' terms. In this case the inference from sea level rise to flooding would be a causal relationship, while that from flooding to sea level would be diagnostic in nature. Eiser and Hoepfner argued that many opinion surveys may unintentionally be introducing bias through response category manipulation. They also suggest that the risk estimates of lay people are neither irrational or meaningless, but should be interpreted in relative rather than absolute terms.

Disaster And Crisis Communication

The literature on disaster and crisis communication comprise their own extensive subset of the risk communication literature. Covello, Slovic and von Winterfeldt (1988) divided this literature into the categories of: disaster education and emergency preparedness; disaster and emergency warning systems; and evacuation and sheltering communications. They reported that there is little evidence that belief that a technological or natural disaster is likely translates into better emergency planning.

Covello et al. suggested that long term disaster predictions (e.g., earthquakes, floods, etc.) may desensitise people to disaster information, encouraging them to deny the realty of the threat. Such predictions could be counterproductive, undermining effective public response to short term disaster warnings.

The emergency planning and response literature clearly distinguishes between natural and man made disasters. For example, unlike for natural disasters, people are generally willing to respond to statements by authorities encouraging them to evacuate in technological emergencies and disasters. In fact sometimes more people evacuate than recommended by the officials.

Quarantelli (1984) has studied emergency warnings for sudden emergencies such as floods from dam breaks, hurricanes, volcanic eruptions and tornadoes and individual reactions to them. He argues that the simple stimulus-response model, in which the warning message is the stimulus and the response is the individual's reaction to it, is wrong in many respects. Instead there is no such thing as a warning message. Instead there is what is perceived by the receiver of the message; and the meaning they give to the message. This message may or may not be the same as that intended by those who issued the warning message. A number of factors which affect the interpretation given to a warning message. Quarantelli views reactions to warnings as a function of selective perception and social confirmation. This is similar to Kasperson's theory of social amplification.

The mode, form, substance and perceived relevance of the message are all important factors. For instance, the more personal the manner in which the message is delivered, the more credence it will be given. In general, warnings via the mass media are more likely to indicate to people that something is wrong than to mobilise them into a desired action. Whenever possible, people will seek out environmental cues (e.g., rising waters in the case of flood warnings) to confirm the warning message. Quarantelli notes the strong tendency on the part of potential disaster victims to assimilate all possible danger cues to the normal (e.g., a loud noise will be perceived as a car backfire rather than an explosion).

Warning specificity is also important. The more specific the information in a warning message and the more it details something relevant to the listener the more it will be believed. Other factors important to warning belief are perceived proximity, severity, and certainty of immediate personal danger. Not only must personal risk be perceived as high but it must also be viewed as relatively certain.

The relationship between prior experience and warning beliefs is more complex. Prior experience renders current warnings more credible if disaster is part of experience. However those with prior experience with disasters will tend to define some potential impact in terms of their earlier experiences with the disaster agent regardless of the content of the current warning message.

Almost always the individual who receives a warning message will seek confirmation of that message. How they view how others are acting in response to the message plays a critical role in confirming or disconfirming the individual's original perception of the warning message. Confirmation is more likely to be sought for unfamiliar disaster agents.

It appears that individuals do not react uniformly to perceived and confirmed warning messages. Just as there are differentiated perceptions there are differentiated responses. Quarantelli (1984) recommended that disaster planners first focus on the perceptual behaviour of the potential victims and not the words used to warn them. He has identified two guiding principles for planners. The first is that if people define a situation as real, it is real insofar as consequences are concerned. The second is that warnings do not impinge on solitary individuals. Because a process of social confirmation will occur, planners should start with what they know of how groups are likely to react rather than focusing on what individual responses might be. And finally, "plans should be adjusted to the probable behaviour of people rather than attempting to force people to adjust to plans."

Evaluating Risk Communication Efforts

For most risk communication activities no empirical evaluation is conducted as to their effectiveness although many researchers have discussed the need for evaluation research (e.g., O'Riordan et al. 1989; Slovic, Kraus & Covello 1990; Gregory 1989; National Research Council 1989). Many of the misconceptions about risk communication pertain to the issue of what constitutes success. Much of this revolves around unrealistic expectations. A common expectation is that improved risk communications will always reduce conflict and smooth the path for risk management. But risk communication does not necessarily result in consensus for controversial issues or in uniform personal behaviour (National Research Council 1989). In fact the National Research Council made the case that such objectives are not appropriate in a democratic society. They stated that "success requires that the recipients do or believe what a particular message source desires is to assume that the message source is a better judge of the recipients' interests than the recipients themselves" (p.28). In addition, "successful risk communication does not always lead to better decisions because risk communication is only part of risk management" (p.27). It is possible to fully understand what is known about the consequences of various options and still make a bad choice (National Research Council 1989).

What constitutes 'success' with respect to risk communication efforts? The US National Research Council (1989) considers that risk communication is successful to the " extent that it raises the level of understanding of relevant issues or actions and satisfies those involved that they are adequately within the limits of available knowledge" (p.26).

O'Riordan (1988) has identified as a research need the comparative assessment of the effectiveness of various approaches to community risk communication servicing (e.g., ombudsmen type arrangements, liaison committees, community networks including specialist panels, and technology assessment devices). The following criteria for effectiveness have been proposed:

1. establishment of mutual trust;
2. capacity to build bridges between parties to develop mutual understanding;
3. alleviation of formality in requirements for information and for justification of in-house regulation;
4. evidence of mediation, where mediation success is defined in terms of diffusing hostility, resolving disputes, and re-establishing trust; and
5. evidence of overall reduction and cost minimisation of the risk management process.

Rohrmann (1990) is another who has written about the importance of evaluating the effectiveness of risk communication programmes and he has identified a number of evaluation criteria. These criteria for risk communication effectiveness form two categories: goal-related criteria and procedural criteria. One striking aspect of these evaluation criteria is their similarity to the evaluation criteria one would apply to any information programme regardless of whether or not it pertained to risk. The only risk specific criteria are the reduction of accident rates or mortality rates and improved risk-controlling behaviour. Rohrmann rejects the use of cognitive variables as acceptable criteria for behavioural change on the basis that the link between knowledge or attitudes and behaviour is usually weak. Similarly, measures of behaviour intentions or behaviour reports are seen as possibly lacking validity for the actual behaviour.

Having reviewed the empirical evaluations of risk communication activities, Rohrmann (1990) identified as common methodological shortcomings: insufficient designs (e.g., no control groups); weak effectiveness criteria (e.g., only intended but not real behaviour); the use of fictitious situations and/or subjects were not personally exposed to the risk; and no stringent analysis of the success or failure of the risk communication strategies. He also noted that longitudinal studies were rare.

To determine the effectiveness of a risk communication activity or programme it is necessary to be able to assess whether implementation of the activity actually lead to the intended results. This is not an easy task since the outcomes of the risk communication activities could be caused by external influences (e.g., knowledge gained from other sources) rather than by the communication activities. The risk communication activities may also lead to unintended impacts (e.g., confusion or fear associations) which potentially could create a feedback link to the intervention itself (Rohrmann 1990).

Weinstein and Sandman (1993) have identified seven criteria for evaluating risk messages:

1. Comprehension - does the receiver understand the content of the message?
2. Agreement - does the audience agree with the recommendation or interpretation contained in the message?
3. Dose-response consistency - do people facing a higher dose of a hazard perceive the risk as greater and/or show a greater readiness to take action than people exposed to a lower dose of this hazard?
4. Hazard-response consistency - do people facing a hazard that is higher in risk perceive the risk as greater and / or show a greater readiness to take action than people exposed to a hazard that is lower in risk?
5. Uniformity - do people exposed to the same level of risk tend to have the same responses to this risk?
6. Receiver evaluation - does the receiver judge the message to have been helpful, accurate, clear, etc.?
7. Types of communication failures - are the failures that occur of the more acceptable variety?

The authors identify a number of considerations in applying the evaluation criteria to specific risk communications. The evaluator must decide which of the criteria are most appropriate for the situation and then establish priorities among the criteria to develop the optimal risk communication strategy. To choose among the criteria three kinds of knowledge are identified: about the hazard (e.g., great or small); about the audience (e.g., risk taking or risk averse); and about the communicator (e.g., to inform or to change behaviour).

Gregory (1989) put forward three approaches to test the effectiveness of risk communication programs. The first is having the communication recipients rate the communication on dimensions such as clarity, completeness, or logical soundness. The second is conducting between-subject tests of internal validity. For example, having been given risk information will they react appropriately (e.g., undertake mitigation measures)? The third approach is within-subject comparisons of pre- and post-information perceptions. In this context an effective risk communication would be one that moves recipients in the direction appropriate to the nature and intent of the message.

Conclusion

As this literature review has demonstrated, as a field of study, risk perception and risk communication is a very broad area of investigation drawing upon knowledge from many disciplines. Part B documents the research component of the thesis. It focus on the question of how individuals determine the acceptability or unacceptability of risk-based decisions. The selected research topics and study design are described in Chapter 5 which includes a further exploration of the key literature pertaining to the research objectives.

PART B - RESEARCH PROGRAM

Chapter 5

Research Objectives and Study Design

Introduction

Following the literature review, three risk research topics were selected to become the focus of the research program. These were:

1. the structure of the risk concept;
2. how individuals determine the acceptability of risks and risk-related decisions; and
3. whether or not those directly affected by risk-related decisions apply different judgement strategies to those of individuals not directly affected by those decisions.

These three research topics reflect the researcher's interest in examining how psychological theories of risk can be applied to real world decision making about risk issues. As described in Part A of this thesis, there is a large and diverse body of risk literature. Some of the this literature is based on empirical psychology experiments in risk perception while non-experimental policy and planning articles on risk communication and risk management form another major section of the literature. However the linkages between these two areas of investigation are not well developed.

With respect to the risk construct there has been extensive empirical psychological investigation of this topic resulting in the development of hazard taxonomies. However a variety of attitudinally based studies have yet to provide clear guidance to real world risk decision makers. In fact, as discussed later in this thesis, the theory derived from these experimental research findings may in some cases be inappropriately applied in real world contexts. Other important issues such as why some people accept a particular risk decision while others reject the same decision has received realtively little empirical investigation in the risk literature. Yet this may be a more critical question for risk managers and decision makers than developing a general construct of risk. This reserach program will examine the three research topics described above not only from a theoretical perspective but also in terms of the application of attitudinally based findings to real world decision making. It is hoped that this research will contribute to a better understanding of the relationships between risk perception research, risk communication and risk management.

Each of the research objectives and its corresponding research design is discussed below. For each research objective a number of hypotheses are identified for testing. This is followed by descriptions of the questionnaire which forms the primary source of data for the research program and the survey methodology (e.g. identification of sample populations).

Research Objectives

<u>Research Objective #1</u>

> *Slovic, Fischhoff and Lichtenstein (e.g. Slovic et al. 1980; Fischhoff et al. 1978) and others have reported that a stable factor structure exists which is generally applicable to all hazards. This study examines the structure of a set of heterogeneous hazard domains and compares these findings with those of Slovic et al.*

The following hypotheses fall within the scope of this research objective:

1. There will be a constant factor structure for each of the tested hazard domains (Slovic et al. 1980)
2. That a 'dread' factor (Slovic et al. 1980) will emerge as the major determinant of perceived risk (i.e. overall level of risk).

<u>Background</u>

Much of the risk perception research has focused on how lay people define risk. As discussed in Chapter 2, it is now generally accepted that lay people use a broader and more complex definition of risk that do risk 'experts' (e.g. Slovic et al. 1979). Research has identified a number of qualitative characteristics which people appear to use when making judgements about risks both in terms of the overall level of risk and the acceptability of that risk (e.g. Otway & von Winterfeldt 1992).

Much of the ground breaking research on the qualitative aspects of risk was conducted by Slovic, Fischhoff and Lichtenstein (e.g. Slovic et al. 1980; Fischhoff et al.1978). They developed a taxonomy for hazards which they hoped would assist risk managers to understand and predict the public's response to different types of hazards. They argued that perceived risk is quantifiable and predictable, having found across a wide range of diverse hazards that many risk characteristics were highly correlated with each other. For example, risks considered to be voluntary were often also judged as controllable (Slovic 1987).

As Gregory and Mendelsohn (1993) have noted, the original factor analyses conducted by Fischhoff et al. (1978) and Slovic et al. (1980) have been granted "classic status" in the field of risk perception with many subsequent researchers having reported replication of their findings. For this reason it is worth while taking a closer look at how they conducted their studies. In their original study Fischhoff et al. (1978) asked four different groups to rate 30 risk related activities with respect to 9 risk characteristics. The study was then extended to a broader set of hazards (90 instead of 30) and risk characteristics (18 instead of 9) (Slovic et al. 1980). The characteristics were rated using a bipolar 7 point scale.

Using factor analysis (principal components analysis) in both studies, Fischhoff et al. (1978) and Slovic et al. (1980) found that the many qualitative risk characteristics or attributes could be reduced to a much smaller number of higher order factors or dimensions. The Fischhoff et al. (1978) study identified two factors, with the most important higher order factor being 'Dread Risk' (i.e., the degree to which a risk evokes a feeling of dread). The higher a particular hazard's score on this factor the higher its perceived risk. The other higher order factor reflected the degree to which a risk is understood and was referred to as the 'Unknown Risk' factor.

In their extended study (Slovic et al. 1980), they found that the pattern of intercorrelations among the risk characteristics could be represented by three underlying risk dimensions or factors. The factor structure identified by Slovic et al. (1980) for the 18 risk characteristics is shown in Table 1. The risk characteristics are described with respect to the end of the bipolar scale (i.e., a rating of 7). They labelled the first factor 'Dread'. Risks whose severity is considered to be uncontrollable tended also to be viewed as dreaded, catastrophic, hard to prevent, fatal, inequitable, threatening to future generations, not easily reduced, increasing, involuntary, and threatening to the respondent personally. These characteristics were found to be highly interdependent and comprise the 'Dread' factor.

Table 1. *Factor Structure from Slovic et al. (1980) Study*

Factor 1	Factor 2	Factor 3
• Severity not controllable • Dread (uncommon) • Globally catastrophic • Little preventative control • Certain to be fatal • Risks & benefits inequitable • Catastrophic • Threatens future generations • Not easily reduced • Risks increasing • Involuntary • Affects me personally	• Not observable • Unknown to those exposed • Effects immediate • New (unfamiliar) • Unknown to science	• Many people exposed

The second factor, labelled 'Familiarity' includes the characteristics: familiarity, knowledge of those exposed, whether it is observable, and immediacy of consequences. The third factor, labelled 'Exposure', consists of a single characteristic, the number of people exposed, which is relatively independent of the other characteristics.

Slovic et al.'s study (1980) found a high level of correlation among many of the qualitative risk characteristics. Within their 'Dread' factor the Pearson Correlation Coefficients ranged from a low of .33 to a high of .86. Similarly within the 'Familiarity' factor the correlations ranged from .32 to .87. Even though Factor 3, 'Exposure', was a single item factor (i.e., the number of people exposed) it correlated significantly with a number of other characteristics. It had a correlation coefficient greater than .30 for 7 of the other 17 characteristics.

Slovic et al., (1980) noted that this three factor structure differed considerably from the two factor structure they found in the initial smaller scale study (Fischhoff *et al.* 1978). They observed that "the particular set of hazards and the particular set of risk characteristics under study can have an important effect on the nature of the observed dimensions of risk" (p.199). Other studies have also found that different sets of hazards revealed somewhat different global factor structures. A study by Kraus and Slovic (1988) revealed a factor structure which substituted the 'Knowledge' factor with an 'Voluntary versus Involuntary Exposure to Risk' factor. Mullet et al. (1993) added an 'Evaluative' factor to the those factors that had been identified in previous risk studies (i.e., the Dread and Knowledge factors). They contended that the 'Dread' factor is the major determinant of riskiness while the 'Evaluative' factor is the primary determinant of risk acceptability.

However Bishop and Syme (1992) found that individual hazard domains have different factor structures. In their study of three hazard domains (traffic accidents, dam failure and bush fires), Bishop and Syme found that people did not use the same underlying frames of reference (i.e., risk dimensions) when making judgements of the three hazard domains. No single or global factor structure was representative of the three hazard domains they examined. In their study of perceptions of the hazard domain dams, Bishop and Syme (1992) found three higher order factors, an 'Impact' factor, a 'Familiarity' factor, and a 'Knowledge' factor.

There have been a number of criticisms of the Slovic et al. findings and interpretation both in terms of their methodology and the willingness of other researchers to adopt and generalise the findings despite their acknowledged limitations. One area of criticism is the non-representativeness of the subjects in the Slovic et al. studies. Gould et al. (1988) have questioned the degree to which the findings of these studies can be applied to the U.S. population in general or to non-American populations. This concern arises from the work of Slovic et al. being based on small, nonrandomly selected groups of volunteers. This problem has been compounded by the fact that despite Slovic et al. having noted the limitations of their studies, others have "cited their work, not only as established fact but as typical of the perceptions of technological risks by the public everywhere" (Gould et al., 1988; p.55).

Another limitation of the application of the Slovic et al. (1980) research was acknowledged by Kraus and Slovic (1988) in their study of individual perceptions of hazard domains. They noted that the original impetus for psychometric studies of perceived risk had come from an interest in why risks from some activities were treated differently to those of other activities. The unit of measure was the hazard or technology rather than the individual. The result being that "information about how individuals differ has been sacrificed in order to gain a more stable picture of differences between hazards" (Kraus & Slovic, 1988; p.436). They went on to report that these approaches have "not adequately considered how and why individuals differ in their judgements of risk".

Gould et al. (1988) have been critical of Fischhoff and Slovic for using group mean ratings to compute correlations across technologies rather than across persons. Other researchers, such as Borcherding et al. (1986) have applied both "person oriented" and risk "source oriented" perspectives to their risk analyses. Gould et al. chose to base their analysis not on aggregated measures but on the ratings of individual respondents for single technologies. Gardner and Gould (1989) used the 'person', rather than 'technology', as their unit of statistical analysis. A strength of their approach is that it avoids the problems of aggregation bias (Orcutt, Watts, & Edwards, 1968; Ostroff 1993). It also allows conditional theoretical statements regarding the types of technologies or hazards to which the general theory applies (Gould et al. 1988; Gardner & Gould 1989).

Their analysis was based on ratings made by individual respondents for single technologies rather than aggregate measures. Unfortunately for the purposes of comparison, Gardner and Gould utilised only three of the qualitative risk characteristics used in the Slovic et al. (1980) study. These were: (1) catastrophic potential; (2) degree of dread; and (3) the degree to which the risk was understood by scientists. A separate statistical analysis was conducted for each of the 6 technologies in the study. For each technology they found that the zero-order correlations between respondents' ratings of 'Overall Risk' and the 3 qualitative risk characteristics were low to moderate. The correlations were much smaller than similar correlations reported by Slovic et al. (1980). They also reported major differences among the technologies regarding how important the qualitative risk characteristics were in defining 'Overall Risk' (Gardner & Gould, 1989; Gould et al., 1988).

It is noteworthy that when Slovic, Fischhoff and Lichtenstein (1986) re-examined the data from Fischhoff et al. (1978) looking across individuals rather than hazards, they found that within-hazard correlations between perceived risk and other risk characteristics were much smaller than the cross-hazard correlations that had been based on group means. However they did report the same pattern of relationships with the qualitative characteristics 'severity of consequences', 'dread' and 'catastrophic potential' being the best predictors of perceived risk.

A number of researchers (Kraus & Slovic, 1988; Gardner et al., 1982; Harding & Eisner, 1984) have observed that if the relationships and factor structures found across sets of heterogeneous hazards by Slovic, Fischhoff and others could also be found within a single hazard, the theory would be strengthened.

Study Design

The methodology employed in this study will examine, across individuals, the relationships among the various risk characteristics for a heterogeneous set of 8 hazards. This study is similar to that of Gardner and Gould (1989) in that relationships are examined across individuals. This means that a direct comparison to the often cited Fischhoff and Slovic studies is not possible. However if the risk taxonomy developed by Slovic et al (1980) is sufficiently robust to be applied as a general theory to all hazards, one would predict that this approach should still support the findings of the Slovic et al studies even though it uses the person rather than the technology as the statistical unit of analysis.

Most of the qualitative risk characteristics included in this study were also examined by Slovic et al.. However a probability characteristic (i.e., likelihood of occurrence) and two benefit (i.e., individual and societal) characteristics were added to this study. In several instances characteristics that were included in the Slovic et al. study as single items were separated into two characteristics in this study. This allowed different aspects of the same attribute to be explored and thereby enrich our knowledge of these attributes. For example, the characteristics knowledge and control as well as risk acceptability were discriminated with respect to different groups. In the case of knowledge, respondents were asked how well the experts understand the risk and then as a separate characteristic how well those exposed to the risk would understand the risk. While it was hoped that this would increase the amount of information gained from respondents it also significantly increased the number of characteristics which respondents had to rate. the other trade-off was that it also reduced our ability to compare the results of this study with the findings of the Fischhoff and Slovic studies.

For this study an exploratory factor analysis was conducted rather than a confirmatory factor analysis. This was done for several reasons. As discussed earlier, a number of researchers have reported a stable 3-factor structure for heterogeneous sets of risk (eg. Slovic et al. 1980). However the nature of the 3 factors has differed from study to study (e.g. Mullet et al. 1993). Slovic and Fischhoff themselves noted that the 3-factor structure reported in their 1980 study (Slovic et al. 1980) differed considerably from the two factor structure they found in the initial smaller scale study (Fischhoff et al. 1978). The particular set of hazards and the set of risk characteristics under study having an important effect on the nature of the observed dimensions of risk. Studies of individual hazard domains (e.g. Bishop & Syme 1992) have reported that individual hazard domains have different factor structures. This suggests that individuals do not use the same underlying frames of reference (i.e., risk dimensions) when making judgements of different hazard domains. Since the literature did not identify an agreed upon factor structure for 'risk' which is generally applicable to all hazards, exploratory rather than confirmatory factor analysis is used in this study.

The factor analysis in this study differs from that conducted by Slovic et al. (1980) in several ways. The Slovic et al. study did not include the level of perceived riskiness and risk acceptability as qualitative characteristics. While the other risk characteristics were rated using a bipolar 7 point scale, perceived risk, risk acceptability and perceived benefit were measured by other means which allowed these variables to be quantified. In the case of acceptable risk, respondents were asked to rate the degree to which the present risk level would need to be adjusted to make the risk acceptable to society. A limitation of these quantifying procedures is that they constrained the definition which respondents could apply to the terms perceived risk, acceptable risk, and perceived benefit. For instance their procedure for measuring benefits allowed only economic benefits to be considered.

In this study, the variables perceived risk, risk acceptability and benefits are evaluated using the same 7 point bipolar scale that was applied for the other risk characteristics. This allows respondents to provide their own definitions for these terms just as they would if faced by a hazard in real life. The relationship between perceived riskiness (i.e., Overall Level of Risk) and risk acceptance and the other risk characteristics was of particular interest to this study. From the Slovic et al. studies one would predict that both of these characteristics (i.e., perceived riskiness and individual risk acceptance) would load onto the same factor which would also be the most dominant factor. Rather than factor analysis, Slovic et al. used linear regression analysis to examine the relationship between perceived riskiness, risk acceptability and the other risk characteristics (e.g., dread). By comparison, in this study, perceived riskiness and risk acceptability are treated as risk characteristics and are included in the factor analysis. This provided an additional opportunity to examine the relationships among all of the risk characteristics including perceived riskiness and risk acceptability. For each of the 8 generic hazard domains in this study, a Principal Axis Factor Analysis is conducted. Orthogonal (ie. varimax) and oblique rotations are used to aid in the interpretation of the factors.

Research Objective #2

> *Kraus and Slovic (1988) have reported that individuals discriminate among risks that fall within the same hazard domain. This finding is tested by using factor analysis to examine 4 risk issues representing 2 hazard domains (i.e. asbestos and toxic waste incineration).*

Specific hypotheses that fall within this research objective are:

1. For specific risks which belong to the same hazard domain, the factor analyses will reveal qualitatively different factor structures.
2. The factor structures for each of the risks described in the risk scenarios will differ substantially from those of their respective generic hazard domains (i.e. toxic waste incineration and asbestos).

Background

As discussed in Chapter 2, Kraus and Slovic (1988) examined whether the structure derived by Fischhoff and Slovic from a 'global' analysis across heterogeneous sets of hazards (Slovic et al., 1980), would also pertain to a 'local' set of hazards all falling within the same hazard domain. They tested whether or not a diverse set of hazard scenarios from a single domain (e.g. railroads) would be judged on various risk characteristics in a similar manner as a heterogeneous set of hazard domains. They constructed a diverse set of 49 railroad hazard scenarios and asked 48 paid subjects to rate each scenario using the same risk characteristics applied in previous studies. In addition, subjects rated each hazard on its overall level of risk.

In their analysis, Kraus and Slovic used mean ratings, taken across subjects, for each of the 7 qualitative risk characteristics for each of the 49 railroad hazards. These were subjected to a Principal Components Factors Analysis, using varimax rotation, to determine if the 7 characteristics could be explained by a smaller number of factors or dimensions. They reported that the characteristics could be represented by 2 factors which accounted for 78% of the total variance among the risk characteristics. Factor 1 is associated with the characteristics of voluntariness, control, and knowledge. Factor 2 was most strongly defined by the characteristics catastrophic potential, newness, and equity. The effects of dread were split between the 2 factors. They noted that the resulting factor structures bore a number of similarities with previous research findings for heterogeneous sets of hazards. One similarity being that the qualitative risk characteristics could be well represented by a smaller set of higher order factors. As in earlier studies, the characteristics knowledge and catastrophic potential were both found to be major components of the factor space, each loading onto different factors. Similarly, overall risk was highly correlated with the characteristics catastrophic potential and dread.

However the inter-relationships among a number of the risk characteristics were quite different to those reported by studies of heterogeneous hazard sets. Characteristics such as catastrophic potential and newness which had loaded onto the same factor in previous studies, loaded onto different factors in the railroad study. Similarly the characteristic control loaded differently in this study. Kraus and Slovic believed these unexpected results were a function of the specific set of railroad hazards presented to the respondents. Another unexpected finding was that the characteristic dread, which had been a primary component of the "dread" factor in previous studies did not play a strong role in the railroad study. The researchers speculated that this result was due to respondents not viewing railroad hazards as being particularly dreaded.

Kraus and Slovic (1989) concluded that "the dimensions of any hazard space are likely to be dependent on the nature of the set of hazards being described" (p. 454). Noting the stable factor structures and factor spaces which they had found in previous studies of diverse sets of hazards, they argued that "for a diverse set of hazards, variations in the set may make little conceptual difference" but "even a slight variation in a more homogeneous set of hazards may have a much larger effect" (p. 454). The implication being that factor representations for hazards within the same domain are likely to be less consistent than the representations that have been found for heterogeneous hazard sets.

Study Design

The methodology employed in the examination of homogenous hazard domains is basically the same as that applied in the examination of the heterogeneous set of 8 hazard domains described earlier. Rather than being provided with a list of generic hazards as in the previous exercise, respondents are presented with descriptions of four risk issues. The four risk issues represented two hazard domains (i.e. asbestos and toxic waste incineration). This design differs from most previous studies, including that of Kraus and Slovic (1988), in that the risk issues presented to respondents as risk scenarios are based on real issues that have already received local media coverage rather than being hypothetical situations.

As with the heterogeneous set of 8 hazards, respondents are first presented with the risk issue and then asked to rate a list of risk characteristics on a bipolar scale ranging from 1 to 7. To allow comparison of the findings for heterogeneous and homogenous domains, similar risk characteristics are rated and the two hazard domains (i.e. asbestos and toxic waste incineration) are common to both exercises. As in the analysis of generic hazards, Principal Axis Factor Analysis is used to explore the factor structure of each of the four risk issues. Varimax and oblique rotations are used to aid in the interpretation of the factors.

Research Objective #3

Are perceived riskiness and risk acceptability basically indicators of the same thing or do they reflect different aspects of the concept 'risk'? The relationships between perceived risk, risk acceptability and other risk attributes or characteristics identified in the risk literature (e.g. Slovic et al. 1980) are examined for a heterogeneous set of hazard domains.

Specific hypotheses which fall within the scope of this research objective are:

1. For each generic hazard domain many of the risk characteristics will correlate strongly with both perceptions of perceived risk and risk acceptability (e.g. Slovic et al. 1980).

2. A strong and positive correlation exists between the characteristics individual acceptance and societal acceptance (Slovic et al. 1980).

3. That the perceived level of overall risk will explain the greatest amount of variance in individual risk acceptance when compared with other risk attributes in a standard regression.

4. The characteristics 'benefits to society' and 'benefits to the individual' significantly and positively correlate with risk acceptability but not perceived riskiness.

Background

As reported in Chapter 2, previous researchers including Slovic and Fischhoff have reported, across a wide range of hazards, that some risk characteristics are highly correlated with each other and that some characteristics could by themselves be good predictors of perceived riskiness and risk acceptability (e.g. Slovic et al. 1980; Gardner & Gould 1989; Gregory & Mendelsohn 1993; Mullet et al. 1993; Fischhoff et al. 1978; Kraus & Slovic 1988).

As discussed previously the Fischhoff et al. (1978) and Slovic et al. (1980) studies are the classic studies on this topic. Fischhoff et al. (1978) found that across all 30 risk items, perceived risk correlated highly with 2 of the 9 qualitative risk characteristics rated (i.e. dread and severity of consequences) but not with other qualitative risk characteristics (Table 2). The other characteristics being: volition, immediacy of effect, expert knowledge, knowledge of those exposed, personal control, newness, and chronic-catastrophic. Of the three non-expert groups tested, they reported that the risk judgements of two of the groups could be predicted "almost perfectly" from their ratings of dread and severity, a subjective fatality estimate, and an estimate of disaster potential.

By examining the mean ratings for 18 risk characteristics across 90 hazards, Slovic et al. (1980) reported that the various risk characteristics tended to be highly intercorrelated. For example, risks with catastrophic potential were also dreaded (r = .83). Perceived risk was found to be closely related to a number of qualitative risk characteristics: threat to future generations, potential for global catastrophe, personal threat, and inequitability (Table 2).

Table 2. *Correlations Between Perceived Risk, Risk Acceptability and Other Characteristics From the Slovic et al. Study (1980)*

Risk Characteristic	Perceived Risk* (1978 study)	Perceived Risk	Risk Acceptability (Adjusted Risk)
Dread	.64	.83	.87
Future generations		.80	.82
Global catastrophe		.78	.77
Fatal (severity)	.67	.74	.76
Increasing		.73	.74
Affects me		.70	.73
Inequitable		.68	.69
Not easily reduced		.63	.65
Uncontrollable	-.04	.63	.65
Not preventable		.51	.57
Catastrophic (chronic)	.30	.50	.54
Involuntary	.08	.39	.42
Many exposed		.25	.17
New	.05	.17	.16
Immediate	-.07	.10	.14
Unknown to exposed	-.20	-.06	-.09
Not observable		-.19	-.22
Unknown to science	-.17	-.27	-.23
Perceived benefit		-.42	-.54
Perceived risk			.91

* 1978 study included only 9 risk characteristics (Fischhoff et al. 1978).

That study also identified perceived risk as the primary determiner of risk acceptability or what they referred to as "adjusted risk" (r = .91). Some characteristics which highly correlated with perceived risk were also significantly correlated with risk acceptability but not as strongly. These were the characteristics dread, global catastrophe and equity. Slovic et al. concluded that perceived risk and risk acceptance are quite predictable from knowledge of other risk characteristics.

Through multiple linear regression analysis, they developed equations involving combinations of characteristics which could predict the ratings for perceived risk and adjusted risk (i.e., risk acceptance). They reported that a linear combination of the characteristics comprising the Dread factor could serve as a model for predicting the mean risk ratings, across individuals, for a diverse set of hazards (Slovic et al. 1980).

Slovic, Fischhoff and Lichtenstein (1986) re-examined the original data from Fischhoff et al. (1978) looking at correlations between perceived risk and various risk characteristics within each of the 30 hazards. They found correlations between perceived risk and the other risk characteristics within hazards to be much smaller but still consistent with the pattern shown for the cross hazard correlations which were based on group means. Once again the dominant risk characteristics of the Dread factor (i.e. severity of consequences, dread and catastrophic potential) were considered to be the dominant predictors of perceived risk.

However Gould et al. (1988), applying correlation and multiple regression analyses, did not find a consistent pattern of dominant characteristics across a range of technologies. They found considerable differences among technologies as to how important they were in determining perceived risk for a particular technology. They reported that among the 6 technologies they investigated, the characteristic dread was important in determining the perceived risk attached to 5 of the 6 technologies with auto travel being the exception. This is consistent with the findings of earlier research by Slovic, Fischhoff and Lichtenstein. However, Gould et al. found that the characteristic catastrophic potential was only moderately important in the cases of nuclear power, nuclear weapons, and industrial chemicals, and virtually irrelevant to auto travel, air travel, and handguns. In addition they reported that the perceived level of understanding of the risk played little or no part in determining the perceived riskiness of any of the 6 technologies.

Study Design

This study is similar to the Slovic, Fischhoff and Lichtenstein (1986) and Gould et al. (1988) studies in that it examines the relationship between perceived risk and other risk characteristics for individual hazards rather than for combined sets of heterogeneous hazards. For each of the 8 hazard domains a risk profile is developed based on the mean ratings of the risk characteristics presented to respondents. Correlation and regression analyses are then employed to explore the relationships between perceived risk, risk acceptability and other qualitative aspects of risk for each hazard domain. The outcomes of these analyses are compared with the findings of previous studies. The results of these analyses are then extended through the use of path analysis. This allows an exploratory assessment of the direct causal contribution of one variable (i.e., risk characteristic) to another.

Research Objective #4

> *Firstly, to determine whether or not individuals employ the same judgement strategy or model when assessing the acceptability of risk-related decisions as they do when determining the perceived level of risk associated with a hazard. Secondly to assess whether those who agree with a risk-related decision employ a similar or different judgement strategy or model to those who find the same decision to be unacceptable.*

Specific hypotheses which fall within the scope of this research objective are:

1. Individuals will apply different judgement strategies in determining the acceptability of a risk based decision than they use in assessing perceived risk.

2. Individuals who reject a risk based decision will apply a different judgement strategy to that used by those who accept the same decision (Otway, Maurer & Thomas 1978).

3. The judgement strategies used by lay persons will differ significantly from those used by risk experts (Slovic et al. 1979).

4. Benefits to society or to the individual will play an important role in determining the acceptability of risk based decisions.

5. A significant positive correlation exists between the characteristics individual acceptance and societal acceptance.

Background

As described in Chapter 2, most previous psychological research has focused on how people view the riskiness or acceptability of particular hazards (e.g. Slovic et al. 1980). Much less attention has been paid to how people determine whether or not the decisions taken to address risk issues are acceptable. The literature review also revealed that when decision making is examined it is most often in terms of how decisions should be made rather than how they are made in the real world (Janis & Mann 1977) (see Chapter 3). Yet the risk literature suggests that many risk debates are less about a particular risk than they are about other aspects of decision making such as the distribution of power (e.g. Armour, 1993). It is not difficult to envisage a situation in which most individuals could agree on the level of risk and even the acceptability of that risk but not agree as to the acceptability of a decision taken by other parties to address that risk. The relationship between the decision strategies employed to determine the perceived riskiness of a hazard and those used to determine the acceptability of a risk-related decision has not been adequately investigated in the past. Yet such an analysis could extend our understanding of risk debates.

If we assume for the moment that individuals employ somewhat different strategies when determining riskiness as opposed to decision acceptability, is it reasonable to assume that all people are applying similar judgement strategies or is it more likely that those who find a decision to be unacceptable might be employing a different strategy to that of those who found the decision acceptable? The risk and decision making literature suggests that different strategies or judgement models might be the case. Some researchers have examined the decision strategies used by different attitude groups. Researchers examining the structure of people's attitudes towards risks, especially nuclear energy, found that different dimensions of a risk issue appear differentially salient to different attitude groups. Otway, Maurer and Thomas (1978) found that for pro-nuclear groups the economic and technical benefits were most important while beliefs about psychological risks (fear, stress, etc.) were most important for those opposed to nuclear energy.

Along similar lines, Eiser and van der Pligt (1979) and van der Pligt et al. (1982) found that individuals with opposing attitudes viewed different aspects of a risk issue as salient with the two groups disagreeing both over the likelihood of consequences and over their importance. They found that the "overall attitude of respondents was more closely related to ratings of - in their view - important aspects than of their ratings of the subjectively less important aspects" (Eiser & van der Pligt 1988, p156). They too found that proponents of nuclear energy stressed the importance of economic benefits and paid less attention to environmental and health risks while opponents did the opposite.

Study Design

This study examines the judgement strategies or models that individuals use to determine the acceptability of risk related decisions. Respondents are presented with four risk scenarios in a questionnaire. Each scenario consists of a risk issue and a decision taken to resolve the risk issue. For each of these risk issues respondents are asked to rate a number of risk characteristics on a bipolar scale ranging from 1 to 7. These ratings are then used to develop a risk profile for each risk issue. Multiple Linear Regression Analysis and Pearson Correlation Coefficients (r values) are employed to identify the primary determinants of perceived riskiness for each of the four risk issues. The outcomes of the regression analysis can be thought of as describing the 'judgement models' that respondents applied in determining the overall level of risk attached to the risk issues.

After having rated the characteristics of a risk issue, respondents are presented with a decision taken to address the risk issue. Whereas respondents had earlier been asked to rate the acceptability of the risks associated with the heterogeneous set of 8 hazard domains, this part of the study asks respondents to rate how acceptable the decisions portrayed in the four risk scenarios are to them as individuals and to society. Using a weighting and ranking procedure similar to that used in MAUT (Multi-Attribute-Utility-Theory) methodologies (Edwards & Newman, 1983), respondents are asked to indicate how important each of the risk characteristics has been in determining their acceptance or rejection of the decision portrayed in the risk scenario.

The analysis of the importance weightings and ranking provides a judgement model of how respondents determined decision acceptability for each risk decision. These judgement models are then compared with their corresponding models for perceived riskiness which were developed using a different methodology (i.e. regression analysis). Such a comparison will provide a greater understanding of the degree to which individuals rely on the characteristics of perceived riskiness when assessing decision acceptability.

The work of Fischhoff and Slovic has been criticised for providing respondents with a list of risk characteristics rather than letting respondents identify important characteristics. This issue is addressed in this study by allowing respondents to identify any additional characteristics or considerations which played a role in their judgements of the riskiness of an issue or the acceptability of the decision taken. It is assumed that any additional considerations identified through these open ended questions would have played a significant role in respondents' thinking.

The second component of this exercise examines whether those who agree with a decision employ a different judgement strategy to that of those who find the same decision to be unacceptable. To test this, for each risk decision, respondents are assigned to one of two groups. Respondents who rated a decision as acceptable form one group while respondents who rated the same decision as unacceptable comprise the second group. For each decision, the two groups are compared with respect to the mean importance rankings they gave to the various risk characteristics. Discriminant analysis is used to determine whether or not the two groups are employing different judgement strategies to evaluate decision acceptability. This is a issue which has received little if any attention in the risk literature.

Research Objective #5

> *To investigate whether those individuals directly affected by a risk related decision utilise similar or different judgement strategies to those not directly affected by the same decision.*

Specific hypotheses which fall within the scope of this research objective are:

1. That NIMBY individuals employ judgement strategies similar to those of unaffected individuals who reject the same decision.

2. That NIMBY individuals will rely significantly on characteristics such as trust, personal control, volition and equity in their judgement strategies (Armour 1993).

Background

Local communities often reject risk related decisions that others in the broader community consider to be acceptable. Many risk issues (e.g. the siting of locally unwanted landuses such as landfills) generate such reactions. Often described as NIMBY (Not-In-My-Backyard) reactions, the reasons for such perceptions and their legitimacy in public decision making have not received adequate attention in the psychological literature.

Are NIMBYs employing different judgement strategies than non-NIMBYs? If they do employ different strategies, this may explain why NIMBY communities often reject decisions that others find acceptable. One possibility is that those individuals who perceive themselves as being directly affected by decisions (i.e. NIMBYs) judge those decisions in a manner similar to that of unaffected individuals who also reject the decision. In other words NIMBYs employ a judgement strategy similar to that of the non-NIMBY 'unaccepting group' described earlier. Another possibility is that people employ completely different judgement strategies when faced with a decision that could directly affect them and their families than they would if they were not directly affected. This would be consistent with Janis and Mann's (1977) concept of "hot cognitions" as well as the concept of social amplification of risk (Renn et al. 1992).

What form might a NIMBY style strategy take? Much of the NIMBY literature pertains to facility siting and has increasingly focused on the issues of procedural justice and trust (e.g., Bord & O'Connor 1992; Mitchell 1992; and Pijawka & Mushkatel 1991; Armour 1993; Hunter & Leyden 1995). A number of the risk characteristics examined in this study are related to issues of trust. The degree of personal control over a risk, the voluntary nature of exposure and the distribution of risks and benefits (i.e., equity issues) are all closely related to the issue of trust. One might anticipate that members of a NIMBY group would rely on these characteristics when assessing the riskiness of a hazard or the acceptability of a decision that would directly affect them.

Study Design

To explore this issue one of the three sample populations is drawn from a resident action group that at the time of the study was opposing the continued operation of a biomedical waste incinerator in their neighbourhood. To allow comparison of NIMBY and non-NIMBY perceptions, the biomedical waste incinerator issue forms the basis for one of the 4 risk scenarios described in the questionnaire administered to all respondents.

The respondents from the resident action group comprise the NIMBY group in this analysis. To assist the researcher in gaining further insight to the thinking of the NIMBY respondents, small group discussions will be conducted with respondents to the questionnaire. This will allow the researcher to explore issues such as the effect of group interaction on individual perceptions of risk and the role of certain risk characteristics such as trust.

A One-Way ANOVA (Bonferroni adjusted) is used to compare the decision acceptability ratings of the NIMBY and non-NIMBY respondents. The importance rankings given to the various risk characteristics are analysed through discriminant analysis to ascertain whether or not NIMBY and non-NIMBY respondents are applying similar judgement strategies. This analysis is also used to examine whether or not risk characteristics that have been discussed in the NIMBY literature (e.g. trust, controllability) are dominant determinants of decision acceptability for the NIMBY respondents in this study.

Design of Questionnaire

A survey questionnaire is used as the principal method of data collection for the study. The design of the questionnaire and the survey methodology are discussed in the following sections. The questionnaire, which is attached as Appendix A, consists of two components - Parts A and B. Part A is related to research objectives 1 and 3 while Part B pertains to research objectives 2, 4 and 5.

Part A - This part of the questionnaire was designed to examine the findings of Fischhoff et al. (1978) and Slovic et al. (1980) regarding the structure of generic hazard domains. Respondents were asked to consider eight hazard domains. The domains were chosen on the basis that they are familiar to Australians and would fall within different quadrants of the factor space defined by Slovic and Fischhoff. The domains were: asbestos, surfing, bush fires, toxic waste incineration, dams, bicycles, vaccinations, and sunbathing. Respondents were not provided with any description or context for the hazard domains and in this sense they can be viewed as generic hazard domains. In the case of bush fires, respondents were informed that this hazard domain did not include controlled burns similar of the type annually conducted by the Department of Conservation and Land Management (CALM) in the Perth metropolitan area. This was done because controlled burns are different in their characteristics from other types of bush fires which result from nature (e.g., lightening strikes) or human activity (e.g., human carelessness or arson).

Respondents were presented with a list of 13 risk characteristics and asked to rate each of the hazard domains in terms of each of the characteristics. Respondents were also asked to rate the overall level of risk associated with the hazard domain and the acceptability of the risk. Risk acceptability was examined from the perspective of the respondents own perceptions and how accepting they believed society would be of the same risk. The ratings exercise used seven point bipolar scales (see Table 3).

The risk characteristics selected for this exercise were a subset of the over thirty characteristics or risk attributes that have been identified in the risk literature. If left undefined, many of the characteristics could be interpreted in a number of

Table 3. ***Risk Characteristics and Scales Used In Questionnaire***

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Risk is assumed involuntarily*

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*People greatly dread this risk*

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g., government, medical profession, industry, etc.).

High level of trust in institution	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Low level of trust in institution*

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Experts have little understanding of the risks*

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risks and benefits distributed equally	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Risks and benefits distributed unequally*

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Those exposed know little about the risks*

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g., nonfatal, fatal) will be the consequence.

Consequences would not be severe	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Consequences would be severe.*

H. Number of people exposed

Refers to how many people are exposed to the risk.

Very few	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Many*

I. Institutional Control

Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Low level of control possible*

Table 3. ***Risk Characteristics and Scales Used In Questionnaire* (continued)**

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Low level of control possible*

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Small amount of benefit*

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Small amount of benefit*

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Highly likely*

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Extremely risky*

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Very Unacceptable*

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Very Unacceptable*

ways. Which definition a person used would affect the rating they gave for the characteristic. To address this issue brief definitions were provided for each of the risk characteristics to encourage consistency in the interpretation of the characteristics by respondents. The characteristics used in Part A of the questionnaire are shown in Table 3.

In several instances characteristics which have been used in other studies were divided into two characteristics so as to examine different aspects of the same attribute. For example the relationship between perceived risk and perceived benefits has received considerable attention in the risk literature (e.g. Rohrmann 1994, Gould et al. 1988, Fischhoff et al. 1978, Gregory & Mendelsohn 1993, Starr 1969). As in the Borcherding et al. study (1986), the influence of benefits was examined from two perspectives, benefits to the individuals who would be exposed to the risks and benefits to society as a whole (see Table 3).

Obviously some caution must be taken in comparing the results with studies which have employed different definitions for the same characteristics. For example the term 'benefit' itself was not restricted in this study allowing the respondent to define the meaning for him or herself. Research by Gardner and Gould (1989) indicated that people can discriminate between different types of benefits and employ a broader concept of benefit than merely the economic benefits which Starr (1969) used in his "revealed preference" approach. For the purposes of this study a person may equate the term benefit solely with economic gain or they may include qualitative aspects of benefits such as pleasure and satisfaction or contribution to basic human needs.

The characteristics knowledge and control as well as risk acceptability were also discriminated with respect to different groups. In the case of acceptability it was between the individual answering the question and society in general. In the case of knowledge, respondents were asked how well the experts understand the risk and then as a separate characteristic how well those exposed to the risk would understand the risk. Similarly, separate characteristics distinguished the ability of the responsible institutions to manage the risks and the ability of those exposed to the risks to exert control over the risks. While it was hoped that such delineation would increase the amount of knowledge gained from respondents there was the down side of significantly increasing the number of characteristics which respondents had to rate.

In some instances the definitions provided are intentionally somewhat open ended. An example being the characteristic 'the number of people exposed to the risk'. The scale ranged from 1 'few' to 7 'many'. One might ask what constitutes a few or many and indeed a few respondents asked that very question. However it would have been inappropriate to define in any quantifiable manner what constituted few or many as it is the respondent's perceptions that are important. It really does not matter if one respondent believes that 50 persons is 'many' while another respondent believes that 50 persons is 'few'. What is important is that one respondent believes that many people would be affected while the other believes that few would be affected. The same rationale applies to the benefits characteristics in the questionnaire.

Part B - This part of the questionnaire was used to examine respondents' perceptions of real world risk-based decision making. The major research question being how individuals decide whether or not decisions are acceptable. This part of the questionnaire presented respondents with four risk scenarios, belonging to two of the hazard domains included in Part A: asbestos and toxic waste incineration. This allowed comparison of respondents' characterisations or risk profiles of the generic hazard domains in Part A with the risk profiles of the same hazard domains when presented in the context of specific risk scenarios in Part B.

The scenarios were formulated to reflect risk issues that have been publicly debated in or are well known to the Western Australian community. Asbestos has been a major risk related health issue in the State for many years due to asbestos mining in the Pilbarra Region and the health legacy of mesothelioma and asbestosis associated with the mining of and exposure to asbestos. Waste management issues have also been on the public agenda for a number of years with the Federal Government having failed to site a national hazardous waste incinerator in the early 1990s. In the Perth metropolitan area difficulties in siting regional landfills and health concerns about emissions from biomedical incinerators have lead to some public opposition to such waste management facilities at the local community level.

Two risk scenarios were formulated for each of the two hazard domains (i.e. asbestos and toxic waste incineration). This was done to allow comparison with the findings of Kraus and Slovic (1988) regarding risk perceptions within homogeneous hazard domains. The four scenarios can be summarised as follows:

<u>Hazard Domain - Asbestos</u>

> ***Scenario A:*** *The State Government chooses to close down a former asbestos mining town due to the risk of asbestos contamination from a nearby asbestos mine which is no longer operational. This decision is taken despite the fact that some residents wish to stay regardless of the health risks because the town is their home.*

Scenario B: *The State's Education Department decides to remove asbestos from the roofs of schools to allay the health concerns of parents and staff despite any risks that may be associated with the asbestos removal process.*

Hazard Domain - Toxic Waste Incineration

Scenario A: *The State's environmental approvals agency grants permission to site a hazardous waste incinerator in a rural area despite local concerns about health impacts.*

Scenario B: *Despite the fears of local residents regarding air and water contamination, government environmental authorities grant approval for an old biomedical waste incinerator to continue operating in an urban setting under the condition that state of the art technology be brought on-line within 2 years.*

The final scenario (i.e., Incineration Scenario B) was based closely on a risk issue that was ongoing at the time of the study. One of the sample populations for the study was drawn from the community involved with this particular waste incineration issue. This was done so as to allow comparison of the risk perceptions of directed affected residents with those of individuals not directly affected by the issues described in the scenarios.

A full description of each risk scenario is included in Chapter 8. Prior to presenting the scenarios, respondents were given a limited amount of general background information on the two hazard domains (see Appendix A). The background information was supplied so that respondents had a common understanding of some of the basic facts associated with these risk domains. In an attempt to minimise bias and value judgements in this information, the background summaries were compiled using encyclopaedia descriptions of the two hazard domains. While no information can be totally value free, this approach seemed as neutral as any. Less than a handful of respondents sought any additional information regarding any of the risk scenarios in Part B. This suggests that respondents found the level and amount of information to be a satisfactory basis for drawing conclusions. Similarly, respondents to Part A did not seek further information about any of the 8 hazard domains despite the fact that they were provided with no more than a one word description of the hazard (e.g., bicycles).

In each of the four scenarios, respondents were presented with a description of a risk issue facing an identified decision maker. They were then asked to describe the risk in question using the same characteristics and rating scales applied in Part A of the questionnaire. The exceptions being that respondents were not asked to rate the acceptability, either to them or to society, of the risk described in the scenario. These risk acceptability scales were omitted to minimise confusion over two types of acceptability. This confusion was evident from pre-tests. That is the acceptability of the risk described in the problem (as in Part A) versus the acceptability of the decision taken to address the risk issue in Part B.

Having described the risk issue in terms of its characteristics, respondents were then presented with the hypothetical decision taken to resolve the risk issue portrayed in the scenario. After rating the acceptability of this decision, both to themselves and to society, respondents were asked to indicate which of and to what extent the various risk characteristics played a role in determining the acceptability of the decision portrayed in the scenario. The ranking and weighting methodology employed was similar to that used in Multi-Attribute Utility Theory

(MAUT) (Edwards & Newman, 1983). Respondents were provided with an example of the ranking and weighting methodology being used for a non-risk issue. The example provided was the purchasing of a new car.

As discussed earlier, for each scenario, respondents were also provided with the opportunity to identify any other factors which significantly influenced their thinking when determining the acceptability of the decisions portrayed in the risk scenarios. The concluding questions in the survey requested demographic data concerning the age and gender of the respondents.

Pilot Testing of Questionnaire

A number of modifications were made to the original questionnaire design after pre-testing 15 subjects including in-depth interviews. The in-depth interviews were used to explore the adequacy of the background material provided on the asbestos and waste incineration hazard domains as well as the clarity of the characteristics, scenarios, and instructions for weighting and ranking risk characteristics.

The use of decision scenarios based on risk issues was central to the exercise but posed problems in terms of design. Initially the scenarios in Part B were written so as to present the risk issue or problem facing the decision maker together with the decision taken in response. These were presented together as a 'scenario'. Pre-testing revealed this to be problematic as it was difficult for a respondent to rate the characteristics of the risk issue in the presence of the decision described in the scenario. For example, with respect to the characteristic 'equity', was the respondent rating the 'equity' of the risk described in the scenario or the 'equity' of the decision taken to address that risk?

To overcome this problem the scenarios were divided into two parts. The respondents were first presented with the specific risk issue in question. They were then asked to describe the risk portrayed in terms of the risk characteristics listed. Having completed this exercise, respondents were then told what decision had been made in response to the risk issue portrayed in the scenario. They were then asked to indicate, using a ranking and weighting procedure, how important various characteristics were in determining their opinion as to the 'acceptability' of the decision described in the second part of the scenario. The methodology for ranking and weighting characteristics was quite onerous. Pre-test respondents indicated difficulty in weighting the full list of fourteen characteristics, especially those characteristics which were not important to their thinking. In response the methodology was modified so that respondents as part of the weighting process could, as a first step, identify any characteristics which did not play a role in determining their assessment of the acceptability of the decision portrayed in the particular scenario. The remainder of the characteristics would then be weighted. The ranking exercise remained the same with all fourteen characteristics being ranked from most important (a rank of 1) to least important (a rank of 14).

As part of the debriefing exercise pre-test respondents were asked to explain any differences in their ratings of their acceptance of a risk or decision and that of society in general. Pre-test respondents indicated that they were more rational decision makers than their fellow members of society. The ratings in the majority of cases varied only + or - 1 or 2 points on the seven point scale between individual and societal judgements of acceptability. Yet these individuals in every instance made some reference to their being more 'rational' than the average member of society. This rationality taking the form of being less emotional and more analytical, having a more complex view of the problem rather than keying on a few characteristics or considerations, or taking a more economically rational approach to judging the situation than society would.

The debriefing also revealed that despite the provision of definitions for the characteristics some respondents tended to utilise their own definition of the characteristic depending upon the hazard domain in question. There was a tendency to change the definition to suit what they viewed as being the characteristics of the hazard domain. This switching of definitions appeared to occur most often with respect to the risk characteristic 'equity'. This is an issue that should be examined further.

Sample Populations

This study was designed to obtain data from three different populations. Those populations being: Curtin University psychology students; residents of the suburb of Craigie; and members of a citizen action group known as the Felspar Road Action Group or FRAG which is based in the suburb of East Cannington.

One sample population was drawn from Curtin University psychology students completing years 1 and 3. Most of those who completed questionnaires did so as a tutorial exercise for their course. The others volunteered to complete the questionnaire. The second sample was drawn from the residential suburb of Craigie which is a northern suburb in the Perth Metropolitan area. This area was selected because it is far removed from the East Cannington area, there is no ongoing risk controversy in this community, and the suburb has similar socio-economic characteristics to the East Cannington area. Both the East Cannington and Craigie suburbs would be characterised as being a mixture of lower and middle income households.

As described earlier, one of the risk scenarios was based on a risk issue ongoing at the time of the study in the suburb of East Cannington. The issue involved a biomedical waste incinerator that local residents have been fighting to have removed for a number of years due to fears of air and groundwater contamination due to stack emissions. Residents opposing the incinerator's continued operation at its current site formed the citizens group FRAG. A sample was drawn from the FRAG membership.

Sample Size and Characteristics

A common criticism of many risk perception studies is that they rely solely on university students as participants and thus are not representative of the general population. This study attempted to address this shortcoming of by being a field based study. In this study two of the three sample populations were drawn from real communities, with the third coming from a student population.

In total 239 individuals participated in the survey. From the Curtin student population, 117 psychology students (years 1 and 3) completed both Parts A and B of the questionnaire. An additional 36 completed only Part B. The respondents drawn from the Craigie and East Cannington suburbs completed only Part B of the survey. From the suburb of Craigie 57 people completed Part B. Twenty-nine residents from East Cannington, each a member of FRAG, completed Part B of the questionnaire.

The original design of the study had all respondents completing both parts of the questionnaire. After having administered 50 questionnaires to the student sample, it was decided that the length of the questionnaire would dissuade members of the general community from participating. Part B was viewed as the more important part of the questionnaire and thus the decision was made to administer only Part B to respondents not drawn from the Curtin University population.

The age and gender of respondents are summarised below in Tables 4 and 5. As one would expect, the average age of respondents from the student sample was significantly lower (average 24.4 years) than that of either of the samples drawn from the general community (see Table 4). The student sample was also unbalanced with respect to gender with almost 70% of respondents being female. This reflected the gender imbalance within the psychology student population.

The majority of respondents drawn from the suburb of Craigie were female. This may reflect the fact that the door to door canvassing for survey respondents was conducted during the daytime when more women than men would be at home. This was necessitated by state laws limiting door to door canvassing to 6pm or earlier. In the case of the East Cannington sample, the questionnaire was administered during the evening and this may explain the fact that more males than females responded to the survey (see Table 5). Despite the fact that the questionnaire was anonymous, a small number of respondents did not provide either their age or gender when completing the questionnaire.

Table 4. *Age of Respondents in Years*

Sample	N	Lower	Upper	Mean	SD
Complete Sample	233	15	68	29.6	12.23
Curtin Students	147	17	52	24.43	7.67
Craigie Residents	57	15	68	36.82	12.84
East Cannington Residents	29	19	67	43.37	13.48

Table 5. *Gender of Respondents*

Sample	% Female	% Male
Complete Sample	63.5	33.0
Curtin Students	69.4	29.9
Craigie Residents	59.6	31.6
East Cannington Residents	41.4	51.7

Administration of Questionnaires

It had originally been hoped that over 300 questionnaires would be completed for the study. However attaining the desired sample size proved to be a very difficult task for a number of reasons. The questionnaire was self-administered to the Curtin psychology students. The participants from the student body were asked to volunteer their time to complete the questionnaire. There was no financial or other form of compensation (e.g. course credit) offered to these respondents. Some of the questionnaires were completed during class or lab time with the researcher present to answer any queries that respondents had regarding instructions. In other cases students took the questionnaires away from class to complete during their own time. The researcher's telephone number was provided should they have any questions while completing the questionnaire. There are a number of reasons for why many students were unwilling to participate in the survey. These include the fact that no reward was offered for their participation, unlike some psychology experiments it was not a "fun" activity, and it may simply have been a low priority activity for students already engaged in courses, assignments and exams.

In the suburb of Craigie the questionnaire was administered as a drop off and pick up survey. Two CSIRO field assistants contacted residents by going door to door in the area between the hours of 9.00 AM and 6.00 PM. Potential respondents were informed of the voluntary nature of the survey and confidentiality regarding responses. If a resident agreed to complete a questionnaire, a copy was left with them along with a covering letter explaining the purpose of the research project and the name and phone number of the researcher should they have any questions about the questionnaire. Arrangements were made with the respondents regarding a time to pick up the completed questionnaire. As an inducement for participating in the survey, each respondent who completed a questionnaire was given the opportunity to enter a draw for a gift dinner voucher for a local restaurant. Over

350 households had to be contacted to obtain the 57 completed questionnaires from the suburb of Craigie.

The third sample came from members of FRAG who live in the Perth suburb of East Cannington. As with many NIMBY type situations the citizen action group consisted of less than 50 active core members although a larger number might come out in support of a special event such as a public meeting regarding the incinerator. For this reason it was never going to be possible to obtain a large statistical sample from this group. That 29 members of FRAG did complete the questionnaire was in fact a high response rate for this group (i.e. over 50%).

Given the difficulties encountered in getting respondents in the suburb of Craigie, a different approach was required in East Cannington in order to achieve a higher response rate among FRAG members. Arrangements were made with the chairperson of FRAG for the researcher to meet with groups of 2 to 5 members of FRAG at a time to complete the questionnaire. To maximise respondent accessibility, the meetings were held in the home of the group's chairperson. Larger meetings were not to be viable for two reasons. The first being logistical as it proved to be very difficult to get agreement on suitable meeting times. The second reason was that larger meetings would have been unmanageable as the larger the number of people at a meeting the greater the tendency for them to want to discuss their perspectives and influence each others responses. Over a number of months, the researcher attended a series of these meetings and answered any questions that respondents had as they answered the questionnaire. Respondents were reminded not to discuss their responses with each other while answering the questionnaire.

Another factor which may have played a role in some FRAG members not participating in the survey was the fatigue factor. Residents in this particular community had been dealing with the incinerator issue for a number of years. Many were demonstrating signs of issue fatigue and a certain resignation to the perception that the issue would never be successfully resolved. Active participation in the action group had dwindled somewhat over time although the issue was ongoing. There was increasing reliance on the group's chairperson to carry the local residents' position forward on behalf of the other group members.

At the end of each group session the researcher and FRAG members discussed their local risk issue and these discussions assisted the researcher to determine whether or not the study methodology was picking up on the sentiments of the residents with regard to their local risk issue. At the outset of the exercise an arrangement was made with FRAG that a $300 donation be made to their group for the participation of its members in the survey.

Although the original target sample size proved not to be achievable, the 232 respondents who did participate in the survey formed a larger sample than that used in many other risk perception studies. For example the Kraus and Slovic (1989) study of railroad hazards included only 49 university students, while the often cited study by Fischhoff et al. (1978) included 76 subjects. Similarly Mullet et al. (1993) tested only 60 French students. Studies such as that conducted by Gardner and Gould (1989) which have the luxury of large (1021 respondents), representative samples are the exception rather than the rule in risk perception research.

The difficulties in obtaining respondents from the non-university populations in particular reflect some of the difficulties in obtaining research data from the general population (i.e. non-students). This problem is likely to be heightened for a study such as this one in which: the methodology is complex; the participants are either not directly affected by the issues being investigated (e.g. Craigie residents) or have become somewhat jaded because the issue has an unsatisfactory and protracted history (e.g. FRAG members); and there is little or no reward associated with participating in the research.

Observations on The Ranking and Weighting Procedures

Not surprisingly the Curtin University psychology students found the questionnaire much easier to answer than did residents from either suburb. The fact that students were already familiar with surveys and the methodologies employed in this questionnaire meant that most were able to answer complete both Part A and Part B in 1.0 to 1.5 hours. By comparison members of the resident action group FRAG (East Cannington sample), most of whom were not familiar with the methodology and had less education found the task much more daunting and took 2-3 hours to complete Part B of the questionnaire.

The importance rankings and weightings were the most difficult tasks for all respondents. Respondents had much less difficulty in ranking the characteristics from 1 to 14 in importance, than they did in weighting their importance. In the weighting exercise, respondents tended to give several characteristics the same weight creating a clustering effect. Many of the respondents, especially those from the non-student population, found the unbounded nature of the weighting exercise confusing. Some indicated they would have been more comfortable if they had been told to give the characteristics weights between 10 and 100. The fact that the ranking and weighting exercises went in opposite directions also created some confusion. Having respondents weight any unimportant characteristics with a zero value appeared to work well and allowed respondents to focus their attention on the more important characteristics. The inclusion of an example of the weighting and ranking methodology also appeared to be useful.

Statistical Analysis

Prior to any statistical analyses, standard tests for unidimensional and multidimensional outliers and distributional normality were undertaken. After the initial data run, cases with extreme values were checked carefully to see that data were correctly entered. There were few problems with univariate outliers due to the fact that most of data was in the form of ratings using 7 point bipolar scales. All of the questionnaires were coded by the researcher and care was taken to identify any obvious cases of respondents not taking the exercise seriously and providing false answers. Seven such questionnaires, all from the Curtin student sample, were identified and omitted from the initial data base leaving an effective sample size of 232 respondents.

PRELIS 2.03 (Joreskog & Sorbom 1992) was used to obtain univariate statistics and test for univariate and multivariate normality (see Appendix B). These tests identified a number of variables which were significantly skewed and / or had problems with kurtosis. Transformations (eg. logarithm, square root) were conducted to reduce the level of skewness and kurtosis to acceptable levels. For the factor analyses and regression analyses, multivariate outliers were eliminated using the Mahalanobis distance to identify cases exceeding the critical chi-square value ($\alpha = .001$).

The SPSSwin statistical package for personal computers was used for most of the statistical analyses in this study. The path analysis used in the analysis of generic hazard domains was conducted with LISREL8 for windows. Statistical methods are described in the results when they are first applied. Probability levels were reported in relation to conventional decision criteria (e.g., $p<.01$).

Due to the difficulties encountered in obtaining respondents it was not possible to achieve optimal forms of quota sampling for gender, age, level of education or sex and still achieve a satisfactory sample size. An analysis of two demographic considerations (ie. age and gender) is provided in Appendix C. The constraints with respect to sampling quotas are a recognised limitation of the study design.

Chapter 6

Factor Structure of Hazard Domains

Introduction

This chapter examines the structure of heterogeneous and homogeneous hazard domains. Principal Axis Factor Analysis is used to examine factor structures for 8 generic hazard domains. The factor structures of two homogeneous hazard domains, asbestos and toxic waste incineration, are also examined. As discussed in Chapter 5, for each of the hazards in this study, an exploratory factor analysis was conducted using SPSSwin Principal Axis Factor Analysis. The outcomes of these analyses are discussed in relation to the findings of previous studies including those of Fischhoff et al. (1978), Slovic et al. (1980) and Kraus and Slovic (1988).

Methodological Issues

Sample Size

Tabachnick and Fidell (1989) have stated that for the purposes of factor analysis there should be at least five cases for each observed variable. For a factor analysis with 16 variables this general rule would necessitate a minimum of 80 cases. The sample sizes for each of the following analyses exceed that threshold with N values ranging from 106 to 226.

Missing Values

Only cases with valid values for all variables in a particular factor analysis were used.

Normality

Prior to commencing the principal axis factor analyses, tests for univariate and multivariate normality were conducted using Windows PRELIS 2.03 (Joreskog & Sorbom, 1992). The results for the 8 generic hazards and the 4 hazards described in the risk scenarios are provided as Appendix B. These summary statistics indicated that for some variables responses were quite skewed. The pattern of responses suggests that they would cause some problems in analyses based on the assumptions of univariate and multivariate normality. As discussed in Chapter 5, variables which demonstrated problems with respect to skewness or kurtosis were transformed (Tabachnick & Fidell 1989). The variables Q1G, Q3G, Q3K, Q3L, Q4G, Q8K were squared and the variables Q3D, Q6D, Q6J, Q6L, Q7D, Q7K, Q7L, Q8A, Q8D, were transformed to base 10 logarithms. Those variables which could not be satisfactorily transformed (ie. Q2A, Q6A, Q8H, Q8J) were recoded into two groups using the median value to assign scores.

Outliers

The treatment of univariate outliers was described in Chapter 5. Multivariate outliers were sought following the transformation of problem variables (i.e. highly skewed variables or high kurtosis). To address the issue of multivariate outliers, prior to the factor analyses and regression analyses (Chapter 7), Mahalanobis distances were calculated and interpreted. The probability estimate $p < .001$ was applied to identify cases as outliers. Cases which exceeded the critical value of Chi Square (i.e. df 15 = 37.697; df 13 = 34.528) were removed from the analyses. The following cases were removed from the analyses: Asbestos (case 99); Bush Fires (cases 31 & 66); Dams (case 109); Bicycles (case 58); Vaccinations (case 94); Asbestos Scenario A (case 138); Asbestos Scenario B (cases 21, 81 & 99); Toxic Incineration Scenario A (cases 25 & 177); and Toxic Incineration Scenario B (cases 69, 108, 126 & 218).

Multicollinearity

Multicollinearity problems occur when variables are too highly correlated (.90 and above). For each factor analysis, the initial correlation matrix (Appendix D) was examined for correlations above .90. In such instances one of the two redundant variables was removed from the analysis. When this situation occurred it is documented in the results section.

Rotation

Both orthogonal and oblique rotations were used to aid in the interpretation of factors. The type of orthogonal rotation applied to the analysis was varimax rotation as it is the most commonly used method of rotation. Varimax rotation maximises the variance of factor loadings by making high loadings higher and low ones lower for each factor.

In orthogonal rotation the factors are uncorrelated. Since it was possible that the factors could be correlated oblique rotation was also applied. The procedure used for oblique rotation was direct oblimin applying the default delta value of 0. In those instances in which 2 or more factors are correlated above .30 the oblique rotation is described in favour of the orthogonal rotation. If the solution to a factor analysis is stable, one would expect the solution to appear regardless of the method of rotation used.

Determining the Number of Factors

Three criteria were used to determine the most appropriate number of factors for a solution. The convention of extracting factors with eigenvalues greater than 1 was used as an initial guide in determining the appropriate number of factors. The scree test of eigenvalues plotted against factors was also used during initial and later runs. The residual correlation matrix also provided assistance in determining the number of factors. The eigenvalues are reported for each factor analysis while the scree tests are documented as Appendix E.

Factorability

Whereas Fischhoff and Slovic had reported a high degree of intercorrelation among the risk characteristics across many hazards, in this study it was not uncommon for a characteristic to be significantly correlated with only one or two other characteristics for a particular hazard. For each analysis an inspection of the correlation matrices (Appendix C) was conducted to ensure that some correlations in excess of .30 did exist. All hazards which were factor analysed met this criteria. Kaiser's measure of sampling adequacy was also applied. Values of .60 and above are required for good factor analysis. In this study the Kaiser-Meyer-Olkin measure ranged from .60 to .75 and is reported for each analysis.

Interpretation of Factors

The greater the factor loading the more a variable is a pure measure of the factor. In this study, after rotation, those variables with correlations less than .40 in the loading matrix were not interpreted as part of the factor solution.

Results for Generic Hazards

This section documents, for each generic hazard, the factor solutions generated through principal axis factor analysis. The purpose of these factor analyses was not to determine theoretical constructs for each of the generic hazards. The primary objective was to determine if a common factor structure was applicable to each of the hazards.

Generic Hazard: Asbestos

The factor analysis revealed a two factor solution. The varimax rotated two factor solution is shown in Table 6. The results of the oblique rotation, which are not described, indicated that the two factors were not significantly correlated (-.13).

Variables were, by and large, not well-defined by this factor solution. Many communality values were low with 8 of the variables having a communality of less than 0.2 (Table 6). The two factors together account for only 22% of the variance.

When a cut-off value of .40 for inclusion of a variable in a factor was applied, 8 of the 16 variables did not load significantly on either factor. The remaining variables are shown in Table 7 ordered by size of loadings.

Table 6. Varimax Rotated Factor Matrix - Asbestos

Characteristic N=109	Factor 1	Factor 2	Communality
Overall level of risk	.65	.18	.45
Individual benefit	.56	.03	.31
Societal benefit	.55	.09	.31
Likelihood of occurrence	.51	.05	.27
Personal control	.41	-.09	.17
Equity	.37	.31	.23
Severity of consequences	.30	.09	.10
Number of people exposed	.28	.00	.08
Trust in institution	.28	.10	.09
Society's knowledge	.16	.03	.03
Individual acceptance	.42	.62	.56
Societal acceptance	.31	.60	.45
Volition	.05	.44	.20
Institutional control	.18	-.38	.18
Dread	.11	.23	.06
Expert knowledge	.07	-.09	.01
Eigenvalues	2.63	0.87	
Percentage of variance	16.5	5.4	

Kaiser-Meyer-Olkin measure of sampling adequacy = .68

Table 7. Order in Which Variables Contribute to Factors (By Size of Loadings) - Asbestos.

Factor 1	Factor 2
• Overall level of risk	• Individual acceptance
• Individual benefit	• Societal acceptance
• Societal benefit	• Volition
• Likelihood of occurrence	
• Personal control	

Generic Hazard: Surfing

The factor analysis revealed a two factor solution. The varimax rotated solution is shown in Table 8. The results of the oblique rotation, which are not described, indicated that the two factors are not significantly correlated (.14).

Table 8. Varimax Rotated Factor Matrix - Surfing

Characteristic N=108	Factor 1	Factor 2	Communality
Individual acceptance	.59	.30	.44
Societal acceptance	.56	.08	.31
Volition	.51	.01	.26
Individual benefit	.45	.22	.25
Dread	.44	.09	.20
Equity	.32	.03	.10
Society's knowledge	.29	-.07	.09
Expert knowledge	.22	.06	.05
Likelihood of occurrence	.22	.68	.52
Overall level of risk	.16	.64	.45
Severity of consequences	.02	.59	.35
Personal control	.13	.31	.11
Institutional control	-.16	.30	.12
Trust in institution	.04	.21	.04
Number of people exposed	-.14	.18	.05
Societal benefit	.05	.13	.02
Eigenvalues	2.29	1.08	
Percentage of variance	14.3	6.8	

Kaiser-Meyer-Olkin measure of sampling adequacy = .61

The initial correlation matrix revealed a low level of correlation among the 16 variables. As was the case with the generic hazard asbestos, the surfing variables are, by and large, not well-defined by this factor solution. Of the 16 variables or risk characteristics 9 have of a communality of less than 0.2. The two factors together account for only 21% of the variance.

Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 5 of the 16 variables did not load significantly onto either factor. The remaining variables are shown in Table 9 ordered by size of loadings. Individual acceptance loaded onto both factors (.59 & .30).

Table 9. Order in Which Variables Contribute to Factors (By Size of Loadings) - Surfing.

Factor 1	Factor 2
• Individual acceptance • Societal acceptance • Volition • Individual benefit • Dread	• Likelihood of occurrence • Overall level of risk • Severity of consequences

Generic Hazard: Bush Fires

The factor analysis revealed a three factor solution. The varimax rotated 3 factor solution is shown in Table 10. The results of the oblique rotation, which are not described, indicated that the factors were not highly correlated. The most highly correlated factors were Factor 1 and Factor 3 (.24).

This appears to be a somewhat better factor solution than the previous two. Of the 16 variables or risk characteristics only 5 have of a communality of less than 0.2. The three factors together account for 35.5% of the variance.

Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 5 of the 16 variables did not load significantly on either factor. The remaining variables are shown in Table 11 ordered by size of loadings. In the case of bush fires several of the risk characteristics loaded significantly onto more than one factor in the rotated solution. The characteristic 'overall level of risk' loaded onto Factor 1 (.45) and Factor 3 (.36), 'expert knowledge' loaded onto Factor 2 (.76) and Factor 3 (-.32), 'severity of consequences' onto Factor 3 (.56) and Factor 1 (.31), and 'dread' onto Factor 3 (.41) and Factor 1 (.31).

Table 10. Varimax Rotated Factor Matrix - Bush Fires

Characteristic N=106	Factor 1	Factor 2	Factor 3	Communality
Societal acceptance	.80	-.16	.14	.69
Individual acceptance	.79	.02	.24	.68
Societal benefit	.68	.21	.18	.54
Individual benefit	.67	.16	.17	.50
Equity	.50	.07	.00	.26
Overall level of risk	.45	-.08	.36	.34
Volition	.28	-.26	-.04	.15
Expert knowledge	-.12	.76	-.32	.68
Institutional control	-.04	.54	.23	.35
Trust in institutions	.17	.38	-.08	.18
Personal control	.06	.27	.04	.08
Society's knowledge	-.01	.22	-.57	.37
Severity of consequences	.31	.08	.56	.42
Dread	.31	-.07	.41	.27
Likelihood of occurrence	.09	.10	.25	.08
Number of people exposed	-.04	.19	.23	.09
Eigenvalues	3.47	1.39	0.81	
Percentage of variance	21.7	8.7	5.1	

Kaiser-Meyer-Olkin measure of sampling adequacy = .66

Table 11. Order in Which Variables Contribute to Factors (By Size of Loadings) - Bush Fires.

Factor 1	Factor 2	Factor 3
• Societal acceptance • Individual acceptance • Societal benefit • Individual benefit • Equity • Overall level of risk	• Expert knowledge • Institutional control	• Society's knowledge • Severity of consequences • Dread

Generic Hazard: Toxic Waste Incineration

The factor analysis revealed a two factor solution. The factor correlation matrix revealed that the two factors are significantly correlated (.31). For this reason the pattern matrix for the oblique rotation is shown below instead of the varimax rotated solution. The direct oblimin rotated two factor solution is shown in Table 12.

Table 12. Direct Oblimin Rotated Factor Matrix - Toxic Waste Incineration

Characteristic N=109	Factor 1	Factor 2	Communality
Societal acceptance	.75	-.17	.51
Individual acceptance	.69	-.01	.48
Societal benefit	.67	.06	.48
Overall level of risk	.62	.06	.41
Individual benefit	.59	.15	.42
Dread	.54	-.13	.26
Severity of consequences	.32	.31	.26
Personal control	.24	.18	.11
Volition	.23	.06	.07
Expert knowledge	-.20	.67	.40
Society's knowledge	-.10	.62	.36
Trust in institution	.20	.57	.43
Institutional control	-.03	.43	.18
Equity	.09	.38	.17
Likelihood of occurrence	.08	.36	.15
Number of people exposed	.03	.18	.04
Eigenvalues	3.30	1.43	
Percentage of variance	20.7	9.0	

Kaiser-Meyer-Olkin measure of sampling adequacy = .67

Of the 16 variables or risk characteristics 6 have of a communality of less than 0.2. The two factors together account for 30% of the variance. Applying a cut-off value of .40 to the oblique rotated factor loadings (pattern matrix) revealed that 6 of the 16 variables did not load significantly on either factor. The remaining variables are shown in Table 13 ordered by size of loadings.

Table 13. Order in Which Variables Contribute to Factors (By Size of Loadings) - Toxic Waste Incineration.

Factor 1	Factor 2
• Societal acceptance • Individual acceptance • Societal benefit • Overall level of risk • Individual benefit • Dread	• Expert knowledge • Society's knowledge • Trust in institution • Institutional control

Generic Hazard: Dams

The factor analysis revealed a three factor solution. The factor correlation matrix revealed that two of the factors (Factor 1 and Factor 3) are significantly correlated (.31). Factor 2 and Factor 1 are also correlated (.29) but Factor 2 and Factor 3 are not correlated (.08). Due to the correlation among the factors, the pattern matrix for the oblique rotation is shown below instead of the varimax rotated solution. The direct oblimin rotated three factor solution is shown in Table 14.

The solution represents the variables quite well with only 3 of the 16 variables or risk characteristics having a communality of less than 0.2. The three factors account for 42% of the variance.

Applying a cut-off value of .40 to the oblique rotated factor loadings (pattern matrix) revealed that only 3 of the 16 variables did not load significantly onto any of the factors. The remaining variables are shown in Table 15 ordered by size of loadings. The characteristic 'society's knowledge' loaded significantly onto Factor 2 (.49) and Factor 3 (.49).

Table 14. Varimax Rotated Factor Matrix - Dams

Characteristic N=108	Factor 1	Factor 2	Factor 3	Communality
Societal acceptance	.83	-.07	-.04	.65
Individual acceptance	.71	.08	.05	.57
Individual benefit	.71	-.01	.02	.51
Societal benefit	.69	.10	.01	.52
Dread	.64	-.06	.01	.39
Overall level of risk	.57	.10	.12	.42
Likelihood of occurrence	.39	.07	.04	.18
Trust in institution	.25	.77	-.11	.75
Institutional control	.03	.66	.01	.45
Expert knowledge	.11	.57	.11	.40
Equity	.02	.34	-.15	.13
Personal control	.06	-.12	.74	.58
Number of people exposed	.06	-.10	.54	.31
Volition	.18	-.04	.51	.34
Society's knowledge	-.18	.49	.49	.45
Severity of consequences	.03	.03	.22	.06
Eigenvalues	4.13	1.47	1.11	
Percentage of variance	25.8	9.2	6.9	

Kaiser-Meyer-Olkin measure of sampling adequacy = .72

Table 15. Order in Which Variables Contribute to Factors (By Size of Loadings) - Dams.

Factor 1	Factor 2	Factor 3
• Societal acceptance • Individual acceptance • Individual benefit • Societal benefit • Dread • Overall level of risk	• Trust in institution • Institutional control • Expert knowledge • Society's knowledge	• Personal control • Number of people exposed • Volition • Society's knowledge

Generic Hazard: Bicycles

The initial correlation matrix indicated that the characteristics 'individual acceptance' and 'societal acceptance' were highly correlated. The r value of .90 indicated that one of the variables was redundant. For the purposes of the principal axis factor analysis the variable 'societal acceptance' was not included.

The factor analysis revealed a two factor solution. The factor correlation matrix revealed that the two factors are not correlated (-.11) and thus an oblique rotation was not appropriate. The varimax rotated factor solution is shown in Table 16. The bicycle variables were, by and large, not well-defined by this factor solution. Of the 15 variables or risk characteristics 7 have communalities of less than 0.2. The two factors together account for only 23% of the variance.

Applying a cut-off value of .40 to the rotated factor loadings revealed that 6 of the 15 variables did not load significantly onto either Factor 1 or Factor 2. The remaining variables are shown in Table 17 ordered by size of loadings. The characteristic 'volition' loaded significantly onto both factors (.42 & .39 respectively) as did the characteristic 'dread' (.56 & .39 respectively).

Table 16. Varimax Rotated Factor Matrix - Bicycles

Characteristic N=109	Factor 1	Factor 2	Communality
Likelihood of occurrence	.57	.00	.32
Dread	.56	.39	.46
Overall level of risk	.54	.27	.36
Individual acceptance	.48	.09	.24
Personal control	.43	.25	.25
Volition	.42	.39	.33
Severity of consequences	.39	-.20	.19
Individual benefit	.37	-.09	.14
Societal benefit	.26	-.14	.09
Equity	.10	.06	.01
Expert knowledge	-.06	.60	.36
Trust in Institution	.00	.50	.25
Institutional control	-.12	.42	.20
Number of people exposed	-.14	-.32	.12
Society's knowledge	.12	.25	.08
Eigenvalues	2.27	1.13	
Percentage of variance	15.2	7.6	

Kaiser-Meyer-Olkin measure of sampling adequacy = .60

Table 17. Order in Which Variables Contribute to Factors (By Size of Loadings) - Bicycles

Factor 1	Factor 2
• Likelihood of occurrence	• Expert knowledge
• Dread	• Trust in institution
• Overall level of risk	• Institutional control
• Individual acceptance	
• Personal control	
• Volition	

Generic Hazard: Vaccinations

Similar to the situation with bicycles, the initial correlation matrix for the hazard domain vaccinations indicated that the characteristics 'individual acceptance' and 'societal acceptance' were highly correlated. An r value of .93 indicated that one of the variables was redundant and the variable 'societal acceptance' was omitted.

The factor analysis revealed a two factor solution. The factor correlation matrix revealed that the two factors are not correlated (-.08) and thus an oblique rotation was not preferred. The varimax rotated factor solution is shown in Table 18. Of the 15 variables or risk characteristics 5 have communalities of less than 0.2. The two factors together account for 30% of the variance.

Table 18. Varimax Rotated Factor Matrix - Vaccinations

Characteristic N=109	Factor 1	Factor 2	Communality
Individual benefit	.80	.18	.67
Volition	.54	.15	.32
Societal benefit	.51	.29	.35
Personal control	.49	-.35	.36
Trust in institution	.46	.22	.26
Expert knowledge	.45	.06	.21
Institutional control	.40	.01	.16
Equity	.34	-.10	.12
Severity of consequences	.28	.12	.09
Society's knowledge	.27	-.19	.11
Overall level of risk	.29	.76	.66
Likelihood of occurrence	-.03	.72	.51
Dread	.23	.53	.33
Individual acceptance	.24	.52	.32
Number of people exposed	.02	-.05	.00
Eigenvalues	3.01	1.47	
Percentage of variance	20.1	9.8	

Kaiser-Meyer-Olkin measure of sampling adequacy = .65

Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 5 of the 15 variables did not load significantly onto either Factor 1 or Factor 2. The remaining variables are shown in Table 19 ordered by size of loadings. The characteristic 'personal control' loaded significantly onto both factors (.49 & -.35 respectively).

Table 19. Order in Which Variables Contribute to Factors (By Size of Loadings) - Vaccinations

Factor 1	Factor 2
• Individual benefit	• Overall level of risk
• Volition	• Likelihood of occurrence
• Societal benefit	• Dread
• Personal control	• Individual acceptance
• Trust in institution	
• Expert knowledge	

Generic Hazard: Sunbathing

The principal axis factor analysis revealed a two factor solution. The factor correlation matrix revealed that the two factors are not correlated (-.08) and thus an oblique rotation was preferred. The varimax rotated factor solution is shown in Table 20. Although this appears to be the best solution, the sunbathing variables are not well-defined by this factor solution. Of the 16 variables or risk characteristics 11 have communalities of less than 0.2. The two factors together account for only 21% of the variance.

Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 9 of the 15 variables did not load significantly onto either Factor 1 or Factor 2. The remaining variables are shown in Table 21 ordered by size of loadings.

Table 20. Varimax Rotated Factor Matrix - Sunbathing

Characteristic N=110	Factor 1	Factor 2	Communality
Individual acceptance	.74	.20	.58
Overall level of risk	.68	.08	.47
Societal acceptance	.56	.09	.32
Dread	.40	-.08	.17
Likelihood of occurrence	.40	-.04	.16
Severity of consequences	.39	-.08	.16
Trust in institution	-.14	-.04	.02
Society's knowledge	-.09	-.01	.01
Societal benefit	.15	.78	.63
Individual benefit	.30	.48	.32
Volition	.08	-.40	.17
Personal control	-.08	-.36	.14
Institutional control	-.10	.33	.12
Equity	.21	.22	.09
Expert knowledge	-.03	-.14	.02
Number of people exposed	.08	-.12	.02
Eigenvalues	2.24	1.16	
Percentage of variance	14.0	7.3	

Kaiser-Meyer-Olkin measure of sampling adequacy = .60

Table 21. Order in Which Variables Contribute to Factors (By Size of Loadings) - Sunbathing

Factor 1	Factor 2
• Individual acceptance	• Societal benefit
• Overall level of risk	• Individual benefit
• Societal acceptance	• Volition
• Dread	
• Likelihood of occurrence	

Summary of Factor Analyses of Generic Hazards

In summary, each of the eight hazard domains revealed a qualitatively different factor structure. This finding is more consistent with the findings of Gardner and Gould (1989) and Bishop and Syme (1992) than those of Fischhoff et al. (1978) and Slovic et al. (1980). This is not surprising in that Gardner and Gould (1989) and Bishop and Syme (1992) also used people rather than technology as their statistical unit of measure.

Whereas the Slovic et al. (1980) study of sets of heterogeneous hazards revealed a very high level of correlation among the various risk characteristics, this study revealed quite low levels of correlation among the tested variables for individual hazards. Although only eight hazard domains were examined in this study, a general factor structure representing the construct 'risk' which could be applied to all hazards was not evident.

One of the objectives of this analysis was to examine the relationship between the variables 'overall level of risk' and 'individual acceptance' and the other risk characteristics. While the principal axis factor analyses in this study did not reveal a dominant factor structure that could fit well with each generic hazard, a few trends could be discerned. For instance the characteristic 'volition' often loaded onto the same factor as the acceptance characteristics (i.e. individual and societal acceptance). Much of the facility siting literature in recent times has focused on the importance of considerations such as equity, personal control, trust, individual benefit and volition in determining the acceptance of siting exercises. Thus one might have expected that each of these variables would have loaded onto the same factor as 'individual acceptance'. However, other than 'volition', this did not prove to be the case for these 8 generic hazards. This might be due to the fact that the hazards are generic and thus not context driven. This issue is explored further in later chapters.

Although the characteristics 'likelihood of occurrence' and 'dread' tended to load onto the same factor as the overall level of risk, a strong 'Dread' factor (eg. Slovic et al. 1980) was not evident in this study. This result may in part be due to the nature of the characteristics tested in this study.

Previous studies, such as Slovic et al. (1980) have reported that the overall level of risk is the best predictor of risk acceptability. However in this study, while the variable 'overall level of risk' sometimes loaded onto the same factor as 'individual acceptance' this was not always the case. Similarly the two benefit characteristics sometimes loaded onto the same factor as the overall level of risk but in other cases the benefit characteristics loaded onto the same factor as the variable individual acceptance. This suggests that benefits can play some role in influencing both perceptions of overall risk and of risk acceptability. It also highlights the need to consider each hazard on a case by case basis when assessing the relationships between perceived riskiness (ie. overall level of risk), individual risk acceptance, and other risk characteristics.

While a strong Dread factor was not evident, for a number of generic hazards (i.e. toxic waste incineration, dams, bicycles, vaccinations) the variables 'expert knowledge', 'trust in institutions', 'institutional control' and 'society's knowledge' either formed a single factor which could be interpreted as an 'Expertise' factor or loaded onto the same factor.

Homogeneous Hazard Domains

Kraus and Slovic (1988) examined whether or not the structure derived by Fischhoff and Slovic from a 'global' analysis across heterogeneous sets of hazards (Slovic et al. 1980), would also pertain to a 'local' set of hazards all falling within the same hazard domain. They tested whether or not a diverse set of hazard scenarios from a single domain, railroads, would be judged on various risk characteristics in a similar manner as heterogeneous sets of hazard domains.

Kraus and Slovic found structural differences from the previous taxonomy for heterogeneous domains. They found that specific railroad accident scenarios had their own unique factor structures. This meant that the point in their previous global factor space which represented railroads was not a good representation of many of the different types of railroad accidents they tested. There were also important similarities between the heterogeneous and homogeneous taxonomies with both local and global domains being well represented by two factors: catastrophic potential and knowledge.

Whereas Kraus and Slovic examined a large number of scenarios for a single hazard domain, railroads, this study examined a small number of risk scenarios within two hazard domains: asbestos and toxic waste incineration. As described earlier two asbestos scenarios and two toxic waste incineration scenarios were presented to respondents in Part B of the questionnaire. As with the generic hazard domains, respondents rated each of the risk scenarios with respect to each of the listed risk characteristics. The factor structures of each of the risks portrayed in the four risk scenarios are described in the following sections. If the Kraus and Slovic findings were to be replicated then one would not be surprised if the risk scenarios revealed different factor structures even if they belong to the same hazard domain (i.e. either asbestos or toxic waste incineration).

Asbestos Scenario A

For each of the Asbestos and Toxic Waste Incineration scenarios only 14 variables were included in the factor analysis rather than the 16 tested in the previous analyses of the generic hazards. This is due to the fact that respondents to the 4 risk scenarios did not rate the characteristics 'societal' or 'individual acceptance' for the risks portrayed in a scenarios.

The principal axis factor analysis revealed a two factor solution for Asbestos Scenario A. Since the factor correlation matrix revealed that the two factors are not correlated (.12) the oblique rotation solution is not described. The varimax rotated factor solution is shown in Table 22.

Of the 14 variables or risk characteristics 5 have communalities less than 0.2. The two factors together account for 29% of the variance. Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 4 of the 14 variables did not load significantly onto either Factor 1 or Factor 2. The remaining variables are shown in Table 23 ordered by size of loadings.

Table 22. Varimax Rotated Factor Matrix - Asbestos Scenario A

Characteristic N=226	Factor 1	Factor 2	Communality
Volition	.76	-.06	.58
Society's knowledge	.63	.09	.41
Expert knowledge	.59	-.11	.36
Dread	.44	-.07	.20
Personal control	.42	.02	.18
Number of people exposed	.39	.35	.28
Trust in institution	.35	.19	.16
Institutional control	.23	.05	.05
Overall level of risk	.01	.76	58
Likelihood of occurrence	-.08	.62	.39
Severity of consequences	-.04	.54	.18
Individual benefit	.14	.50	.27
Societal benefit	-.04	.47	.22
Equity	.11	.16	.04
Eigenvalues	2.15	1.85	
Percentage of variance	15.4	13.2	

Kaiser-Meyer-Olkin measure of sampling adequacy = .71

Table 23. Order in Which Variables Contribute to Factors (By Size of Loadings) - Asbestos Scenario A

Factor 1	Factor 2
• Volition	• Overall level of risk
• Society's knowledge	• Likelihood of occurrence
• Expert knowledge	• Severity of consequences
• Dread	• Individual benefit
• Personal control	• Societal benefit

Asbestos Scenario B

The factor analysis revealed a three factor solution. The results of the oblique rotation indicated that factors are not significantly correlated. The varimax rotated factor matrix is shown in Table 24. The oblique rotated solution, which is not described, revealed a similar factor structure.

This appears to be a somewhat better factor solution than most of the others. Of the 14 variables 3 have of a communality less than 0.2. The three factors together account for 37% of the variance. Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 4 of the variables did not load significantly onto any factor. The remaining variables are shown in Table 25 ordered by size of loadings.

Table 24. Varimax Rotated Factor Matrix - Asbestos Scenario B

Characteristic N=209	Factor 1	Factor 2	Factor 3	Communality
Likelihood of occurrence	.85	-.04	-.09	.74
Overall level of risk	.79	-.02	-.10	.63
Number of people exposed	.50	.20	.14	.31
Severity of consequences	.36	.24	.13	.21
Dread	.35	.13	.11	.15
Societal benefit	.05	.83	-.21	.74
Individual benefit	.09	.79	-.14	.65
Volition	.09	.46	.17	.25
Personal control	.05	.36	.35	.26
Equity	.24	.32	.06	.16
Society's knowledge	-.08	.08	.58	.35
Trust in institutions	.11	.04	.54	.31
Institutional control	.09	-.01	.41	.18
Expert knowledge	.00	-.07	.41	.17
Eigenvalues	2.36	1.50	1.24	
Percentage of variance	16.9	10.7	8.9	

Kaiser-Meyer-Olkin measure of sampling adequacy = .65

Table 25. Order in Which Variables Contribute to Factors (By Size of Loadings) - Asbestos Scenario B.

Factor 1	Factor 2	Factor 3
• Likelihood of occurrence	• Societal benefit	• Society's knowledge
• Overall level of risk	• Individual benefit	• Trust in institutions
• Number of people exposed	• Volition	• Institutional control
		• Expert knowledge

Toxic Waste Incineration Scenario A

The principal axis factor analysis revealed a two factor solution for Toxic Waste Incineration Scenario A. The results of the oblique rotation, indicated that the two factors are significantly correlated (.34). The pattern matrix for the oblimin rotated 2-factor solution is shown in Table 26. The varimax rotated solution, which is not described, revealed a similar factor structure.

Of the 14 variables or risk characteristics 4 have communalities less than 0.2. The two factors together account for 31% of the variance. Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that 5 of the variables do not load significantly onto either Factor 1 or Factor 2. The remaining variables are shown in Table 27 ordered by size of loadings.

Table 26. Oblimin Rotated Factor Matrix - Toxic Waste Incineration Scenario A

Characteristic N=220	Factor 1	Factor 2	Communality
Overall level of risk	.90	-.06	.78
Likelihood of occurrence	.78	-.03	.60
Societal benefit	.60	-.07	.33
Number of people exposed	.58	-.08	.31
Severity of consequences	.43	.10	.22
Institutional control	.29	.20	.16
Expert knowledge	.25	.10	.09
Personal control	-.04	.65	.40
Volition	-.04	.61	.36
Equity	.19	.47	.31
Trust in institution	.10	.43	.23
Dread	.12	.38	.19
Individual benefit	.26	.34	.24
Society's knowledge	-.07	.20	.03
Eigenvalues	3.12	1.16	
Percentage of variance	22.3	8.3	

Kaiser-Meyer-Olkin measure of sampling adequacy = .76

Table 27. Order in Which Variables Contribute to Factors (By Size of Loadings) - Toxic Waste Incineration Scenario A

Factor 1	Factor 2
• Overall level of risk	• Personal control
• Likelihood of occurrence	• Volition
• Societal benefit	• Equity
• Number of people exposed	• Trust in institutions
• Severity of consequences	

Toxic Waste Incineration Scenario B

The principal axis factor analysis revealed a two factor solution for Asbestos Scenario A. Since the factor correlation matrix revealed that the two factors are not highly correlated (.22), the oblique rotation solution is not described although it revealed a similar factor structure to the varimax rotated solution. The varimax rotated factor structure is shown in Table 28.

Table 28. Varimax Rotated Factor Matrix - Toxic Waste Incineration Scenario B

Characteristic N=219	Factor 1	Factor 2	Communality
Overall level of risk	.71	.27	.57
Likelihood of occurrence	.68	.31	.56
Individual benefit	.60	.09	.36
Number of people exposed	.60	.06	.36
Severity of consequences	.57	.07	.33
Volition	.57	-.07	.33
Societal benefit	.55	.20	.34
Dread	.50	-.12	.26
Equity	.50	.25	.31
Personal control	.34	.21	.16
Trust in institution	.34	.33	.22
Expert knowledge	.13	.70	.51
Institutional control	.16	.61	.40
Society's knowledge	-.09	.51	.27
Eigenvalues	3.83	1.15	
Percentage of variance	27.4	8.2	

Kaiser-Meyer-Olkin measure of sampling adequacy = .79

Of the 14 variables or risk characteristics only 1 (i.e. Personal control) has a communality less than 0.2. The characteristics likelihood of occurrence and trust in institutions load onto both factors. The two factors together account for 36% of the variance. Applying a cut-off value of .40 to the varimax rotated factor loadings revealed that only 2 variables did not load significantly onto either Factor 1 or Factor 2. The remaining variables are shown in Table 29 ordered by size of loadings.

Table 29. Order in Which Variables Contribute to Factors (By Size of Loadings) - Toxic Waste Incineration Scenario B

Factor 1	Factor 2
• Overall level of risk	• Expert knowledge
• Likelihood of occurrence	• Institutional control
• Individual benefit	• Society's knowledge
• Number of people exposed	
• Severity of consequences	
• Volition	
• Societal benefit	
• Dread	
• Equity	

Summary of Findings for Homogeneous Hazard Domains

In summary, the factor analyses of the risks portrayed in the four risk scenarios generally supported the findings of Kraus and Slovic (1988). Within a single hazard domain, the factor structures of specific risks differed from one another and from the structures of their respective generic hazard domains. Just as Kraus and Slovic found that all railroad scenarios could not be adequately represented by a single point in the global factor space labelled railroads, the same appears to be true for asbestos scenarios and toxic waste incineration scenarios.

Implications for Global Structures

Kraus and Slovic (1988) found that "the dimensions of any hazard space are likely to be dependent on the nature of the set of hazards being described" (p.454). They went on to note that for a diverse set of hazards variations in the set may make little conceptual difference but "even a slight variation in a more homogeneous set of hazards may have a much larger effect" (p.454). They concluded that "factor representations for hazards within the same domain are likely to be, in general, less consistent than representations that have been found for diverse sets of hazards" (p.454). This study would suggest that regardless of whether one is considering a set of heterogeneous hazards or a set of homogeneous hazards, each hazard has it own factor structure.

Kraus and Slovic appear to be comfortable with their finding of a stable factor structure for a diverse set of hazards but different factor structures for individual hazards within the same domain. But given the results of the Kraus and Slovic (1988) study and this study, one must question whether the stable factor structures reported across a large number of heterogeneous hazard domains by Slovic, Fischhoff and others really reflects anything about the general structure of risk that is meaningful. If we agree that specific risks within homogeneous hazard domains have different factor structures it seems unreasonable that an analysis of sets of heterogeneous hazard domains would reveal a stable factor structure that reflects the construct 'risk'.

It appears from the risk literature that the results from analyses based on aggregate rather than individual level data are being used to analyse specific risks. However, given that quite different factor structures can be generated by changing the particular hazard, can we legitimately draw conclusions from such generic factor structures which have valid applications for individual risk items or hazards? Since most real world risk managers are concerned about specific hazards in specific contexts, the application of a general 3-factor risk construct based on aggregated data (e.g. Slovic et al. 1980) may be quite misleading. This finding does not mean that earlier work to develop a general risk construct is meaningless but it does mean that risk managers must be careful in its application to specific risk contexts.

One possible explanation for the stable factor structures reported for heterogeneous sets of hazards (e.g. Slovic et al. 1980) is that by aggregating data from a diverse set of hazards, structural information specific to individual risks tend to cancel each other out and all that remains are the semantic similarities of the characteristics. Beck (1981) has warned of possible problems in using factor analysis as a result of the semantic structure of multidimensional ratings. If one examines the factor structures produced by studies such as those by Slovic and Fischhoff for heterogeneous hazard sets, they are not dissimilar to what one would expect if one tried to group the characteristics on the basis of similar or related meanings.

It would be interesting to test whether or not the factor structure found by Slovic et al. (1980) is actually the result of semantic structure. In other words, certain characteristics tend to cluster together naturally as a result of their semantic similarities regardless of the context. If one combines data from a diverse set of hazards then the factor analysis may largely be revealing the degree of semantic similarity rather than saying anything about the hazards themselves or the concept of risk.

Chapter 7

Risk Characteristics and Risk Judgements

Introduction

As discussed in Chapter 5, previous researchers including Slovic and Fischhoff have found, across a wide range of hazards, that many risk characteristics are highly correlated with each other and that some characteristics could by themselves be good predictors of perceived riskiness and risk acceptability (e.g. Slovic et al. 1980; Gardner & Gould 1989; Gregory & Mendelsohn 1993; Mullet et al. 1993; Fischhoff et al. 1978; Kraus & Slovic 1988).

Slovic et al. (1980) identified perceived risk as the best predictor of risk acceptability or what Slovic et al. referred to as "adjusted risk". Some characteristics highly correlated with perceived risk were also significantly correlated with risk acceptability but not as strongly. These were the characteristics dread, global catastrophe and equity. They concluded that perceived risk and risk acceptance were quite predictable from knowledge of other risk characteristics.

Through multiple linear regression analysis, they developed equations involving combinations of characteristics which could predict the ratings for perceived risk and adjusted risk (i.e., risk acceptance). In particular "a linear combination of the characteristics comprising the Dread Factor can serve as a model for predicting the mean risk ratings, across individuals, for a diverse set of hazards" (Slovic et al. 1980, p. 436).

Slovic and Fischhoff did not include perceived benefits in their list of risk characteristics. However in a separate analysis, they found that perceived benefit demonstrated an inverse relationship to perceived risk and a moderate relationship to perceived acceptance (Slovic et al. 1980).

Slovic, Fischhoff and Lichtenstein (1986) in another study examined the relationship between perceived risk and other risk characteristics for individual hazards rather than for combined sets of hazards as in their earlier studies (e.g., Slovic et al. 1980). They found correlations between perceived risk and the other risk characteristics within hazards to be much smaller but still consistent with the pattern shown for the cross hazard correlations which were based on group means. Again severity of consequences, dread and catastrophic potential were considered to be the dominant predictors of perceived risk.

The analyses in this chapter pertain to Research Objective #3 and its associated hypotheses as described in Chapter 5. The relationships between perceived risk, risk acceptability and other risk characteristics identified in the risk literature are examined for a heterogeneous set of hazard domains.

This chapter develops risk profiles for each of the eight generic hazard domains. The risk profiles are based on the mean ratings of the various risk characteristics presented to respondents. Having described the risk profiles, the relationships between a respondent's perception of the riskiness and acceptability of a hazard domain and other risk characteristics are examined. This is achieved through the use of correlation analysis, multiple linear regression and path analysis.

The second part of the chapter examines relationships among the other risk characteristics which have been discussed in previous risk perception research. This includes the relationships between benefits and perceived riskiness, dread and perceived riskiness, and volition and risk acceptability. The possibility that individuals use their view of how acceptable society finds a risk when judging their own level of acceptability is explored through the development of a risk attitude model.

Risk Profiles

Approach

The following sections examine each of the eight hazard domains in turn. A risk profile is developed for each hazard domain based upon the mean ratings for each of the risk characteristics.

The relationships between perceived riskiness, individual risk acceptance and other risk characteristics explored further through an analysis of Pearson Correlation Coefficients and multiple linear regression analyses. Those characteristics most strongly correlated with either the overall level of risk or individual acceptance are reported in tables. The complete correlations matrices can be found in Appendix D.

In the regression analysis, standard multiple regression was used. A regression analysis was conducted for each of the 8 generic hazard domains setting the characteristics overall level of risk and individual acceptance as the dependent variables. The sample for this analysis provided an adequate ratio of cases to independent variables. Tabachnick and Fidell (1989) state that at least 5 times more cases than independent variables are required for standard regression analysis. Each regression analysis involved approximately 110 cases making the ratio of cases to independent variables 7:1. As described earlier problem variables with respect to skewness or kurtosis were transformed. A description of how univariate (Chapter 5) and multivariate (Chapter 6) outliers were addressed was documented in earlier chapters.

Mahalanobis distance was used to eliminate multivariate outliers. Multicollinearity was addressed by eliminating redundant variables. This occurred most often with the two benefit variables and the two acceptance variables. When these situations arose one of the variables in the pair was dropped from the analysis. This is described in the results section. While only the key outcomes of the regression analyses are described in this chapter, a detailed description of each of the linear multiple regressions is documented in Appendix F. Multiple R, R square and adjusted R square are documented for each regression analysis (Appendix F). Adjusted R-squared is the preferred measure of goodness of fit because it is not subject to the inflationary bias of the unadjusted R-squared (Norusis 1993). A list-wise treatment of missing values was applied.

Path analysis was used to assess the direct causal contribution of one variable (i.e., risk characteristic) to another. The initial models for each hazard were developed and later refined by applying:

(a) the findings of the risk perception literature (e.g. Slovic et al. 1980, Fischhoff et al. 1978, Slovic et al. 1986, Gould et al 1988, Gregory & Mendolsohn 1993, Rohrmann 1994) regarding the relationship between perceived risk, risk acceptability and the qualitative risk characteristics investigated in this study. The initial list of risk characteristics presented for subjects to rate, had been drawn from risk characteristics which other studies had identified as important.

(b) what is known about the particular hazards from their risk context and profiles.

(c) the relationships suggested by the data (i.e. the results of the correlation and regression analyses).

For each hazard these three sources of information were used to develop initial models of perceived riskiness and individual risk acceptance which were examined further using LISREL path analysis (Joreskog & Sorbom 1993). The path analysis used correlation matrices due to the limited sample size. For each of the path analysis models, adjusted goodness of fit index (AGFI) and chi-square ($\chi2$) goodness of fit statistics are reported. With respect to significance levels, pathways with t-values less than 1.96 were considered non-significant (Jorskog & Sorbom 1993).

As is the case with analyses of this type, the path models put forward as solutions are tentative in nature. While the models described in the following sections for each of the hazard domains fit the data, they do not necessarily represent the only possible model.

Hazard Domain: Asbestos

The mean ratings for each of the risk characteristics provides a profile of the risk perceptions of asbestos (see Table 30). As a hazard domain asbestos is viewed as having little benefit for either the affected individual or society and as having a moderate-high level of overall riskiness. The risks associated with asbestos are viewed as being moderate-highly unacceptable by respondents who believe that society would also find them to be unacceptable. Asbestos is perceived as a hazard domain of which experts have a good understanding.

Table 30. *Risk Profile for the Hazard Domain Asbestos*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	4.69	1.73
Dread of risk	5.04	1.45
Trust in Institution	4.08	1.65
Expert Knowledge	2.76	1.37
Equity	5.18	1.36
Society's Knowledge	4.38	1.46
Severity of Consequences	6.06	1.30
Number of People Exposed	4.26	1.67
Institutional Control	3.06	1.53
Personal Control	3.39	1.64
Benefit to Society	5.08	1.53
Benefit to Individual	5.51	1.45
Likelihood of Occurrence	4.67	1.29
Overall Level of Risk	5.36	1.22
Your Acceptance of Risk	5.58	1.30
Societal Acceptance	5.17	1.44

There is a moderate-high level of dread associated with this hazard domain with only a moderate level of personal or institutional control considered possible. Although on average respondents viewed the risk of exposure to be moderately involuntary (mean 4.69), approximately 30% viewed exposure to be voluntary (rating<=3) while 62% believed exposure to be involuntary (rating>=5). Although the likelihood of a negative outcome occurring was viewed as moderate (mean rating 4.67), the consequences were perceived as being severe (mean rating 6.06).

The analysis of Pearson Correlation Coefficients (Tables 31) indicates that the 2 benefit characteristics, the 2 acceptance characteristics and the characteristics likelihood of occurrence and equity are most strongly correlated with the perceived overall level of risk. The multiple linear regression analysis indicated that only the characteristic likelihood of occurrence contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 31. *Pearson Correlation Coefficients - Asbestos*

Characteristic	Overall Level of Risk	Individual Acceptance
Dread		.25
Equity	.34	.38
Societal benefit	.38	
Individual benefit	.37	.32
Likelihood of occurrence	.42	
Societal acceptance	.34	.56
Individual acceptance	.35	N/A
Overall level of risk	N/A	.35

A multiple regression analysis with individual acceptance as the dependent variable indicated that the characteristics societal acceptance and individual benefit are significant predictors of individual acceptance at $p<.01$. The characteristics dread and equity are also significant at $p<.05$. The Pearson Correlation Coefficients for these characteristics are shown in Table 31.

The LISREL path diagram for the asbestos hazard domain is shown in Figure 3. Goodness of fit statistics indicate that the model fits the data moderately well, $\chi 2$ (1) = 1.65, p = .20 and AGFI = 0.90. The path diagram indicates that a person's perception of the riskiness of the asbestos hazard domain is influenced by the characteristics *equity*, *benefit to those exposed*, *likelihood* of a negative outcome and *society's acceptance* of the risk. Looking at the estimated values for these paths we see that the effect of likelihood of occurrence on perceived riskiness is the strongest relationship.

If we interpret this model in light of the risk profile for asbestos (Table 30), it appears that people view asbestos as being moderately-highly risky, at least in part, because it is inequitable in its distribution of costs and benefits, offers little in the way of benefits to those exposed to the risk, and there is a moderate probability that undesired outcomes would occur. It also seems reasonable that respondents' perceptions of riskiness are influenced by their belief that society also views it as being risky. This is reflected in the perception that society is not very accepting of asbestos as a hazard domain.

Based upon the work of Slovic and Fischhoff one would have anticipated that the characteristic *dread* would be a predictor of the level of riskiness. However, although respondents perceived the level of dread to be moderate-high for this hazard domain, it does not appear to have significantly influenced perceived risking.

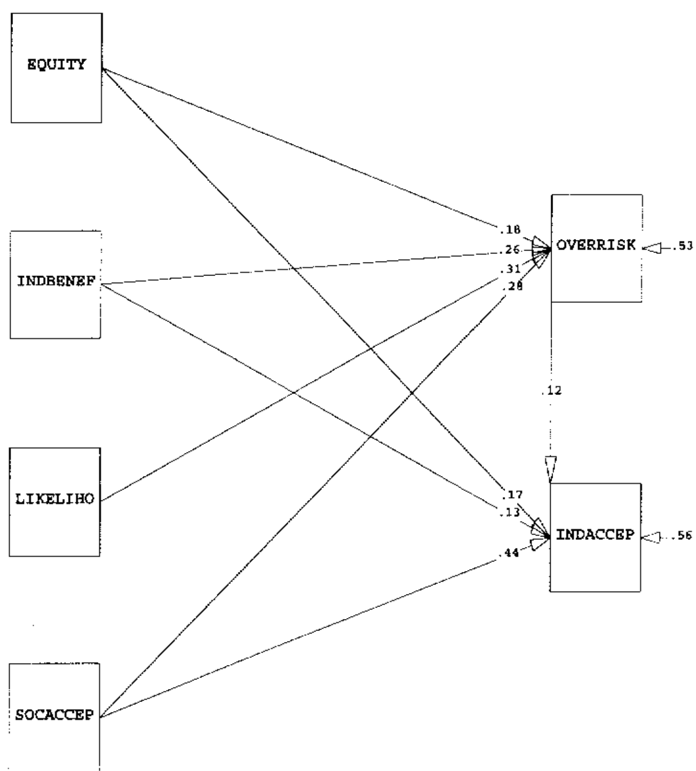

Figure 3. Path Diagram for Asbestos

Along similar lines, one might have predicted from the asbestos profile that *severity of consequences* would be a good predictor of the level of riskiness. People indicated that severe consequences could occur giving this risk characteristic the highest rating of any asbestos characteristic (mean rating 6.06). This high rating would lead one to anticipate *severity* being an important determinant of riskiness. It should be noted that this result is not merely a ceiling effect as there is sufficient variance to avoid marked correlation attenuation.

That the severity characteristic is not a good predictor points to the difficulties in using a risk profile to predict the important determinants of riskiness and acceptability. An examination of the Pearson correlation coefficients did not revealed a significant relationship between the characteristic severity of consequences and any other characteristic. By comparison the characteristic *likelihood of occurrence* appears to be a much better predictor of riskiness despite the fact that people indicated that there is only a moderate probability of a negative outcome.

Returning to the path diagram (Figure 3) we see that most of the same characteristics which influence perceived riskiness also influence individual acceptance although the strength of the relationships is different. Perceived riskiness has an influence on individual acceptance although the relationship is not very strong, having a non-significant t value (i.e., < 1.96). The strongest relationship is the influence of perceived societal acceptance on individual acceptance.

From the risk profile, we can interpret the path diagram to mean that the moderate-low level of individual acceptance reflects in part the moderate-low level of perceived societal acceptance. The characteristics equity and individual benefit appear to influence individual acceptance both directly and indirectly through perceived riskiness. As a hazard domain asbestos is considered to be somewhat unacceptable at least in part because of the perception that asbestos offers little in the way of benefits to those exposed to the risks, with any benefits going to others (i.e., inequitable), and that asbestos carries a moderate-high level of riskiness. In addition respondents believe that others in society view asbestos as being somewhat unacceptable.

Hazard Domain: Surfing

Table 32 provides the mean ratings of the various risk characteristics for the hazard domain surfing. The risk profile indicates that surfing is perceived as a voluntary risk, having a low level of associated dread, but a high level of benefit and personal control for the individual engaged in the activity. Surfing is viewed as having only a moderate level of riskiness with a moderate to high level of acceptance.

The mean rating of 4.0 for trust may reflect the lack of an easily identifiable institution associated with the management of this risk. There is a moderate-low likelihood of an accident occurring although the severity of the consequences is moderate-high if an accident does happen. Surfing is perceived as being moderately equitable in terms of the distribution of costs and benefits.

Table 32. *Risk Profile for the Hazard Domain Surfing*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	1.29	0.84
Dread of risk	2.18	1.08
Trust in Institution	4.00	1.70
Expert Knowledge	2.54	1.41
Equity	3.17	1.86
Society's Knowledge	2.52	1.32
Severity of Consequences	4.73	1.38
Number of People Exposed	4.33	1.87
Institutional Control	5.58	1.47
Personal Control	2.72	1.65
Benefit to Society	4.96	1.78
Benefit to Individual	2.30	1.31
Likelihood of Occurrence	3.47	1.31
Overall Level of Risk	4.17	1.36
Your Acceptance of Risk	2.84	1.37
Societal Acceptance	2.68	1.33

The analysis of Pearson Correlation Coefficients (Tables 33) indicates that the characteristics likelihood of occurrence, severity of consequences and individual acceptance are most strongly correlated with overall level of risk. The multiple linear regression analysis indicated that only the characteristic likelihood of occurrence and severity of consequences contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 33. *Pearson Correlation Coefficients - Surfing*

Characteristic	Overall Level of Risk	Individual Acceptance
Equity		.24
Severity of consequences	.43	
Individual benefit		.28
Likelihood of occurrence	.51	.33
Societal acceptance		.61
Individual acceptance	.30	N/A
Overall level of risk	N/A	.30

A multiple regression analysis with individual acceptance as the dependent variable indicated that the characteristics societal acceptance is by far the best predictor of individual acceptance ($p<.01$). When societal acceptance was removed from the analysis the characteristic equity was also significant ($p<.05$). The Pearson Correlation Coefficients for these characteristics are shown in Table 33.

It appears that likelihood of occurrence is a significant predictor of both perceived riskiness and individual risk acceptance. The other significant predictor of perceived riskiness being severity of consequences, with societal acceptance being the strongest predictor of individual risk acceptance.

As with the asbestos hazard domain, LISREL path analysis was used to examine the major determinants of perceived riskiness and individual risk acceptance. The path diagram for surfing is shown in Figure 4. Goodness of fit statistics indicate that the model explains the data well, $\chi2$ (4) = 4.54, p = .34 and the AGFI = 0.99.

The path diagram reveals that severity of consequences and the likelihood of those consequences significantly influence perceptions of overall riskiness. The ratings in the risk profile are consistent with such relationships. The moderate level of perceived riskiness reflecting the moderate probability of an accident as well as moderate-highly severe consequences should there be an accident. Unlike the model developed for asbestos, societal acceptance does not appear to have a major influence on perceived riskiness (t = 1.95, ns). This may reflect the fact that surfing is a very

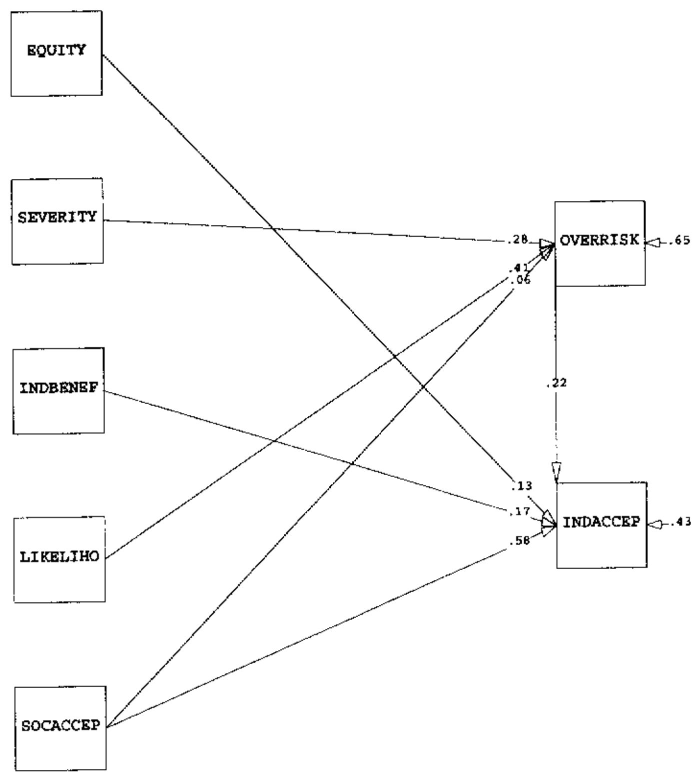

Figure 4. Path Diagram for Surfing

individual activity and thus one is less likely to judge its riskiness on the basis of what others in society think.

The major influences on individual acceptance of surfing as a hazard domain are society's acceptance, perceived riskiness, individual benefit and equity. Equity however has a non-significant t value. Again looking at the risk profile it seems reasonable that surfing is viewed by individuals as an acceptable hazard domain, at least in part, because it is perceived as having a moderate level of riskiness and it brings considerable benefits to the person engaged in the activity. Individuals also view surfing as being acceptable because they believe others in society view it as being acceptable.

The regression analysis suggested that the characteristic likelihood of occurrence should be a significant determinant of individual acceptance. Yet the path diagram indicates no direct relationship between the two. This may be explained by the moderate relationship between perceived riskiness and likelihood ($r = .51$). It is likely that there is a relationship between likelihood and individual acceptance but that relationship is an indirect one translated via perceived riskiness.

Based on the Slovic and Fischhoff regression-based research and the risk profile developed for surfing one would have anticipated that the characteristics dread, volition, personal control and society's knowledge of the risk would have played significant roles. Surfing is considered to be a very voluntary activity with a low level of dread and high level of personal control. Yet none of these characteristics appears to contribute significantly to a person's view of the overall riskiness of surfing or its acceptability.

Hazard Domain: Bush Fires

The risk profile for the bush fires hazard domain is shown in Table 34. The mean ratings of the risk characteristics portray bush fires as having a high level of overall riskiness with the potential for severe consequences. Of the eight hazard domains, bush fires were perceived as having the greatest overall level of risk.

Table 34. *Risk Profile for the Hazard Domain Bush Fires.*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	5.43	1.68
Dread of risk	6.01	1.15
Trust in Institution	2.83	1.55
Expert Knowledge	2.03	1.21
Equity	5.31	1.78
Society's Knowledge	2.81	1.60
Severity of Consequences	6.17	1.08
Number of People Exposed	4.66	1.58
Institutional Control	4.00	1.83
Personal Control	3.72	1.71
Benefit to Society	6.22	1.18
Benefit to Individual	6.28	1.34
Likelihood of Occurrence	4.84	1.37
Overall Level of Risk	6.06	1.18
Your Acceptance of Risk	5.50	1.62
Societal Acceptance	5.54	1.62

Although respondents indicated that experts have a good understanding of bush fires and that they trust the experts responsible for their management, they believe that only moderate levels of personal or institutional control of bush fires is possible. Considered an involuntary risk, bush fires possess a high level of dread and are viewed as offering little individual or societal benefit. Respondent perceptions of bush fires as an involuntary risk are interesting. Since people can avoid bush fires by not living next to the bush, bush fires could to some extent be considered a voluntary risk. However, as in this study, the risks associated with bush fires are typically not viewed from that perspective. The risks associated with bush fires are viewed by respondents as being moderate-highly unacceptable to both the respondents and society.

It is also interesting to note that although bush fires are considered to pose the greatest overall level of risk of the 8 hazard domains, they are not the least acceptable risk. Both the hazard domains toxic waste incineration and asbestos have lower acceptability ratings. A possible explanation from the risk literature is that people view the acceptability of natural hazards (e.g., bush fires) more positively than they do man-made hazards (e.g., waste incineration and asbestos) (e.g., Bell et al. 1990). However this explanation is not completely satisfying in this instance since media coverage of bush fires in Western Australia typically highlight the fact that many, if not most, are the result of arson.

The analysis of Pearson Correlation Coefficients (Tables 35) indicates that the characteristics likelihood of occurrence, dread, societal acceptance and individual acceptance are most strongly correlated with overall level of risk. The characteristic societal acceptance was omitted from the regression analysis because of the strong correlation between societal and individual acceptance ($r = .78$). The multiple linear regression analysis indicated that only the characteristics individual acceptance and likelihood of occurrence contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 35. *Pearson Correlation Coefficients - Bush Fires*

Characteristic	Overall Level of Risk	Individual Acceptance
Equity	.25	.36
Dread	.30	.33
Severity of consequences	.26	.42
Individual benefit	.29	.53
Likelihood of occurrence	.32	
Societal acceptance	.47	.78
Individual acceptance	.53	N/A
Overall level of risk	N/A	.53

A multiple regression analysis with individual acceptance as the dependent variable indicated that the characteristics individual benefit and overall level of risk are the best predictors of individual acceptance ($p<.01$) in the absence of the characteristic societal acceptance. The Pearson Correlation Coefficients for these characteristics are shown in Table 35 and indicate that the characteristic severity of consequences is also significantly correlated with individual acceptance ($r = .42$).

The LISREL path analysis revealed the path diagram shown in Figure 5. Goodness of fit statistics indicate that the model explains the data well, $\chi 2$ (2) = 0.24, p = .89 and the AGFI = 0.99. The path diagram indicates that a person's perception of the riskiness of bush fires is influenced by the characteristics: severity of consequences, likelihood of occurrence, societal acceptance and individual acceptance. Although the pathway from severity of consequences to perceived riskiness was non-significant (t = .70, ns), severity may still be important indirectly. Severity of consequences as well as

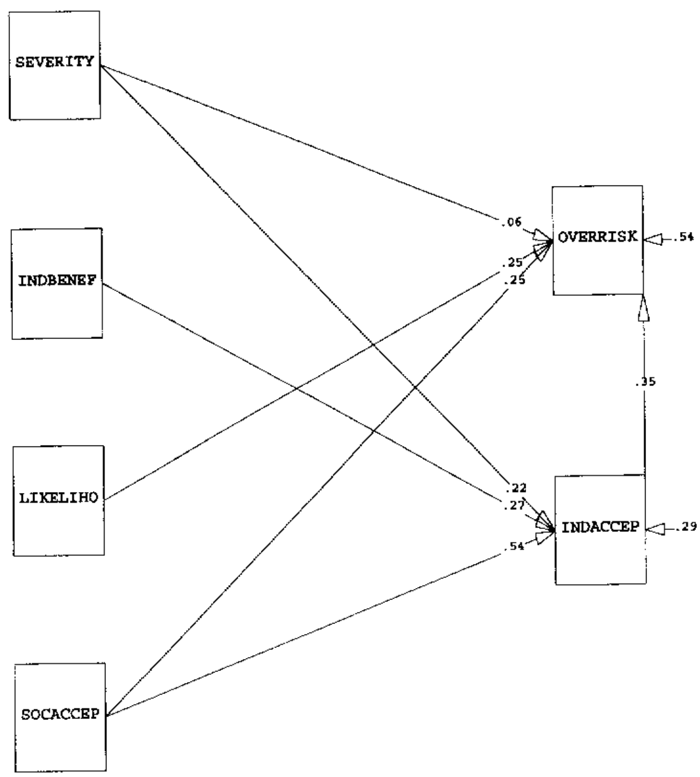

Figure 5. Path Diagram for Bush Fires

the characteristic benefits to those exposed may indirectly influence perceived riskiness through their significant influence on individual acceptance (r values of .46 and .49 respectively).

The risk profile (Table 34) suggests that people believe bush fires are very risky because they offer little benefit to those exposed, have potentially severe consequences with a moderate likelihood of occurring, and they believe society is also unaccepting of these risks.

With respect to individual risk acceptance, the significant determinants appear to be severity of consequences, benefits to those exposed and the degree of perceived societal acceptance. In other words people perceive bush fires as being moderately-highly unacceptable at least in part because bush fires offer little benefit to those exposed and because any negative consequences would be severe. In addition respondents believe that society would not find the risks associated with bush fires to be acceptable.

Of the 8 hazard domains, this is the only path model which has a pathway from individual acceptance to perceived riskiness (i.e. Overall Risk). The risk literature typically describes the relationship between perceived risk and risk acceptability in terms of the predictive capability of perceived risk with respect to perceived acceptability. However the opposite relationship does not seem unreasonable if one accepts that the way we view the world and our decisions is through a cultural lens.

Thus such a path model is not inconsistent with cultural theory of risk. This issue is explored further later in this chapter.

While the path model in Figure 5 represents the best fit for the bush fire data another path model, Figure 6, also fits the data well and is more consistent with the risk literature . Figures 5 and 6 display the same variables, however the model in Figure 6 shows perceived riskiness influencing individual risk acceptance. Figure 5 displayed the opposite relationship. The goodness of fit statistics for Figure 6 are $\chi2$ (2) = 2.11, p = .35 and the AGFI = 0.93.

If one had attempted to predict the most important determinants of perceived riskiness and individual acceptance solely on the basis of the risk profile and the findings of the risk literature the conclusions would have been different. Given the high level of dread associated with bush fires (mean of 6.01) one might have expected dread to have a significant influence on a person's assessment of overall riskiness. Given the small standard deviation (1.15) for the variable dread, a ceiling effect may be playing a role. However other variables with similarly low standard deviations were found to be significant determinants for other hazard domains. An example being the characteristic severity of consequences which is a significant determinant of perceived riskiness for the hazard domain toxic waste incineration.

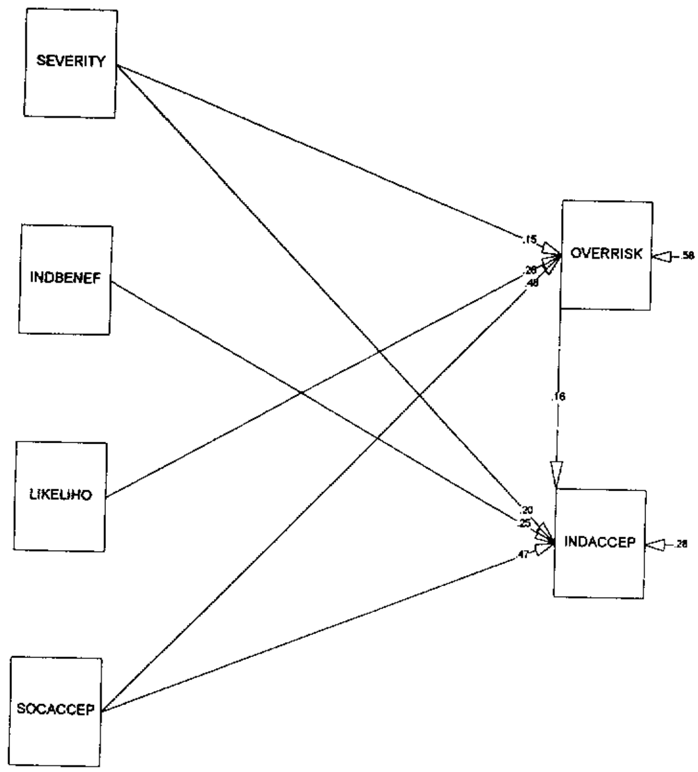

Figure 6. Alternative Path Diagram for Bush Fires

Hazard Domain: Toxic Waste Incineration

The risk profile for toxic waste incineration is provided in Table 36. Of the eight hazard domains, toxic waste incineration was viewed as posing the second highest overall level of risk. The risks associated with toxic waste incineration were considered moderately-highly unacceptable to both the respondents and society. Although it has the second highest mean rating for overall riskiness, it was considered to be the least acceptable by respondents. Toxic waste incineration was viewed as an involuntary hazard domain characterised by a high level of dread, little benefit for those exposed, and with the potential for severe consequences albeit with a moderate likelihood of occurrence.

Table 36. *Risk Profile for Toxic Waste Incineration*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	5.55	1.62
Dread of risk	5.50	1.66
Trust in Institution	4.38	2.11
Expert Knowledge	3.22	1.82
Equity	5.86	1.41
Society's Knowledge	4.68	1.64
Severity of Consequences	6.04	1.18
Number of People Exposed	4.56	1.78
Institutional Control	2.96	1.75
Personal Control	4.96	1.87
Benefit to Society	5.36	1.77
Benefit to Individual	5.76	1.67
Likelihood of Occurrence	4.58	1.46
Overall Level of Risk	5.80	1.21
Your Acceptance of Risk	5.79	1.59
Societal Acceptance	5.65	1.54

Respondents indicated that the experts had a good understanding of the risks and reasonable potential to control outcomes but there was only a moderate-low level of trust in the institutions responsible for managing the risks. By comparison, those exposed to the risk were seen as having only a moderate level of control. Any benefits of toxic waste incineration to society were not greatly acknowledged by respondents.

The analysis of Pearson Correlation Coefficients (Tables 37) indicates that the characteristics severity of consequences, likelihood of occurrence, societal benefit, societal acceptance and individual acceptance are most strongly correlated with overall level of risk. The multiple linear regression analysis indicated that 4 characteristics (i.e. individual and societal acceptance, likelihood of occurrence, and severity of consequences) contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 37. *Pearson Correlation Coefficients - Toxic Waste Incineration*

Characteristic	Overall Level of Risk	Individual Acceptance
Societal benefit	.39	.43
Dread		.33
Severity of consequences	.46	
Individual benefit	.35	.30
Likelihood of occurrence	.34	
Societal acceptance	.46	.64
Individual acceptance	.53	N/A
Overall level of risk	N/A	.53

A multiple regression analysis with individual acceptance as the dependent variable indicated that only the characteristics societal acceptance and overall level of risk are significant predictors of individual acceptance ($p<.01$). The Pearson Correlation Coefficients for these characteristics are shown in Table 37 and indicate that the characteristics societal benefit and dread are also significantly correlated with individual acceptance.

The model of riskiness and individual acceptance developed with LISREL path analysis is shown in Figure 7. Goodness of fit statistics indicate that the model fits the data moderately well with $\chi 2$ (8) = 11.21, p = .19 and the AGFI = 0.97. All pathways have significant t values (i.e., > 1.96). The path diagram indicates that a person's perception of the riskiness of toxic waste incineration is influenced by the degree of perceived *societal acceptance,* the *severity of the consequences* and the *likelihood* that those consequences would occur.

Comparing this model with the risk profile (Table 36), we see that toxic waste incineration is viewed as being unacceptable to society, with a moderate likelihood that severe consequences would occur. Collectively these characteristics contribute to a moderate-high assessment of overall risking.

The path diagram also suggests that the level of *dread* and the amount of *benefit to society* are significant determinants of a person's *level of acceptance* of this hazard domain. *Society's level of acceptance* and perceived riskiness also significantly influence individual acceptance. Thus the low level of individual acceptance reflects the perception that society does not accept this risk, the perceived lack of societal benefits, the moderate-high level of dread and a moderate-high level of perceived riskiness.

The contribution of societal benefits to determining acceptance is interesting. Slovic et al. (1980) and others have reported that people are willing to accept more risk if

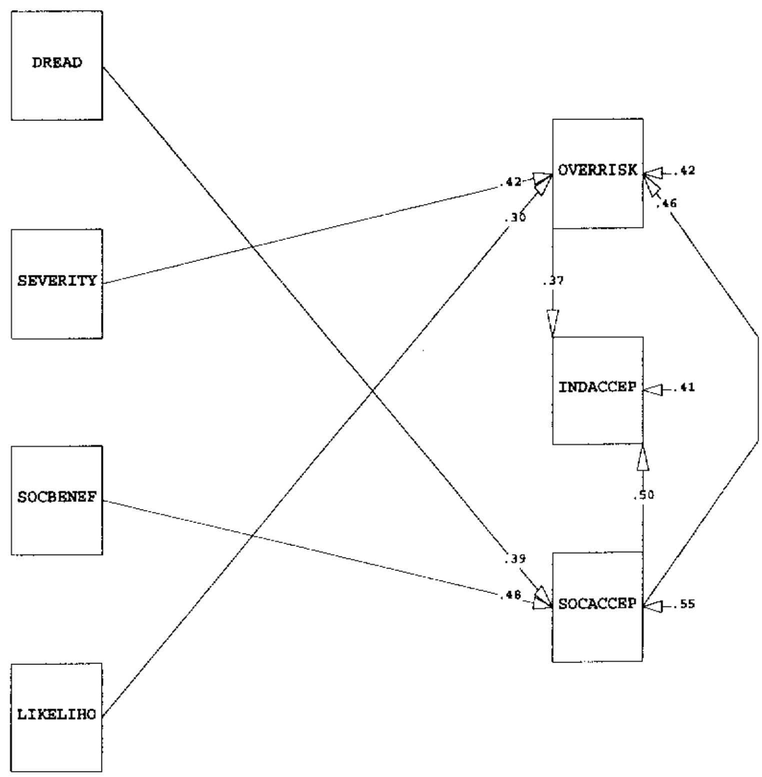

Figure 7. Path Diagram for Toxic Waste Incineration

there are considerable benefits. The situation with toxic waste incineration is somewhat different. In this instance, societal benefit appears to be a significant determinant of acceptance but the amount of perceived benefit is low and the degree of individual acceptance is also low. This suggests that benefits need not be high to have an influence on individual acceptance. Rather that benefits can play an influential role regardless of their magnitude.

Hazard Domain: Dams

Table 38 provides the risk profile for dams as a hazard domain. From the characteristics' mean ratings we see that people perceive dams as having a low overall level of risk with little associated dread and a low likelihood that a accident will occur. As a hazard domain dams are viewed as being well understood by the experts who are both trusted and perceived as having a good level of control in the management of the risks. Dams are seen as being beneficial to both the individual exposed to the risk and to society.

Respondents were most divided in their views with respect to the voluntary nature of the risk and the ability of those exposed to the risks to exert control. Approximately 50% of respondents viewed dams to be a voluntary risk while 35% viewed it as involuntary. Similarly approximately 40% of respondents believed that those exposed to the risk could exert some level of control while 51% indicated that only a low amount of control is possible.

Table 38. *Risk Profile for the Hazard Domain Dams*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	3.70	2.03
Dread of risk	2.80	1.65
Trust in Institution	2.52	1.53
Expert Knowledge	2.29	1.28
Equity	3.81	2.00
Society's Knowledge	3.64	1.64
Severity of Consequences	4.85	1.62
Number of People Exposed	3.83	2.03
Institutional Control	2.78	1.76
Personal Control	4.17	2.14
Benefit to Society	2.13	1.35
Benefit to Individual	2.49	1.55
Likelihood of Occurrence	2.78	1.61
Overall Level of Risk	2.91	1.51
Your Acceptance of Risk	2.76	1.67
Societal Acceptance	2.62	1.68

Respondents indicated that they believe that dams pose an acceptable level of risk and that society has a similar view. As noted earlier, personal experience has been identified as a determinant of risk perception (Slovic et al. 1980, Bishop & Syme 1992). It is worth noting that in the Perth metropolitan area from which the sample population was drawn, the public's experience with dams has been positive. Dams are recognised as a major source of drinking water for the metropolitan area. The major dams around the metropolitan area have also been developed as popular recreation facilities. There has never been a major accident associated with any of the dams in Western Australia.

The analysis of Pearson Correlation Coefficients (Tables 39) indicates that the characteristics likelihood of occurrence, dread, societal and individual acceptance, and societal benefit are most strongly correlated with overall level of risk. The characteristics societal acceptance and individual benefit were omitted from the regression analysis because of they strongly correlated with the variables individual acceptance and societal benefit respectively. The multiple linear regression analysis indicated that 3 characteristics (i.e. dread, societal benefit, and likelihood of occurrence) contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 39. *Pearson Correlation Coefficients - Dams*

Characteristic	Overall Level of Risk	Individual Acceptance
Trust	.30	.36
Dread	.45	.49
Expert knowledge		.33
Societal benefit	.50	.44
Individual benefit	.41	.41
Likelihood of occurrence	.46	.22
Societal acceptance	.47	.87
Individual acceptance	.41	N/A
Overall level of risk	N/A	.41

A multiple regression analysis with individual acceptance as the dependent variable indicated that only the characteristic dread was a significant predictor of individual acceptance ($p<.01$) in the absence of the characteristic societal acceptance. The Pearson Correlation Coefficients for individual acceptance are shown in Table 39 and indicate that the characteristics societal benefit and overall level of risk are also significantly correlated with individual acceptance ($r = .42$).

The path diagram from the LISREL path analysis is shown in Figure 8. Goodness of fit statistics indicate that the model fits the data moderately well with $\chi2$ (11) = 12.95, p = .30) and the AGFI = 0.91. All pathways have significant t values. The path analysis suggests that likelihood of occurrence, severity of consequences, societal benefit and dread significant influence perceived riskiness. Viewed against the risk

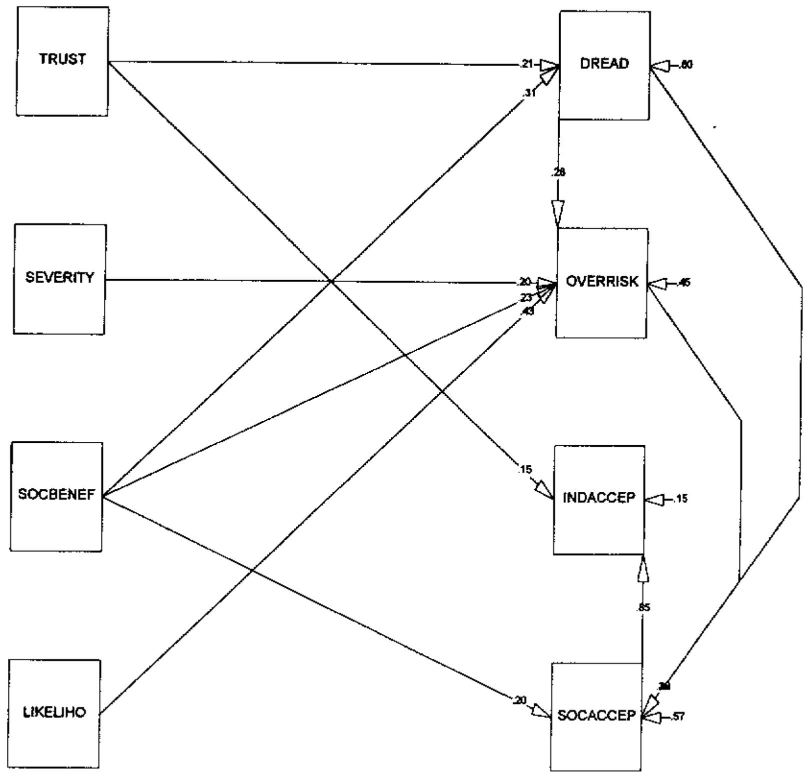

Figure 8. Path Diagram for Dams

profile (Table 38), we can interpret the path diagram to mean that respondents perceive dams as having a low level of riskiness due at least in part to their perception that dams offer significant benefits to society, their risks are not feared and while the consequences of accidents could be somewhat severe they have a fairly low probability of occurring.

As shown in the path diagram, trust in the risk managers, the degree of dread, societal acceptance of the hazard and perceived riskiness all influence the degree of individual acceptance. On the basis of the risk profile we can interpret this model in the following manner. Respondents view dams as posing an acceptable level of risk because they trust those responsible for managing the risk, they do not fear the risk of dam failure, and they believe that overall dams pose a fairly low level of risk that is accepted by others in society.

Characteristics such as severity, likelihood and societal benefit may also influence individual acceptance indirectly through their relationships with perceived riskiness and in the case of societal benefit the characteristic dread.

Hazard Domain: Bicycles

The risk profile for bicycles is shown in Table 40. As a hazard domain, bicycles are perceived as having a moderate-low level of overall risk and a high level of risk acceptability. It is a hazard domain which affects many people and over which a high level of personal control is perceived to be possible. As a hazard domain it is viewed as being well understood by both the experts and those who ride bicycles. Cycling is perceived as providing benefits to both the individual and society.

Table 40. *Risk Profile for Bicycles*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	1.62	1.15
Dread of risk	2.54	1.51
Trust in Institution	3.38	1.55
Expert Knowledge	1.96	1.11
Equity	3.18	2.01
Society's Knowledge	2.31	1.25
Severity of Consequences	4.78	1.54
Number of People Exposed	5.46	1.66
Institutional Control	3.86	1.69
Personal Control	2.06	1.25
Benefit to Society	2.94	1.56
Benefit to Individual	2.14	1.43
Likelihood of Occurrence	3.65	1.31
Overall Level of Risk	3.53	1.36
Your Acceptance of Risk	2.45	1.38
Societal Acceptance	2.48	1.46

As an activity it generates a relatively low level of dread although negative consequences are moderately likely to occur resulting in moderately severe consequences. Equity was the risk characteristic which displayed the greatest range of opinions. Approximately 49% of respondents believe that cycling is highly equitable in its distribution of costs and benefits (mean rating <=2) (i.e., those who enjoy the benefits also those who would experience any costs). However approximately 21% of respondents believe there is a very unequal distribution of costs and benefits (mean rating =>6).

The analysis of Pearson Correlation Coefficients (Tables 41) indicates that the characteristics likelihood of occurrence, dread, and personal control are most strongly correlated with overall level of risk.

Table 41. *Pearson Correlation Coefficients - Bicycles*

Characteristic	Overall Level of Risk	Individual Acceptance
Volition		.27
Dread	.44	.33
Personal control	.32	.25
Likelihood of occurrence	.52	.23
Societal acceptance	.23	.94
Individual acceptance	.26	N/A
Overall level of risk	N/A	.26

The characteristic societal acceptance was omitted from the regression analysis because it was strongly correlated with the variable individual acceptance ($r = .94$). The multiple linear regression analysis indicated that the characteristic likelihood of occurrence contributed significantly ($p<.01$) to prediction of overall level of risk. The characteristics dread and equity were significant at $p<.05$.

A multiple regression analysis with individual acceptance as the dependent variable indicated that no characteristic was a significant predictor of individual acceptance at $p<.01$ in the absence of the characteristic societal acceptance. However the characteristics dread and trust in institutions were both significant at $p<.05$. The Pearson Correlation Coefficients for individual acceptance are shown in Table 41.

Any relationship involving trust in institutions needs to be considered carefully. The moderate level of trust in institution reported for cycling (mean rating 3.38) is likely to be more a reflection of the lack of a clearly identifiable risk manager than anything else.

The path diagram from the LISREL path analysis is shown in Figure 9. Goodness of fit statistics indicate that the model fits the data very well, $\chi 2$ (6) = 3.53, p = .74 and AGFI = 0.96. Each of the pathways is significant with the following exceptions: the effect of personal control on both perceived riskiness and societal acceptance, and the influence of societal acceptance on perceived riskiness.

The path diagram demonstrates the influential role of the characteristics dread, societal acceptance and likelihood of accidents in determining overall riskiness. In light of the risk profile (Table 35) this means that people view bicycles and cycling as having a low-moderate level of risk at least in part because they experience little dread and believe that there is only a moderate probability that an accident will occur. The low level of dread reflects the perception that significant personal control is possible, the voluntary nature of cycling as an activity and the belief that other people are also accepting of the risks of cycling. Thus volition and personal control may indirectly influence perceived riskiness by their influence on a person's perception of dread.

The path diagram demonstrates a very close relationship between individual and societal risk acceptance. Although only likelihood of occurrence and societal acceptance have direct pathways to individual acceptance, a number of other characteristics also influence individual acceptance indirectly through societal

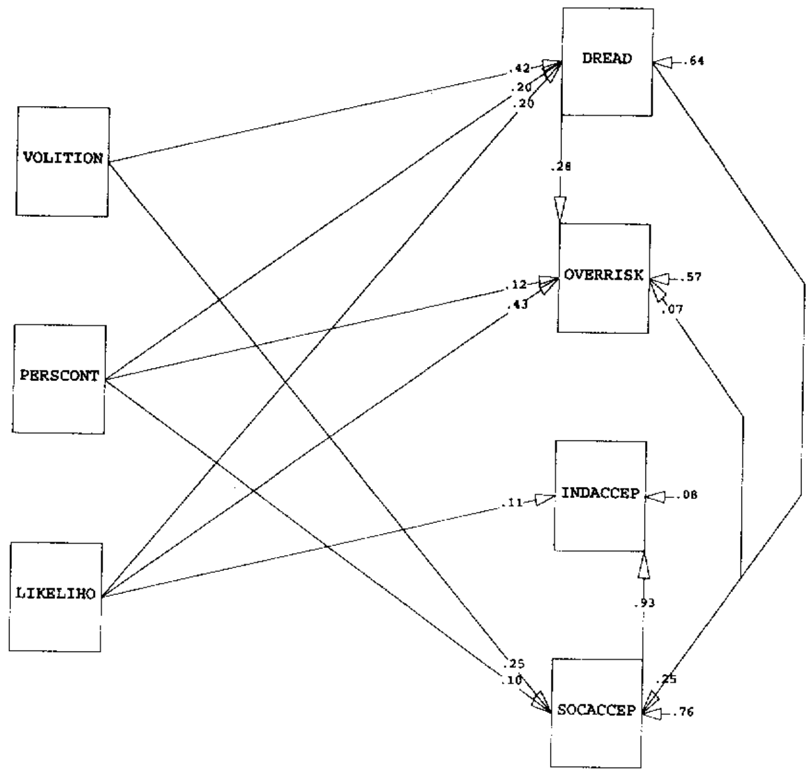

Figure 9. Path Diagram for the Hazard Domain Bicycles

acceptance. It appears that the high degree of individual acceptance reflects not only a perception that society is also accepting of risks but the view that there is only a moderate-low probability of an accident. The voluntary nature of cycling, the high level of personal control and low level of dread also contribute to a high level of individual acceptance. Interestingly the acknowledged individual benefits of cycling (mean rating 2.14) do not play a significant role in determining the acceptability of the risks associated with cycling ($r = .16$).

Hazard Domain: Vaccinations

The mean characteristic ratings in Table 42 provide a risk profile for vaccinations as a hazard domain. As a hazard domain vaccinations are perceived as having a low level of riskiness and as being very acceptable. The risks associated with vaccinations are thought to be very well understood by experts. There is a high level of trust in the experts managing the risks who are viewed as being able to exert a large amount of control over the risks associated with vaccinations.

Not surprisingly, of the 8 hazard domains, vaccinations are perceived as offering the greatest amount of benefit to both the affected individual and to society as a whole. There is a moderate level of dread associated with vaccinations with the recognition that somewhat severe consequences are possible although such outcomes are perceived as having a low likelihood of occurring.

Table 42. *Risk Profile for Vaccinations as a Hazard Domain*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	3.11	1.98
Dread of risk	3.48	1.82
Trust in Institution	1.90	1.46
Expert Knowledge	1.94	1.27
Equity	3.37	2.22
Society's Knowledge	4.26	1.87
Severity of Consequences	4.87	1.56
Number of People Exposed	5.49	1.85
Institutional Control	2.23	1.51
Personal Control	3.76	2.21
Benefit to Society	1.67	1.41
Benefit to Individual	1.59	1.26
Likelihood of Occurrence	2.73	1.53
Overall Level of Risk	2.65	1.34
Your Acceptance of Risk	2.54	1.79
Societal Acceptance	2.57	1.82

The analysis of Pearson Correlation Coefficients (Tables 43) indicates that the characteristics likelihood of occurrence, dread, and societal and individual acceptance are most strongly correlated with overall level of risk.

Table 43. *Pearson Correlation Coefficients - Vaccinations*

Characteristic	Overall Level of Risk	Individual Acceptance
Volition	.30	
Trust	.31	
Dread	.48	.33
Severity of consequences	.29	
Societal benefit		.33
Likelihood of occurrence	.56	
Societal acceptance	.47	.93
Individual acceptance	.54	N/A
Overall level of risk	N/A	.54

The characteristic societal acceptance was omitted from the regression analysis because it strongly correlated with the variable individual acceptance (r = .93). The multiple linear regression analysis indicated that the characteristics likelihood of occurrence and individual acceptance contributed significantly ($p<.01$) to prediction of overall level of risk.

A multiple regression analysis with individual acceptance as the dependent variable indicated that only the characteristics societal benefit and overall level of risk were significant predictors of individual acceptance ($p<.01$) in the absence of the characteristic societal acceptance. The Pearson Correlation Coefficients for individual acceptance are shown in Table 43 and indicate that the characteristics societal benefit and overall level of risk are also significantly correlated with individual acceptance ($r = .42$).

The path diagram for perceived riskiness and individual acceptance generated by LISREL path analysis is shown in Figure 10. Each of the pathways in the diagram is significant (i.e., t value exceeds 1.96). Goodness of fit statistics indicate $\chi2$ (9) = 23.96, $p = 0.004$ and the AGFI = 0.83.

From the path diagram we see that the characteristics likelihood of occurrence, severity of consequences and volition significantly influence perceived riskiness. Individual acceptance appears to be strongly influenced by the characteristics perceived riskiness and perceived societal benefits. Examining these relationships in light of the risk profile for vaccinations (Table 42) suggests that the low level of perceived risk reflects the perception that a negative outcome is unlikely and that vaccinations are perceived as a voluntary risk. The high level of individual acceptance appears to reflect the low level of perceived risk and the high degree of benefit

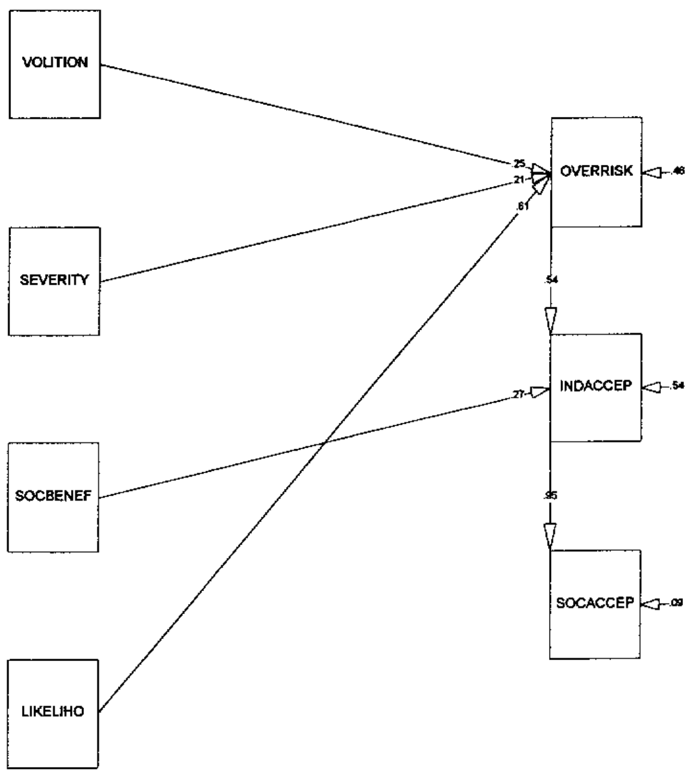

Figure 10. Path Diagram for Vaccinations

associated with vaccinations. In the case of vaccinations, societal benefits and benefits to the exposed individual are highly correlated (r = .75). Respondents indicated that vaccinations created substantial benefits both for society and the affected individual.

Hazard Domain: Sunbathing

The risk profile for sunbathing is displayed in Table 44. As a hazard domain sunbathing is characterised as a voluntary activity, affecting a large number of people, and over which individuals can exert a high level of personal control. It is a hazard domain that is viewed as being well known by both the experts and those exposed to the risk, although the experts are perceived as being able to exert far less control than the exposed individual.

There is recognition that moderate-highly severe outcomes are possible with a moderate-high probability of occurrence. Overall sunbathing represents a moderate-high level of riskiness which is moderately unacceptable to individuals as well as to society as a whole.

Perhaps as an indication of the effectiveness of major education campaigns in recent years, sunbathing is not viewed as being beneficial to the individual exposed. However a major theme of the education campaigns has been the relationship between sunbathing and skin cancer and, in particular, melanoma which has a very high mortality rate. While the individual benefits rating might be encouraging to associations like the Cancer Society who continue to wage a strong campaign against unprotected or extended sunbathing, the ratings for severity of consequences would be somewhat disappointing. The mean severity rating of 5.50 while being on the high side of the scale is below the mean severity rating for bush fires (6.17), asbestos (6.06), and toxic waste incineration (6.04).

Table 44. *Risk Profile for the Hazard Domain Sunbathing*

Characteristic (N=110)	Mean Rating (1-7)	Standard Deviation
Volition	1.61	1.13
Dread of risk	3.60	1.70
Trust in Institution	2.99	1.44
Expert Knowledge	1.69	1.00
Equity	4.86	2.03
Society's Knowledge	2.62	1.44
Severity of Consequences	5.50	1.25
Number of People Exposed	6.16	1.24
Institutional Control	5.09	1.71
Personal Control	1.52	1.00
Benefit to Society	5.90	1.43
Benefit to Individual	4.86	1.93
Likelihood of Occurrence	5.14	1.26
Overall Level of Risk	5.35	1.25
Your Acceptance of Risk	4.77	1.75
Societal Acceptance	4.34	1.68

The analysis of Pearson Correlation Coefficients (Tables 45) indicates that the characteristics likelihood of occurrence, dread, and societal and individual acceptance are most strongly correlated with overall level of risk. The multiple linear regression analysis indicated that 3 characteristics (i.e. dread, individual acceptance, and likelihood of occurrence) contributed significantly ($p<.01$) to prediction of overall level of risk.

A multiple regression analysis with individual acceptance as the dependent variable indicated that two characteristics, societal acceptance and overall level of risk were significant predictors of individual acceptance ($p<.01$). At $p<.05$ the characteristic individual benefit was also significant. The Pearson Correlation Coefficients for individual acceptance are shown in Table 45.

Table 45. *Pearson Correlation Coefficients - Sunbathing*

Characteristic	Overall Level of Risk	Individual Acceptance
Dread	.30	
Individual benefit		.34
Likelihood of occurrence	.34	
Societal acceptance	.33	.60
Individual acceptance	.49	N/A
Overall level of risk	N/A	.49

LISREL path analysis revealed the path diagram shown in Figure 11. With the exception of the pathway from individual benefit to perceived riskiness, all pathways are significant (i.e., t values > 1.96). Goodness of fit statistics indicate that the model fits the data very well with $\chi 2$ (2) = 0.53, p = .77 and the AGFI = 0.98.

The path diagram indicates that dread, likelihood of occurrence and societal acceptance have the greatest influence on perceived riskiness. Using the risk profile in Table 44 to interpret these relationships suggests that the perception that sunbathing is quite risky (mean of 5.35) is consistent with respondent perceptions of a moderate level of dread (mean of 3.60), a significant probability of a negative outcome (e.g., skin cancer), and a moderate degree of unacceptance on the part of society. Respondents indicated that sunbathing could result in quite severe consequences (mean of 5.50) The characteristic severity of consequences may be contributing indirectly though likelihood of occurrence (r = .27).

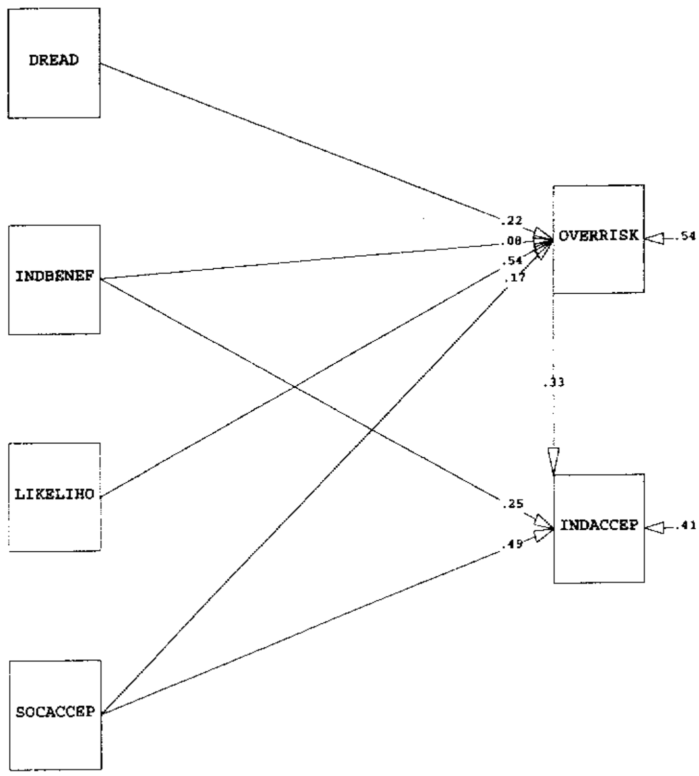

Figure 11. Path Diagram for Sunbathing

With respect to individual acceptance, the path diagram demonstrates the influence of perceived riskiness, individual benefit and societal acceptance on individual risk acceptance. The moderate-low degree of individual risk acceptance is consistent with the risk profile which reflects the perceptions that society is slightly unaccepting of the risk, that sunbathing is quite risky and that it generates quite limited benefits for those exposed. Characteristics which significantly influence riskiness may also be influencing individual acceptance. Most notable is the characteristic dread which is both a significant determinant of perceived riskiness and is significantly correlated with individual acceptance ($r = .25$).

Summary of Results

The correlation, regression and path analyses of the 8 generic hazard domains indicate that the relationships among the various risk characteristics is risk or hazard specific. For many of the hazard domains, characteristics which from the risk perception literature one might have expected to display a significant relationship did not. Unlike the Slovic et al. (1980) findings, most of the hazard domains did not reveal a high degree of correlation among the various risk characteristics.

For a given hazard domain, it proved particularly difficult to assess which characteristics would significantly influence perceived risk or risk acceptability solely on the basis of the risk profiles based on mean characteristic ratings. For example, although the risk literature would suggest that 'dread' would be a good predictor of the overall level of perceived risk, in the case of the hazard domain asbestos it did not appear to be a significant determinant even though respondents rated the level of dread to be moderate-high.

Across the 8 hazard domains a significant relationship was found between the overall level of perceived risk and individual acceptance. However this relationship for some of the hazard domains was not as strong as had been hypothesised and other variables were sometimes better indicators of individual acceptance. The perceived level of risk and individual acceptance of the risk do not appear to be indicators of the same thing. While some of the same variables may be good predictors of both of these attributes for a given hazard domain, perceived level of risk and individual acceptance reflect different aspects of the concept 'risk'.

Although the path analyses did quite well, for the most part the relationships among the variables were weak with few strong predictors of overall level of risk or individual acceptance emerging from the hazard analyses. The lack of strong predictive characteristics does not mean that such predictive characteristics do not exist. Rather it may indicate that critical risk characteristics for this particular set of hazard domains were not included in the study. In future research this question could be explored by developing the initial list of test variables from focus group discussions on the selected hazard domains rather than relying on the risk perception literature to identify the variables as was done in this study.

Risk / Benefit Relationship

A number of studies have reported an inverse relationship between perceived risk and perceived benefit for a range of hazards (e.g., Alhakami & Slovic 1994). Psychometric studies by Fischhoff et al. (1978) and Slovic et al. (1991) found that in general, for a range of hazards, the greater the perceived benefit the lower the perceived risk.

When researchers such as Fischhoff and Slovic investigate the relationship between perceived risk and benefit they conceptually view risk and benefit as being separate and do not include benefit in their list of risk attributes. In their instructions to respondents they emphasise the importance of separating benefit from risk and of not weighing the benefits against the risks in determining perceived risk. This separation does not allow one to explore whether or not benefit may play a legitimate role in determining perceived risk as well as determining risk acceptability.

Gregory and Mendelsohn (1993) put forward a similar argument. Their research found that average risk ratings were significantly affected by perceived individual benefits suggesting that perceptions of risk are net rather than gross indicators of harm. It should be noted that Gregory and Mendelsohn used 84 of the 90 risk items (products, technologies, activities) that Slovic et al. (1980) used in their studies. They also combined the data from the various risks before using correlation and regression analysis to examine the relationship among risk attributes. They found that personal benefit measures, which were defined as pleasure benefits as opposed to economic benefits, negatively affected risk ratings. They also found that economic benefits to society also correlated negatively with risk ratings although the effect was smaller.

This study suggests a similar conclusion, that when asked to judge riskiness people incorporate benefits into their thinking. In this study benefit was divided into two characteristics - societal benefit and benefit to exposed individuals. In both instances respondents could define benefits in any manner. This allowed them to include economic and non-economic benefits.

The correlation coefficients for the two types of benefits and riskiness are shown in Table 46 for the eight hazard domains. The results support the existence of an inverse relationship between perceived benefit and perceived riskiness for six of the eight risk domains. The values in Tables 46 and 47 are positive because of the structure of the scales for these characteristics with a rating of "1" indicating little overall risk, a very acceptable risk, or a large amount of benefit.

Table 46. *Pearson Correlation Coefficients for Perceived Riskiness and Perceived Benefit*

Hazard Domain	Overall Risk and Societal Benefit	Overall Risk and Individual Benefit
Asbestos	.31*	.45*
Surfing	.03	.09
Bush Fires	.30*	.33*
Toxic Waste Incineration	.43*	.41*
Dams	.45*	.42*
Bicycles	.01	.10
Vaccinations	.27*	.31*
Sunbathing	.26*	.27*

* Significant (p<.01)

Table 47. *Pearson Correlation Coefficients for Individual Acceptance and Perceived Benefit*

Hazard Domain	Ind. Acceptance and Societal Benefit	Ind. Acceptance and Individual Benefit
Asbestos	.21*	.29*
Surfing	.14	.28*
Bush Fires	.38*	.49*
Toxic Waste Incineration	.44*	.31*
Dams	.43*	.43*
Bicycles	.15	.17
Vaccinations	.36*	.31*
Sunbathing	.18	.34*

* Significant (p<.01)

As shown by the mean ratings in Table 48, people tended to judge dams and vaccinations as hazard domains having a low level of overall riskiness and high levels of benefit to both the exposed individuals and society. By comparison asbestos, bush fires, toxic waste incineration and sunbathing were characterised as having high risk but low individual or societal benefit. The study found no significant relationship between perceived riskiness and perceived benefit for either surfing or bicycles. However, as shown in Table 47, the individual benefits of surfing significantly correlated with an individual's acceptance of the risks associated with surfing (r=.28).

Table 48. *Mean Ratings for Perceived Riskiness, Individual Acceptance and Benefit Characteristics*

Hazard Domain	Overall Risk	Individual Acceptance	Societal Benefit	Individual Benefit
Asbestos	5.36	5.58	5.08	5.51
Dams	2.91	2.76	2.13	2.49
Bush Fires	6.06	5.50	6.22	6.28
Toxic Waste Incineration	5.80	5.79	5.36	5.76
Vaccinations	2.65	2.54	1.67	1.59
Sunbathing	5.35	4.77	5.90	4.86
Bicycles	3.53	2.45	2.94	2.14
Surfing	4.17	2.84	4.96	2.30

Vlek and Stallen (1981) found no relationship between judgements of overall riskiness and overall benefit across a set of 26 activities. However they did find a relationship between benefit and acceptability. They concluded that judgements of acceptability primarily depend on judgements of benefit, with judgement of riskiness playing a less important role.

The Pearson Correlation Coefficients in Tables 46 and 47 indicate that for the hazard domains in this study, there is a significant relationship between either individual and or societal benefit and both perceived riskiness and individual acceptance. Only the hazard domain bicycles demonstrated no significant relationship between benefit and either perceived riskiness or individual risk acceptance.

Alhakami and Slovic (1994), in a study of 40 risk items, found that perceived risk and perceived societal benefit were almost unrelated when the risk level was considered low or moderate. When the risk level was perceived to be high then the perceived benefit dropped significantly. They concluded that activities perceived as having a low or moderate level of risk were also viewed as being highly beneficial. Whereas risk items perceived as having high risk were judged as having low benefit.

The results of this study also found that domains deemed to be high in risk were low in either societal or individual benefit. However the domains vaccinations and dams which were perceived as having low risk also demonstrated a strong inverse relationship with both societal and individual benefits. The domain which did not demonstrate a significant relationship (i.e., bicycles) was considered to have a moderate level of risk. Bicycles were perceived as being very beneficial both for the individual cyclist and for society as a whole.

In summary, this study indicates that a significant relationship exists between benefit and both perceived riskiness and individual acceptance. This suggests that when lay persons judge the riskiness of an activity or item, unlike risk experts, they are likely to consider the associated individual or societal benefits as part of that judgement especially if both the costs and benefits are made apparent in the framing context.

Volition and Risk Acceptance

Previous research has found that involuntary risks are generally regarded as being less acceptable than voluntary risks (Slovic 1987). The ratings for volition and individual acceptance for the eight hazard domains are shown in Table 49. Both variables were measured on a 7 point scale with 1 representing a "very voluntary" risk or "very acceptable" risk and a rating of 7 representing a "very involuntary" risk or "very unacceptable" risk.

Of the eight hazard domains, surfing, cycling, sunbathing, dams and vaccinations were viewed as being voluntary in nature (i.e., rating < 4). By comparison, asbestos, bush fires and toxic waste incinerators were deemed involuntary risks. The 'voluntary' risks were also judged as being acceptable. The exception being the hazard domain sunbathing. The three 'involuntary' risks were each viewed as being unacceptable to some degree (i.e., rating > 4). While the risk ratings fit the pattern predicted by earlier research, the Pearson Correlation Coefficients are not significant ($p<.01$) for 4 of the 8 hazard domains and the rest are not large. Thus there does not appear to be a strong relationship between volition and risk acceptance for these hazard domains.

Table 49. *Relationship Between Volition and Risk Acceptability*

Hazard Domain	Volition rating	Individual Acceptance rating	r-value
Asbestos	4.69	5.58	.29*
Surfing	1.29	2.84	.12
Bush Fires	5.43	5.50	.26*
Toxic Waste Incineration	5.55	5.79	.19
Dams	3.70	2.76	.28*
Bicycles	1.62	2.45	.28*
Vaccinations	3.11	2.54	.19
Sunbathing	1.61	4.77	.03

* significant ($p<.01$)

Sunbathing is an interesting case in that it is considered both a voluntary risk and an unacceptable risk. Hansson (1989, p. 109) has noted that "the reaction of a society to highly voluntary risks is closely related to the degree of paternalism that is practised or recommended". Sunbathing is an example of such a risk as is smoking. Twenty years ago most people would have considered sunbathing to be an acceptable activity, low in risk. But this is no longer the case. As a result of intense media campaigns to educate the public of the risks of skin cancer we are being sent the message that sunbathing poses an unacceptable risk if mitigating steps are not taken (e.g., sunscreens, hats, limited exposure, etc.).

The relationship between volition and risk acceptability has received considerable attention in the risk literature. Slovic et al. (1980) disagreed with Starr's conclusion that the voluntariness of exposure to a hazard is the prime determinant of acceptability. They contend that the observed relationship between volition and risk acceptance is due to other characteristics that are closely associated with volition, particularly the characteristics control, catastrophic potential, and equity. However the correlation analysis in this study did not reveal a close relationship between volition and either equity or personal control. Catastrophic potential was not included as a characteristic in the study.

While this analysis of the 8 hazard domains did not reveal a strong relationship between volition and either perceived risk or risk acceptability, the analysis of the 4 risk scenarios produced different findings. For three of the four risk scenarios, those who disagreed with the decision portrayed in the scenario indicated that volition was an important consideration in determining the acceptability of the decision. As discussed in Chapter 8, it was as much the voluntary or involuntary nature of the decision as it was the nature of the risk which was important to respondents.

Perceived Risk and Dread

There has been a tendency to interpret the risk perception literature as saying that perceived risk and dread are largely one and the same. This is partly due to unfortunate factor labelling by Slovic et al (1980). They labelled their dominant factor 'Dread" when dread was but one of the characteristics included in this factor and this has lead to some confusion between the characteristic dread and the factor "Dread".

Gregory and Mendelsohn (1993) examined the relationship between perceived risk and dread. Their linear regression analysis revealed that much of the variation in both dread and risk ratings could be explained by three risk characteristics: future generations, immediacy, and catastrophic potential. However the regression patterns were not identical leading to the conclusion that perceived risk and dread are not equivalent. They found that expected mortality significantly impacted perceptions of risk but did not affect dread. While voluntariness was found to have little effect on either dread or perceived risk when other risk characteristics were present.

This study did not include the attributes: future generations, immediacy or catastrophic potential. Thus it is not possible to directly compare these findings. However, a linear regression analysis was conducted to determine if any of the other risk attributes (not including overall riskiness or acceptance) were related to dread. As shown by the low R squared values in Table 50, other characteristics do not explain much of the variation in dread. Separate analysis were conducted for each of the eight hazard domains and the four risk scenarios.

Although the other characteristics do not explain a large amount of the variation for dread, a few characteristics are significant for a number of hazard domains. These are volition, trust, severity and likelihood. As shown in earlier analyses, severity and likelihood also influence perceived risk. In a regression analysis with perceived risk as the dependent variable, trust was significant ($p<.05$) only for surfing and volition was significant ($p<.05$) only for vaccinations. It is clear from this analysis that the characteristic dread and perceived risk are not synonymous. In a linear regression analysis of perceived risk for each of the 8 hazard domains and the 4 risk scenarios, dread was significant at the .01 level only for sunbathing and bicycles and was significant at the .05 level for dams.

Table 50. *Significant Determinants of Dread*

Domain / Scenario	R squared	Characteristic	Beta value
Asbestos	.04	Trust	.21
Surfing	.19	Volition	.20
		Trust	.31*
		Institutional control	-.23
		Personal control	.24
Bush Fires	.23	Severity	.37*
		Societal benefit	.21
Toxic Waste Incineration	.15	Volition	.28*
		Severity	.23
Dams	.18	Individual benefit	.43*
Bicycles	.30	Volition	.31*
		Trust	.26*
		Personal control	.20
		Likelihood	.20
Vaccinations	.33	Volition	.26*
		Trust	.29*
		Expert knowledge	-.22
		Likelihood	.36*
Sunbathing	.07	Trust	-.19
		Equity	.20
Asbestos Scen A	.19	Volition	.44*
Asbestos Scen B	.16	Volition	.18*
		Trust	.22*
		Likelihood	.25*
Incineration Scen A	.17	Volition	.28*
		Severity	.19*
		Likelihood	.15
Incineration Scen B	.25	Volition	.28*
		Trust	.15
		Severity	.20*

* denotes significance at .01 level.
All others are significant at .05 level.

The data from this study did not reveal a strong relationship between individual acceptance and the characteristics volition, trust and dread. Linear regression analysis with individual acceptance as the dependent variable revealed a significant relationship with dread only for asbestos (.05 level), with volition only for bicycles (.05 level) and with trust only for vaccinations (.05 level).

Although some of the relationships discussed above are not strong, for those situations in which dread is high it would still be valuable for risk managers to examine ways they could increase the level of trust in the risk managers and risk decision makers as well as the voluntariness of the risk.

Non-linear Relationships

Although the path analysis provides a good 'best bet' beginning to examining the relationships among the risk characteristics, it would be a mistake to interpret the path analysis as having identified the precise nature of the relationship between various risk characteristics even for a particular hazard domain. For instance for the hazard domain asbestos, the path diagram indicates that perceived riskiness influences individual acceptance while being influenced by societal acceptance. Whereas in the case of bicycles perceived riskiness appears to influence societal acceptance which influences individual acceptance. For a number of the hazard domains, variations on the reported models are also possible which would fit the data although not quite as well (e.g., bush fires).

How should we interpret these findings? Perhaps we need to remember Tsonis' (1992) warning that non-linear problems should be treated as non-linear problems and not as simplified linear problems. The analytic techniques that have been applied in our study assume linear and positivistic relationships. Yet, it seems reasonable to suggest that in forming risk perceptions a person may not follow a linear path but a process which is synergistic in nature involving feedback loops. This would eliminate the chicken and egg type questions such as did the person decide the risk was high and then find it unacceptable or vice versa. A synergistic process would allow many characteristics to contribute to a perception of risk which is of a cumulative nature. Such processes are currently the subject of complex systems science and chaos theory (e.g., Goertzel, 1994).

Risk Attitude Models

This section explores what form a general model of risk perception might take. Bajgier and Moskowitz (1982) have already put forward one model. Using data from psychometric surveys they developed a model which described the manner in which individual attitudes, risk perceptions, and benefit perceptions are interrelated with respect to issues about risky technologies.

They hypothesised that attitudes and beliefs are determined interactively, with risk and benefit perceptions influencing attitudes as well as attitudes influencing benefit and risk perceptions. Their model demonstrates a type of "halo" effect in which a person's belief about an attribute effect his beliefs about other attributes. They suggested that the halo effect may explain the negative association between perceived risk and perceived benefit as observed by Fischhoff et al. (1978) in the following manner. A person who viewed a new technological innovation with a favourable attitude would tend to perceive its risks as low and its benefits as high. The statistical consequence being multicollinearity between risk and benefits arising from their being determined by the same variable (i.e., the favourable attitude).

Bajgier and Moskowitz (1982) believed that a third process contributes to the causal structure of the process which determines attitudes and perceptions about risk issues. This involves the contribution of the social environment through variables such as peer attitudes, peer perceptions of risk and benefits. They hypothesised that for a given individual, any combination of these three processes could be operating simultaneously. They proposed a model which embeds these three processes (Figure 12).

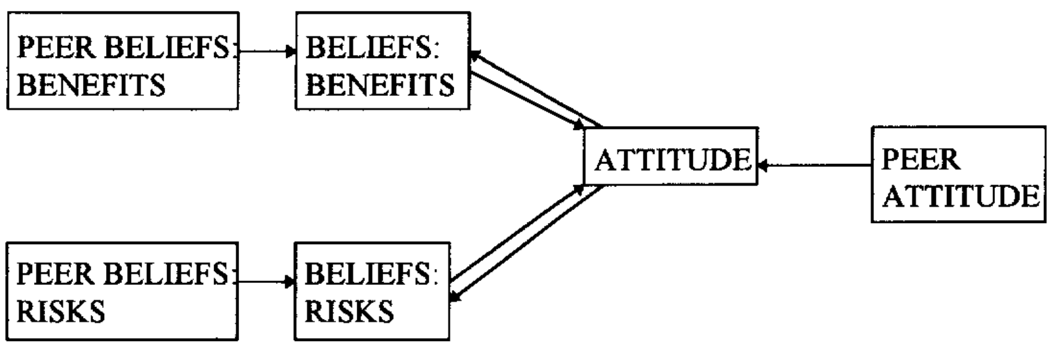

Figure 12. Bajgier and Moskowitz Risk Attitude Model

Testing their model in both a simulated and field setting, they found that on average, perceived risk, perceived benefit, and peer attitude were respectively the most, next most, and least important determinants of attitude. A person's own risk and benefit perceptions were found to be more influential in determining the person's attitude toward a risk issue than the perceptions of their peers. Peer beliefs were more influential with respect to an individual's risk perceptions than their perceptions of benefits. In addition, individual attitudes toward an issue were more influential than individual benefit perceptions in determining individual risk perceptions.

A Revised Model

Using the ratings for adjusted risk as a surrogate for risk acceptability, Slovic et al. (1980) reported a very close relationship between perceived risk and risk acceptability (r = .91). Such a high value is surprising and could even suggest that the two variables were measuring the same thing. Slovic et al. concluded that perceived risk is the primary determinant of risk acceptability but that certain other risk characteristics could to a lesser degree also predict risk acceptability (i.e., dread, global catastrophe, and equity).

Table 51 provides the Pearson Correlation Coefficients for perceived riskiness with both individual risk acceptance and societal risk acceptance for the 8 hazard domains. As one would expect those hazard domains considered to have the greatest risk also were rated by respondents as being the least acceptable. However, if a perfect relationship between perceived risk and individual acceptance existed, very high r values would be expected. However for certain hazard domains, such as bicycles and surfing, the relationship between perceived riskiness and risk acceptability is not particularly strong.

The correlation values for perceived risk and individual acceptance range from a high of .53 (vaccinations and toxic waste incineration) to a low of .26 (bicycles). Not surprisingly this is well below the .91 found by Slovic et al. (1980). These values suggest that while there is a relationship between perceived risk and individual acceptance, other considerations also play significant roles. These need not be limited to other characteristics of the hazard but might include values or beliefs which are held by the individual and are reflected in the way in which they determine risk acceptability.

Table 51. *Correlation between Perceived Riskiness and Individual and Societal Acceptance of Hazard Domains*

Hazard Domain	Individual Risk Acceptance (r-value)	Societal Risk Acceptance (r- value)
Asbestos	.33*	.38*
Surfing	.29*	.10
Bush Fires	.48*	.45*
Toxic Waste Incineration	.53*	.46*
Dams	.43*	.48*
Bicycles	.26*	.24
Vaccinations	.53*	.46*
Sunbathing	.49*	.33*

* denotes significance at $p<.01$

As discussed in the literature review, the idea that our social environment and culture play an important role in determining our risk perceptions has been advocated by cultural theorists such as Douglas and Wildavsky for many years. They contend that culture provides the template against which individuals judge the riskiness and acceptability of hazards. In more recent times, this theme has been picked up by risk researchers such as Renn et al. (1992) in the development of the framework of social amplification of risk which integrates the social, cultural and psychological risk paradigms in a common framework.

If our social environment influences our individual perceptions of the riskiness and acceptability of different hazards, how does this happen? One possible model has our perception of how the rest of society judges a hazard or issue influencing our perceptions of riskiness and risk acceptability. This would be consistent with both Eiser's (1987) contention that as individuals we are motivated to conform to the expectations that others hold of us and Bajgier and Moskowitz's (1982) position that peer attitudes effect our own attitudes.

The Pearson Correlation Coefficients in Table 52 indicate the significant correlation between individual acceptance of a hazard domain and perceived societal acceptance of the same domains. All r-values in Table 108 are significant at $p<.01$.

Table 52. *Correlation between Individual and Societal Acceptance of Hazard Domains*

Hazard Domain	r value
Asbestos	.54
Surfing	.60
Bush Fires	.69
Toxic Waste Incineration	.64
Dams	.87
Bicycles	.90
Vaccinations	.93
Sunbathing	.60

Similarly, perceived societal acceptance may significantly influence an individual's acceptance of a risk-based decision. The significant correlations between these two variables suggest that a person's perception of how society would judge a decision may be reflected in their own acceptance or rejection of the decision. The influence may also be in the opposite direction. On their own, the very high r values for bicycles and vaccinations might indicate that respondents could not discriminate between individual and societal acceptance. However given the r values for the other hazard domains, these values may reflect a strong relationship between these variables. Table 53 displays the correlation coefficients for individual and societal acceptance of the decisions portrayed in the four risk scenarios. The high r values (significant at $p<.01$) suggest a significant relationship between these two variables.

Table 53. *Correlation between Individual and Societal Acceptance of Risk Scenario Decisions*

Risk Scenario	r value
Asbestos Scenario A	.51
Asbestos Scenario B	.65
Toxic Waste Incineration Scenario A	.63
Toxic Waste Incineration Scenario B	.67

The analysis above suggests the risk attitude / perception model shown in Figure 13. Unlike the Bajgier and Moskowitz model which separated benefits from risk, the model below incorporates benefits within risk beliefs and risk attitudes.

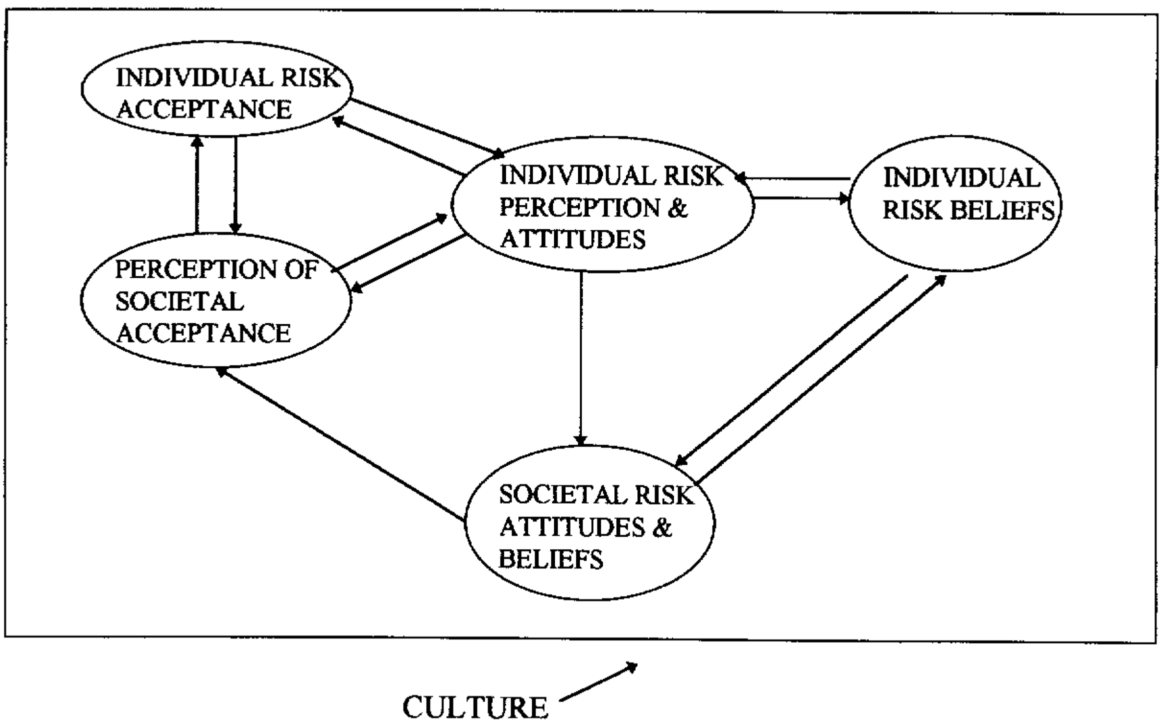

Figure 13. Hypothesised Risk Attitude / Perception Model

The model demonstrates the relationship between individual perceptions and attitudes toward risk and those of the rest of society. This is consistent with the framework of social amplification put forward by Kasperson et al. (1988) and Renn et al. (1992). These relationships are enclosed within a box representing culture which influences everything from how we as individuals or as a society view risks to how we initially conceptualise an event as constituting a risk. This model is consistent with cultural theories of risk.

Summary of Findings

- For a given hazard or risk item, many of the risk characteristics hypothesised to be important to lay individuals (e.g., dread) do not correlate with each other or with perceived risk or risk acceptability. The importance of various risk characteristics is risk specific.

- It is difficult to determine which characteristics significantly influence perceived risk and risk acceptability solely on the basis of a risk profile drawn from mean ratings of the various risk characteristics.

- While a significant relationship exists between the overall level of perceived risk and individual risk acceptance, the level of perceived risk is not always the best predictor of individual acceptance. The two attributes appear to be reflecting different aspects of the construct 'risk'.

- The significant relationship between societal acceptance and individual acceptance may mean that respondents did not discriminate between these variables. Alternatively it may suggest that people believe their perspective of acceptability is largely shared with the rest of society. It also suggests that individuals when determining their own perceptions regarding risk and acceptability consider how the rest of society would view the same hazard. This would be consistent with the position of cultural theorists that culture and our social environment provides the template against which individuals make their own judgements and that people wish to keep relatively in step with the rest of society in their views.

- There is a relationship between perceived risk and risk acceptability that occurs to a varying but significant degree across many types of hazards. The analysis suggests that for any single risk item there are only a limited number of characteristics which significantly influence perceived risk or acceptability. Often for a specific hazard domain or risk item, there will be some characteristics which influence both perceived riskiness and risk acceptability. However their contribution to one will typically be more significant than to the other.

- This study indicates that a significant relationship exists between benefit and both perceived riskiness and individual acceptance. This suggests that when lay persons judge the riskiness of an activity or item, unlike risk experts, they consider the associated individual or societal benefits as part of that judgement.

- An individual's perceptions of riskiness and risk acceptability may not be the product of linear relationships but of a process which is synergistic in nature.

CHAPTER 8

ANALYSIS OF RISK SCENARIOS

Introduction

The previous chapter examined respondent perceptions of 8 generic hazard domains. This chapter examines respondent perceptions of the risk issues portrayed in four risk scenarios as well as the judgment strategies employed in assessing the acceptability of decisions taken in response to those issues.

As discussed in Chapter 5, respondents were presented with four risk scenarios. Each scenario consisted of a risk issue and a decision taken to resolve the risk issue. The scenarios were based on risk issues familiar to residents of Western Australia. The risk scenarios belong to two of the hazard domains examined in the previous chapter: asbestos and toxic waste incineration.

Respondents were first presented with the risk issue and then asked to rate a list of risk characteristics on a bipolar scale ranging from 1 to 7. As was done in Chapter 7 for the generic hazard domains, a risk profile is developed for each of the risk issues portrayed in the 4 scenarios using the mean ratings for the various risk characteristics. Again, the relationship between perceived riskiness and the other risk characteristics was of particular interest. To explore this relationship Multiple Linear Regression Analysis and Pearson Correlation Coefficients (r values) are used to identify the significant predictors of perceived riskiness for each of the four risk scenarios. The tables in this chapter document the significant r values for only the key variables in this analysis. The correlation matrices for all variables are contained in Appendix D. Similarly the complete results from the standard multiple regression analyses are reported in Appendix F.

As discussed in Chapter 5, the characteristics 'individual acceptance' and 'societal acceptance' of the risk were not rated as part of this exercise. This was done so as to avoid possible confusion between respondent acceptance of the risk issue and the questions which followed regarding the acceptability of the decision portrayed in the risk scenario.

Having characterised the risk issue, for each scenario respondents were then presented with a decision taken to address the risk issue. Using a ranking and weighting procedure, respondents were asked to indicate how important each of the characteristics had been in determining their acceptance or rejection of the decision portrayed in the scenario. The instructions provided to respondents for ranking and weighting the importance of the risk characteristics are provided in Table 54. The importance weights were then standardised by the researcher.

The importance ranks and weights are examined to determine which characteristics are the best predictors of decision acceptability. To test whether those respondents who found a risk decision acceptable applied a similar judgment strategy to those who rejected the same decision, multiple discriminant analysis is used to compare the two groups.

Table 54. *Instructions for Ranking and Weighting Importance of Risk Characteristics*

In the following section you will be presented with a list of 14 risk characteristics (e.g., volition) and be asked to indicate how important each of these characteristics was in determining ***your opinion*** as to how acceptable or unacceptable is the decision portrayed in the scenario.

This will be done in two ways - by "ranking" the characteristics and by giving them "importance weights". The steps for ranking and weighting the characteristics are presented below and must be followed in the order presented.

Step 1:
In the column labeled "**RANK**", please rank the characteristics from 1 to 14 in the order of their importance. The most important characteristic *to you* in determining the acceptability/unacceptability of the decision portrayed in the scenario should be ranked as #1. The least important characteristic should be ranked as #14. Ties are acceptable.

Step 2:
Having ranked the 14 characteristics, please move to the far right hand column, labeled "**IMPORTANCE WEIGHT**". In this column we would like you to indicate how important each characteristic is in comparison to the other characteristics. For example, you might believe that a particular characteristic (e.g., "dread of risk") is twice as important as another characteristic (e.g., "personal control") or vice versa.

Please assign weights to each characteristic in the following manner:

A. Place a zero (0) by any characteristics which in *your opinion* played no role in determining the acceptability of the decision portrayed in the scenario. In other words, if a characteristic was not important to you then give it a zero (0)

B. Of the remaining characteristics (i.e., those not given a zero value), identify the one that is least important and give it a value of 10. You may decide that you want to give more than one characteristic a value of 10.

C. Having completed Step 2B, consider the remaining characteristics. Please indicate how important each of these characteristics is relative to the characteristic(s) which you gave a value of 10 to in the previous step. For example if you feel that a particular characteristic is twice as important as a characteristic given a value of 10 it should be given a value of 20 (i.e., 2X10). Similarly if the characteristic is 50 times as important it should receive a score of 500 (i.e., 50X10).

Repeat this step for each of the remaining characteristics.

The last sections of this chapter include discussions of a number of issues which arose from the analyses of the generic hazard domains and risk scenarios. These issues are the role of hazard prototypes, the influence of context effects, and similarities between 'risk expert' and 'lay' judgment strategies.

Asbestos Scenario A - Relocation of Residents

The Issue: Due to concerns about potential health effects resulting from exposure to asbestos, the State Government is faced with deciding whether or not to close down a town located in close proximity to an asbestos mine which has ceased operation. While many of the town's residents have already moved from the area due to health concerns, others have stayed on because the town is their home. The remaining residents have indicated that they are willing to accept the risk of continued exposure to the local environment. A decision by the government to close down the town would effectively force the remaining residents to relocate and would prevent new residents from moving to the area.

The Decision: Faced with the issue described above, the State Government made the following decision. It decided to close down the town due to its concerns about the potential health effects on residents associated with continued exposure to asbestos as a result of the former mining activities in the area. This decision was made despite opposition from the local residents.

The Risk Profile

As shown by the risk profile in Table 55, respondents viewed the risk portrayed in Asbestos Scenario A as a voluntary risk with a moderate-high level of riskiness. While experts were seen as having a good understanding of the risk and being able to exert a moderate level of control in its management, there was only a moderate level of trust in the institutions responsible for risk management. Those exposed to the risk were viewed as having a good level of understanding of the risk but having less ability to control the risks than the experts.

The risk was seen as offering little benefit to either the exposed individual or to society. While the level of perceived dread was only moderate, the potential severity of the consequences was recognized as well as a moderate-high likelihood that such consequences would occur.

Table 55. *Risk Profile for Asbestos Scenario A*

Risk Characteristic (N=230)	Mean Rating (1-7)	Std Deviation
Volition	1.55	0.98
Dread of risk	3.44	1.69
Trust in Institution	4.25	1.77
Expert Knowledge	2.06	1.39
Equity	4.79	1.98
Society's Knowledge	2.46	1.41
Severity of Consequences	6.22	0.98
Number of People Exposed	4.05	1.93
Institutional Control	3.35	2.02
Personal Control	2.45	1.93
Benefit to Society	5.56	1.57
Benefit to Individual	5.10	1.80
Likelihood of Occurrence	5.28	1.15
Overall Level of Risk	5.72	1.18

Significant Predictors of Perceived Riskiness

As shown in Table 56, an analysis of the Pearson Correlation Coefficients for this risk indicates that the characteristics *Severity of consequences, Likelihood of occurrence, Societal Benefit* and the *Number of People Exposed* are most strongly correlated with the characteristic *Overall level of risk* for this scenario. The regression analysis (Appendix F) indicated that the characteristics severity of consequences, likelihood of occurrence and societal benefit contributed significantly ($p<.01$) to prediction of the overall level of risk. The number of people exposed was significant at $p<.05$.

Table 56. *Pearson Correlation Coefficients - Asbestos Scenario A*

Characteristic	Overall Level of Risk
Severity of consequences	.52
Likelihood of occurrence	.51
Societal benefit	.33
Number of people exposed	.30

The risk profile for this scenario indicated a moderate-high level of perceived risk (Table 55). This appears to reflect the perceptions of a moderate-high likelihood of negative consequences that would be severe, that exposing people to this risk would not generate significant benefits for society and the belief that a moderate number of people would be affected.

One should be cautious in interpreting the number of people exposed to the risk as a significant indicator of perceived riskiness since the mean rating of 4.05 for this characteristic may be mainly a reflection of respondent uncertainty regarding the number of people. No specific information was provided in the scenario regarding the number of households remaining in the town. On the other hand the fact that this characteristic was also identified as important in assessing the acceptability of the decision using a very different method suggests that its contribution to perceived riskiness is meaningful.

Although there are similarities between the risk profiles for the generic asbestos domain and Asbestos Scenario A, there are few similarities among the best predictors of perceived riskiness (i.e. overall level of risk). While both analyses indicate that likelihood of occurrence is a significant predictor of a person's assessment of overall riskiness, they differ when it comes to other influential characteristics. In the case of the generic asbestos domain, equity and benefits to the exposed individuals were also important indicators of riskiness. For Asbestos Scenario A these same characteristics are less important but the number of people exposed to the risk and the severity of the consequences of exposure are significant.

Acceptability of Decision

Unlike Part A of the questionnaire which asked respondents to rate the acceptability of the risks associated with a generic hazard domain, in Part B respondents were asked how acceptable the decisions portrayed in the four risk scenarios were to them as individuals and to society.

In the case of Asbestos Scenario A, the majority of respondents found the decision portrayed in the scenario to be acceptable. Seventy three percent gave the decision an acceptability rating in the range 1-3 (1 is 'very acceptable' and 7 is 'very unacceptable'). The mean acceptability rating was 2.79. Respondents believed that society would also consider the decision to be acceptable (mean rating 3.20).

Respondents were asked to rank and weight the importance of the characteristics in determining their acceptance or rejection of the decision portrayed in the scenario. They were also asked to identify those characteristics which were unimportant to them when assessing the acceptability of the decision.

The importance ranks and weights for Asbestos Scenario A are shown in Table 57. The second column in the table provides an adjusted ranking of the characteristics based upon the mean ranks shown in column 3. For example, the characteristic severity of consequences was given an adjusted ranking of 1 because it had the highest mean ranking (4.3). The more important a characteristic in determining the acceptability / unacceptability of a decision the higher its rank (i.e., 1 = most important characteristic) and the greater its weight.

Table 57. *Importance of Characteristics in Determining Decision Acceptance*

Characteristic (N=214)	Adjusted Rank (1-14)	Mean Rank (1-14)	Mean Weight	% Not at all Important
Volition	10	8.1	.064	33.3
Dread of risk	9	7.9	.081	26.7
Trust in Institution	13	9.1	.038	36.9
Expert Knowledge	4	6.5	.083	13.3
Equity	14	9.2	.041	39.5
Society's Knowledge	8	7.9	.058	24.6
Severity of Consequences	1	4.3	.131	5.1
Number of People Exposed	3	6.4	.091	16.9
Institutional Control	12	8.7	.051	28.2
Personal Control	5	7.2	.082	23.1
Benefit to Society	11	8.3	.061	31.3
Benefit to Individual	6	7.4	.074	24.1
Likelihood of Occurrence	2	5.9	.094	10.8
Riskiness of decision	7	7.6	.067	20.5

As shown in Table 57, *severity of consequences* was identified as the most important characteristic in determining the acceptability of the decision. It had the highest mean ranking (4.3), the greatest importance weight (0.131), and the fewest respondents found this characteristic unimportant (5.1%). The next most highly ranked characteristics were *Likelihood of Occurrence* (mean rank 5.9) which also had the second highest mean importance weight (0.094) and the *number of people exposed* with a mean rank of 6.4 and a mean weight of 0.091. *Expert knowledge*, the fourth ranked characteristic, also appears to play a role in determining the level of acceptance of the decision. The least important characteristics were *Equity* and *Trust in Institutions*.

That the majority of respondents found the government's decision to close the town acceptable was possibly due to the perception that severe consequences would be likely if asbestos exposure continued and would affect a moderate number of people. Expert knowledge may play a role in that if the experts have a good understanding of the risks of further exposure to asbestos, as is the perception, then there should be greater certainty or confidence associated with their decision to close the town.

In Chapter 7, the analysis of the generic hazard domains revealed that some characteristics were significant determinants of both perceived riskiness and risk acceptability. In other instances a characteristic may significantly influence one but not the other. Making similar comparisons for the risk scenarios is more difficult since different methods were applied to determine the significant influences on perceived riskiness (i.e., regression) and decision acceptability (i.e., importance ranking and weighting). However it is still worth while comparing the dominant characteristics from these analyses. Table 58 displays those characteristics which most greatly influenced perceived riskiness and the acceptability of the decision portrayed in Asbestos Scenario A. The characteristics *severity of consequences, likelihood of occurrence* and *number of people exposed* played a significant role in determining both perceived riskiness and decision acceptability.

Table 58. Primary Determinants of Perceived Riskiness and Acceptability of Decision

Perceived Riskiness	Acceptability of Decision
• Likelihood of occurrence	• Severity of consequences
• Severity of consequences	• Likelihood of occurrence
• Societal benefit	• Number of people exposed
• Number of people exposed	• Expert knowledge

The strong correlation between individual and societal acceptance of the decision (r=.51) suggests that a person's perception of how society would judge the decision is reflected in their own judgment of acceptance. The influence may also be in the opposite direction.

In addition to determining the importance of the 14 listed characteristics, respondents were asked to identify any additional considerations which played an important role in determining their acceptance or rejection of the decision portrayed in the scenario. Two additional considerations were identified for this scenario. The first being the right of individuals to choose whether or not to expose themselves to a risk. In other words, the rights of individuals to choose to stay in their town even though the experts had identified a significant risk to their health in doing so. Twelve respondents or 5.2% of those surveyed identified a private right to choose as an important factor in determining the acceptability of the government's decision. The issue of the right to choose ones own fate is related to but is not the same as asking respondents whether or not the risk was voluntary or involuntary. It also appears that those respondents who identified volition as an important determinant of decision acceptability may have viewed volition from the perspective of the decision rather than the asbestos risk itself.

In addition 3.4% of respondents (i.e., 8 individuals) identified the financial costs of health care as an important determinant in their thinking. These respondents were concerned that if people were not required to move from the town the future health costs for these people would have to be borne by society. No other responses to this question obtained a frequency greater than four. The low number of responses to this question was common of all four risk scenarios. The fact that few respondents identified additional considerations may be attributable to the greater salience of the characteristics listed in the previous question. Rather than stimulating their thinking, the list of characteristics may have actually inhibited respondents in thinking about other factors that influenced their assessment of decision acceptability.

It should be noted that it is not possible to compare the model of individual acceptance developed for the generic asbestos domain with the individual acceptance model developed for this scenario. The reason being that they are modeling different things. In the case of the generic hazard domains we were interested in the individual's acceptance of the risk posed by asbestos. In the case of the risk scenarios the focus was on the individual's acceptance of the decision taken in response to the risk issue. As discussed in Chapter 5, in designing the questionnaire and after pre-testing, the researcher believed that asking respondents to both rate the acceptability of the risk and the acceptability of the decision portrayed in the risk scenarios would be too confusing.

Judgment Strategies of Accepting and Unaccepting Groups

In the previous section a model of decision acceptance was developed for Asbestos Scenario A. But is a single judgment model appropriate for each scenario? Is it reasonable to assume that all people are applying similar types of judgment strategies or is it more likely that those who find a decision to be unacceptable might be employing a different strategy to that of those who found the decision acceptable? As discussed in Chapter 5, the risk and decision making literature suggests that different strategies may be used by different attitude groups. The following analysis examines this question.

To test whether those who accepted the decision applied a similar judgment strategy to those who rejected the same decision, two groups based on decision acceptance were compared. Respondents who rated the decision portrayed in the scenario as being acceptable (i.e., individual acceptance rating of <= 3) formed one group. Respondents who rated the same decision as being unacceptable (i.e., rating of >= 5) formed a second group. For each scenario the two groups were compared with respect to the importance rankings they gave to the 14 listed characteristics. The two groups were also compared with respect to the risk profiles developed for each scenario. The comparisons of importance rankings and risk profiles were conducted using multiple discriminant analysis. Cases with any missing information for the variable that defined the groups were excluded from the analysis. Prior probabilities were based on the sample proportion of cases in each group. When these results were compared with those obtained assuming that prior probabilities of group membership are equal it did not change the findings. As described in Chapter 6, multivariate outliers were addressed through the use of Mahalanobis distances.

Table 59 provides a risk profile for each group based upon their mean characteristic ratings. Table 60 displays the univariate F-ratios for the equality of group means for each characteristic. The standardised discriminant function coefficients are also provided. A test of the null hypothesis that in the populations from which the samples were drawn there is no difference between the group means can be based on Wilk's lambda. Wilk's lambda is 0.860 with a $\chi 2$ of 30.34 with 14 degrees of freedom and an observed significance level of 0.0068.

Table 59. Risk Profiles for Accepting and Unaccepting Groups (Asbestos Scenario A)

Characteristic	Accepting Group	Unaccepting Group
	Mean Rating	Mean Rating
Volition	2.27	2.65
Dread	3.85	4.33
Trust in Institutions	4.43	4.60
Expert Knowledge	2.25	3.23
Equity	5.01	4.75
Society's Knowledge	3.23	3.54
Severity of Consequences	6.28	6.10
Number of People Exposed	4.80	4.40
Institutional Control	3.85	4.08
Personal Control	2.97	3.50
Benefit to Society	5.56	5.02
Benefit to Individual	5.22	4.56
Likelihood of Occurrence	5.40	4.79
Overall Risk	5.96	5.31
Number of Respondents	162	48

The data in these tables indicate that the accepting and unaccepting groups perceived the asbestos hazard described in this scenario quite similarly. The F values indicate that the two groups differ significantly ($p<.01$) with respect to only three variables: expert knowledge, overall level of risk, and likelihood of occurrence. The standardised discriminant function coefficients in Table 60 indicate the relative importance of the variables. In this case the variables (i.e. characteristics) expert knowledge and overall level of risk appear to be the most important.

Table 60. Comparison of Risk Profiles for Accepting and Unaccepting Groups (Asbestos Scenario A)*

Characteristic	F	Significance	Function Coefficient**
Volition	1.58	.210	.143
Dread	2.55	.112	-.229
Trust in Institutions	0.35	.555	-.023
Expert Knowledge	13.41	.000	-.587
Equity	0.75	.388	.130
Society's Knowledge	0.93	.336	-.059
Severity of Consequences	1.17	.281	-.196
Number of People Exposed	1.57	.212	.191
Institutional Control	0.47	.494	.034
Personal Control	2.41	.122	-.273
Benefit to Society	3.80	.053	.064
Benefit to Individual	5.00	.026	.198
Likelihood of Occurrence	9.65	.002	.186
Overall Risk	12.94	.000	.481

* Univariate F-ratio with 1 and 208 degrees of freedom.

** Standardised canonical discriminant function coefficients

Table 61 displays the mean importance rankings of the two groups for the various risk characteristics. In the case of Asbestos Scenario A, those who found the Government's decision to close the town to be acceptable indicated by their rankings that *severity of consequences, likelihood of occurrence, expert knowledge*, and the *number of people exposed* were their most important determinants of acceptability. By comparison, those who found the decision to be unacceptable relied on the characteristics *volition, personal control, severity of consequences* and *likelihood of occurrence* to determine decision acceptability.

It is interesting to note that the most important determinant of acceptability for those who found the decision to be unacceptable was the characteristic volition. By comparison those who accepted the decision did not think volition was a very important characteristic. Yet the risk profiles indicate that both groups viewed the risk in Scenario A to be highly voluntary. Thus the mean characteristic ratings from the risk profiles cannot by themselves explain the importance of the characteristics in determining the acceptability of a decision.

Table 61. *Mean Importance Ranks for Accepting and Unaccepting Groups*

Characteristic	Accepting Group	Unaccepting Group
	Mean Ranking	Mean Ranking
Volition	8.95	5.20
Dread	7.82	7.43
Trust in Institutions	9.37	7.91
Expert Knowledge	6.20	7.61
Equity	9.58	8.40
Society's Knowledge	8.00	7.34
Severity of Consequences	3.63	6.88
Number of People Exposed	6.17	7.27
Institutional Control	8.65	8.54
Personal Control	7.72	6.10
Benefit to Society	8.14	8.72
Benefit to Individual	7.25	7.74
Likelihood of Occurrence	5.59	6.90
Riskiness of Decision	7.45	8.18
Number of Respondents	164	49

As was done for the risk profiles, the importance rankings of the two groups were compared. Table 62 displays the F ratios and standardised discriminant function coefficients for the two groups. Wilk's lambda is 0.736 with a $\chi 2$ of 62.63 with 14 degrees of freedom and an observed significance level of 0.0000. This analysis indicates that the two groups differed in terms of the importance they placed on the characteristics *volition, severity of consequences,* and *personal control* when determining the acceptability of the Government's decision to close the town. These same characteristics were the most highly ranked by the groups of respondents who considered the decision to be unacceptable (Table 61). The characteristic *severity of consequences* had also played a key role in the judgment strategy of those who accepted the decision portrayed in the scenario. Thus while the judgment strategies of the two groups shared some common features, such as the importance placed on the characteristic *severity,* they differed significantly in other respects. Most significant was the importance given to the characteristics *volition* and *personal control.*

Table 62. Comparison of Importance Rankings for Accepting and Unaccepting Groups (Asbestos Scenario A).*

Characteristic	F	Significance	Function Coefficient**
Volition	32.46	.000	.554
Dread	0.37	.545	.043
Trust in Institutions	6.75	.010	.281
Expert Knowledge	6.06	.015	-.077
Equity	4.52	.035	.348
Society's Knowledge	1.29	.257	.216
Severity of Consequences	36.97	.000	-.464
Number of People Exposed	3.05	.082	-.030
Institutional Control	0.04	.843	.061
Personal Control	7.39	.007	.299
Benefit to Society	0.74	.389	.101
Benefit to Individual	0.53	.466	-.068
Likelihood of Occurrence	5.85	.016	.019
Riskiness of Decision	1.58	.210	-.005

* Univariate F-ratio with 1 and 211 degrees of freedom.

** Standardised canonical discriminant function coefficients

An analysis of respondents who identified "private rights" as being important in determining acceptability indicated that most also rated the government's decision as being unacceptable. Of the 12 respondents who identified private rights as an important consideration, 9 fell into the unacceptable decision group. Of the remaining 3 respondents, 2 rated the decision as being neither acceptable nor unacceptable (i.e., a rating of 4). Only one person who identified private rights as important also rated the decision as being acceptable.

Those who were accepting of the decision appear to have largely used the characteristics of the asbestos risk to determine the acceptability of the decision. Characteristics which reflected issues such as the severity of the consequences, the likelihood of negative outcomes, and expert knowledge were dominant. Whereas those less accepting of the Government's decision appear to have taken a different approach in judging decision acceptability. It is an approach more reliant upon the characteristics of the decision itself than the characteristics of the risk being addressed by the decision.

Private rights, volition, and personal control are all aspects of the decision itself rather than the risk being addressed by the decision. For this group the issue which determined the acceptability of the decision was freedom of choice to determine ones own fate. The Government by its decision would remove a person's right to choose and thus the decision was unacceptable to this group of respondents. This appears to be the case even though they may have agreed with other respondents regarding most of the characteristics of the asbestos risk, resulting in similar risk profiles for the two groups.

Asbestos Scenario B - Removal of Asbestos From Schools

<u>The Issue:</u> The Education Department is faced with requests from concerned parents to remove asbestos from the roofs of schools. The parents are concerned that the health of their children may be impacted by the asbestos in the roofs of the schools. However the evidence from risk experts is that there is a greater health risk created for the workers who would remove the asbestos than that faced by students and teachers if the asbestos was left undisturbed.

<u>The Decision:</u> Faced with the issue described above, the Education Department made the following decision. It decided to remove the asbestos from the school roofs despite the risks to the workers who would remove the materials.

The Risk Profile

Table 63 displays the risk profile for Asbestos Scenario B. Respondents to this scenario believed that the experts have a good understanding of the risk associated with asbestos in buildings and its removal. Institutional control was thought to be possible although respondents revealed only a moderate-low level of trust in those institutions responsible for managing the risk.

Table 63. *Risk Profile for Asbestos Scenario B*

Risk Characteristic (N=230)	Mean Rating	Std Deviation
Volition	5.35	1.71
Dread	5.75	1.42
Trust in Institutions	4.88	1.67
Expert Knowledge	2.66	1.53
Equity	5.24	1.44
Society's Knowledge	4.01	1.79
Severity of Consequences	5.79	1.39
Number of People Exposed	5.56	1.55
Institutional Control	3.13	1.73
Personal Control	4.67	1.86
Benefit to Society	5.19	1.78
Benefit to Individual	5.29	1.87
Likelihood of Occurrence	4.40	1.55
Overall Level of Risk	5.03	1.49

Unlike Scenario A, those exposed to the risk were perceived as doing so involuntarily with only a moderate-low level of personal control. The perception being that more people would be exposed to this risk and those exposed would possess only a moderate understanding of the risks and would not benefit from the risk, nor would society. The costs and benefits associated with this risk scenario were seen to be distributed unequally. Although the likelihood of the risk being realised was considered moderate, the consequences were viewed as being severe and potentially affecting many people. There is a high level of dread associated with this risk and the overall level of riskiness was deemed to be moderate-high.

Significant Predictors of Perceived Riskiness

As shown in Table 64, an analysis of the Pearson Correlation Coefficients for this risk indicates that the characteristics *Severity of consequences, Likelihood of occurrence,* and the *Number of People Exposed* are most strongly correlated with the characteristic *Overall level of risk* for this scenario. The regression analysis (Appendix F) indicated that only the characteristics likelihood of occurrence contributed significantly ($p<.01$) to prediction of the overall level of risk.

Table 64. *Pearson Correlation Coefficients - Asbestos Scenario B*

Characteristic	Overall Level of Risk
Likelihood of occurrence	.71
Number of people exposed	.36
Severity of consequences	.25
Dread	.24

As shown by the risk profile (Table 63), respondents believed that a moderate-high overall level of risk or perceived riskiness is associated with the hazard in Asbestos

Scenario B. This appears to reflect the perception that, although there is only a moderate likelihood of a negative outcome, should it occur the consequences would be severe and a significant number of people would be affected. These characteristics, along with trust and volition, appear to combine to create a moderate-high degree of dread which also influences the perception of riskiness.

Acceptability of Decision

With respect to the decision taken by the Education Department to remove the asbestos from school roofs, the majority of respondents approved of the decision (55% <= 3) with a mean rating of 3.43 (Table 65). Respondents believed that society would also be accepting of the decision (mean rating of 2.99).

Table 65. *Acceptability of Decision Taken in Asbestos Scenario B*

Characteristic	Mean Rating	Std Deviation	Variance
Your Acceptance of Risk	3.43	1.88	3.53
Societal Acceptance	2.99	1.71	2.91

As shown in Table 66, both the ranking and weighting procedures identified *severity of consequences* and the *number of people exposed* as the most important characteristics in determining the acceptability of the decision. *Expert knowledge, dread* and the *likelihood* that the risk would be realised were also important.

With the exception of *expert knowledge,* these same characteristics were also indicators of perceived riskiness. The number of people exposed to the risk appears to be more influential with respect to decision acceptability than it is with respect to perceived riskiness. While the likelihood of a negative outcome was the dominant determinant of perceived riskiness it appears to play a less dominant role in determining the acceptability of the decision taken in Asbestos Scenario B although it is still influential. As was the case with Asbestos Scenario A, the characteristic *expert knowledge* is part of the acceptance strategy for this scenario while playing no significant role in determining perceived riskiness.

Table 66. *Importance of Characteristics in Determining Acceptability of Decision*

Risk Characteristic (N=208)	Adjusted Rank (1-14)	Mean Rank (1-14)	Mean Weight	% Not at All Important
Volition	8	7.97	.061	33.3
Dread	5	7.14	.071	23.3
Trust in Institutions	13	8.73	.043	39.2
Expert Knowledge	3	6.81	.074	18.5
Equity	14	9.08	.045	33.3
Society's Knowledge	11	8.13	.054	27.5
Severity of Consequences	1	4.65	.127	7.4
Number of People Exposed	2	5.11	.114	13.2
Institutional Control	12	8.57	.048	30.7
Personal Control	9	8.09	.063	29.6
Benefit to Society	10	8.11	.062	31.7
Benefit to Individual	7	7.95	.071	30.7
Likelihood of Occurrence	4	6.92	.095	13.2
Riskiness of Decision	6	7.55	.070	22.2

It appears that respondents found the decision to remove the asbestos from the school to be at least somewhat acceptable due in part to the belief that it would remove the potential for severe consequences for a significant number of people. People believe that the experts have a good understanding of this risk and associated with this is the view that the experts are also able to manage or control this risk. This confidence in the experts is reflected in the confidence in and acceptability of the expert's decision to remove the hazard. The perception that there is a significant level of dread associated with this hazard would increase the acceptability of a decision which is seen as removing the hazard.

Table 67 displays those characteristics which most greatly influenced the perceived riskiness of the hazard and the acceptability of the decision portrayed in Asbestos Scenario B. For this scenario only one characteristic, likelihood of occurrence, is common to both.

Table 67. *Primary Determinants of Perceived Riskiness and Acceptability of Decision*

Perceived Riskiness	Acceptability of Decision
• Likelihood of occurrence	• Severity of consequences • Number of people exposed • Expert knowledge • Likelihood of occurrence

As with Asbestos Scenario A, societal acceptance may also play a role in determining individual acceptance of the decision. A correlation of 0.65 suggests there is a relationship between individual and societal acceptance. Again it is not possible to determine the causal nature of this relationship.

When asked if there were any additional factors (i.e., other than those characteristics listed) that were important in determining the acceptability of the decision, three responses dominated. As shown in Table 68, the fact that the risk would affect children and that respondents believed they were making a choice between risk to school children and the risk to workers was raised most often. That workers would be able to limit the potential risks through protective clothing was also important.

Table 68. *Additional Determinants of Decision Acceptability*

Characteristic	Frequency	% Respondents (N=213)
Risk effects children	7	3.3
Risk to workers	10	4.7
Worker protective wear	8	3.8

Although the frequencies and percentages are small for these characteristics they are still worthy of examination. It is likely that respondents would only provide additional characteristics if they were very significant to their thinking. That the risk to children was raised is not surprising as they are typically viewed as being incapable of controlling their exposure to risks. The risk literature has identified the potential to affect children as a risk characteristic although it was not included as one of the listed characteristics in this study.

Some people noted that the workers hired to remove the asbestos from the schools would have protective clothing so that they could control their exposure, at least to a greater extent than children or school staff could. Comments about the need to recognise that workers would be placed at some risk by the decision reflected the trade-off nature of the risk problem and decision. People were being asked to choose whether to expose the school staff and children to a risk or expose workers to a risk by removing the hazard.

Judgment Strategies of Accepting and Unaccepting Groups

Table 69 provides the risk profile for the two groups for this scenario while Table 70 provides the F ratio and significance level for each characteristic. Wilk's lambda is 0.828 with a $\chi 2$ of 31.99 with 14 degrees of freedom and an observed significance level of 0.0040. Tables 69 and 70 indicate that the two groups viewed the risk portrayed in Asbestos Scenario B very similarly. Only with respect to the level of trust in institutions did the two groups differ significantly with the accepting group indicating a significantly higher mean level of trust in those managing the risk.

Table 69. Risk Profiles for Accepting and Unaccepting Groups (Asbestos Scenario B)

Characteristic	Accepting Group	Unaccepting Group
	Mean Rating	Mean Rating
Volition	5.47	5.26
Dread	6.00	5.50
Trust in Institutions	5.21	4.37
Expert Knowledge	2.74	2.47
Equity	5.42	5.03
Society's Knowledge	3.97	3.95
Severity of Consequences	5.91	5.71
Number of People Exposed	5.74	5.13
Institutional Control	3.12	3.05
Personal Control	4.73	4.60
Benefit to Society	4.98	5.66
Benefit to Individual	5.11	5.60
Likelihood of Occurrence	4.50	4.19
Overall Risk	5.19	4.71
Number of Respondents	118	62

Table 70. Comparison of Risk Profiles for Accepting and Unaccepting Groups (Asbestos Scenario B).*

Characteristic	F	Significance	Function Coefficient**
Volition	.61	.435	.146
Dread	5.59	.019	.172
Trust in Institutions	11.21	.001	.435
Expert Knowledge	1.27	.261	.177
Equity	2.88	.092	.439
Society's Knowledge	.00	.959	-.248
Severity of Consequences	.82	.366	-.002
Number of People Exposed	6.14	.014	.419
Institutional Control	.35	.556	-.096
Personal Control	.21	.648	.047
Benefit to Society	6.05	.015	-.780
Benefit to Individual	2.71	.102	.041
Likelihood of Occurrence	1.58	.210	-.499
Overall Risk	4.33	.039	.512

* Univariate F-ratio with 1 and 178 degrees of freedom.

** Standardised canonical discriminant function coefficients

Table 71 displays the mean importance rankings of the two groups for the various risk characteristics. This table suggests that those who found the decision to be acceptable relied on two characteristics in particular, the *number of people exposed* and the *severity of consequences*. Other highly ranked characteristics were *dread*, *expert knowledge* and *likelihood of occurrence*. Those who found the decision unacceptable placed greatest importance on *severity of consequences*, *expert knowledge* and the *number of people exposed*. *Riskiness of the decision* and *likelihood of occurrence* were also important.

Table 71. *Mean Importance Ranks for Accepting and Unaccepting Groups*

Characteristic	Accepting Group Mean Ranking	Unaccepting Group Mean Ranking
Volition	8.18	7.83
Dread	6.69	8.18
Trust in Institutions	9.06	8.68
Expert Knowledge	7.19	5.94
Equity	9.37	8.47
Society's Knowledge	8.10	7.93
Severity of Consequences	4.46	5.19
Number of People Exposed	4.33	6.07
Institutional Control	8.63	8.40
Personal Control	8.24	7.88
Benefit to Society	7.43	8.72
Benefit to Individual	7.39	8.71
Likelihood of Occurrence	7.31	6.55
Riskiness of Decision	8.29	6.50
Number of Respondents	119	59

As was done for the risk profiles, the mean importance rankings of the two groups were compared in order to assess whether or not the two groups were employing similar judgment strategies. Wilk's lambda is 0.829 with a $\chi 2$ of 31.67 with 14 degrees of freedom and an observed significance level of 0.0045. Table 72 displays the F values and standardised discriminant function coefficients for the two groups. Significant (p<.01) differences were found for only two variables, the *number of people exposed* to the risk and the *riskiness of the decision*. The number of people exposed was an important consideration for both groups in determining decision acceptability although the accepting group gave it more weight. This group also gave this characteristic a higher mean rating (i.e. more people exposed) than did the unaccepting group. By comparison the unaccepting group gave more weight to the level of risk attached to the decision than did the accepting group.

Table 72. Comparison of Importance Rankings for Accepting and Unaccepting Groups (Asbestos Scenario B).*

Characteristic	F	Significance	Function Coefficient**
Volition	.30	.584	.004
Dread	5.97	.016	.468
Trust in Institutions	.45	.502	.117
Expert Knowledge	5.19	.024	-.379
Equity	2.32	.130	-.103
Society's Knowledge	.09	.759	.174
Severity of Consequences	1.75	.188	.093
Number of People Exposed	9.69	.002	.500
Institutional Control	.16	.686	.080
Personal Control	.32	.569	-.119
Benefit to Society	4.28	.040	.227
Benefit to Individual	4.22	.041	.334
Likelihood of Occurrence	1.70	.193	.045
Riskiness of Decision	9.77	.002	-.378

* Univariate F-ratio with 1 and 176 degrees of freedom.

** Standardised canonical discriminant function coefficients

Overall, there do not appear to be great differences in the strategies employed by the two groups for this scenario. Most of the important characteristics were common to both groups and the mean ratings from the risk profile provide few additional clues as to why one group found the decision acceptable and the other unacceptable. The only exception being the number of people exposed. However these differences do not appear significant enough to make this characteristic the sole or major determinant of decision acceptability.

This might mean that considerations more important to determining decision acceptability were not among the listed risk characteristics. One possibility is that those unaccepting of the decision placed more importance on the risk to the workers in removing the asbestos from the roofs. Alternatively those who approved of the decision placed greater emphasis on the fact that workers had some protection and had more personal control over the risk. A number of responses to the open ended question about additional considerations pertained to either the risk to workers or the relative differences in the exposure of children relative to workers. However analysis of these responses revealed no pattern that would explain the differences between the two groups.

This does not preclude one or more of these considerations having played an important role. Although the frequency of responses was low, more respondents may have actually employed these considerations in their thinking than indicated. Another possible explanation is that collectively respondents employed more than two strategies for determining the acceptability of the decision. The answer may be more complex than one strategy for those who accepted and another strategy for those who disapproved of the decision.

Toxic Waste Incineration Scenario A - Siting of Incinerator in Rural Area

<u>The Issue:</u> A private waste management firm hires a team of specialist consultants to carry out an environmental impact study (EIS) to select the best site for a new toxic waste incinerator. The site recommended by the consultants and chosen by the company is in a rural agricultural area selected to avoid major population centres. The company indicates that all government emission standards will be met by the incinerator. However local residents and farmers oppose the proposal due to their concerns about the possible long term effects of emissions on human health and agricultural production in the area. The Environmental Protection Agency must decide whether or not to approve the establishment of the incinerator on the proposed site.

<u>The Decision:</u> The Environmental Protection Agency approves the construction of the incinerator stating that based on the environmental impact study (EIS) the facility should be able to meet all emission standards and its operation will be monitored.

The Risk Profile

The risk profile for this scenario is shown in Table 73. Unlike either of the Asbestos scenarios, respondents indicated that the siting of the incinerator would have some benefit for society although there was a mix of views on this issue. Approximately 45% of respondents indicated that the risks included a large amount of benefit to society (rating of 3 or <) while 41% indicated that the incinerator would create little or no societal benefit (rating of 5 or >). There was greater agreement that the siting of the incinerator would not be beneficial to those individuals exposed to the hazard. This perception is also appears to be reflected in a perceived lack of equity in the distribution of costs and benefits.

Exposure to the risks associated with the proposed incinerator was viewed as involuntary, with those exposed having only a moderate understanding of the risks and limited personal control. There is a high level of dread associated with this risk and a belief that negative consequences could be severe. However there is only a moderate perceived likelihood that a negative outcome would occur.

Table 73. *Risk Profile for Toxic Waste Incineration Scenario A*

Risk Characteristic (N=230)	Mean Rating	Std Deviation
Volition	5.81	1.54
Dread	5.74	1.50
Trust in Institutions	5.14	1.74
Expert Knowledge	3.47	1.61
Equity	5.28	1.54
Society's Knowledge	4.26	1.75
Severity of Consequences	5.35	1.41
Number of People Exposed	4.76	1.66
Institutional Control	3.44	1.86
Personal Control	5.46	1.50
Benefit to Society	4.11	1.91
Benefit to Individual	5.46	1.64
Likelihood of Occurrence	4.35	1.45
Overall Level of Risk	4.81	1.43

Whereas respondents believed that the experts have a good understanding of the risks associated with asbestos, they are less confident that experts understand the implications of toxic waste incineration. Although they do believe that at least a moderate level of institutional control is possible, respondent trust in these institutions was quite low.

Overall the level of risk is moderate (mean rating 4.81) and lower than that of either of the asbestos scenarios. This is interesting since the generic toxic waste incineration hazard domain examined in Chapter 7 was rated by respondents as having the highest overall level of risk of the eight generic hazard domains including asbestos. Other significant differences between the generic incineration hazard domain and the incineration risk issue in Scenario A include greater recognition of the societal benefits of incineration and less severe consequences with Scenario A.

Significant Predictors of Perceived Riskiness

As with the asbestos scenarios, Multiple Linear Regression Analysis and Pearson Correlation Coefficients (r values) were used to identify the best predictors of perceived riskiness for this scenario. The characteristic overall level of risk significantly correlated with many of the other risk characteristics. Table 74 shows that the characteristics, *Likelihood of occurrence, Societal Benefit, Severity of consequences* and the *Number of People Exposed* have the strongest correlations. The regression analysis (Appendix F) indicated that each of these characteristics contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 74. *Pearson Correlation Coefficients - Toxic Waste Incineration Scenario A*

Characteristic	Overall Level of Risk
Likelihood of occurrence	.70
Societal benefit	.48
Severity of consequences	.47
Number of people exposed	.47

From the risk profile (Table 73), the moderate level of riskiness appears to reflect the combined influence of a moderate probability of consequences that would be somewhat severe for a moderate number of people. The fact that a significant percentage of the respondents believed that the incinerator would serve some societal good appears to have also played a role in determining the level of perceived risk for this scenario.

Acceptability of Decision

Whereas a greater number of respondents found the decisions taken in Asbestos Scenarios A & B to be acceptable, a slight majority found the decision in this scenario (i.e., to approve the incinerator siting) to be at least somewhat unacceptable (Table 75). This was the case both in terms of societal acceptance and the respondent's personal acceptance of the decision with 52% of respondents finding the decision in this scenario to be unacceptable (i.e., mean rating of 5 or >).

Table 75. *Acceptability of Decision in Toxic Waste Incineration Scenario A*

Risk Characteristic	Mean Rating	Std Deviation	Variance
Your Acceptance of Risk	4.57	1.76	3.09
Societal Acceptance	4.40	1.73	2.98

Analysis of the importance rankings and weights reveals a model of acceptance that is very similar to that for perceived riskiness (Table 76). *Severity of consequences* is clearly the most important characteristic in determining the acceptability of the decision. The *number of people exposed* was next in importance. This is somewhat surprising since a stated rationale for selecting the incinerator site was to reduce the number of people exposed to the risk by locating in a rural as opposed to an urban environment. Yet from the risk profile described earlier, respondents seem to still feel that a significant number of people would be exposed to the risk (mean rating of 4.76).

Other important characteristics are *expert knowledge* and *societal benefit*. Respondents indicated by the risk profile that the experts had a moderate understanding of this particular risk (mean rating 3.47). Societal benefit also had a moderate rating indicating neither a lack of benefit or a large amount of benefit (mean rating 4.11). As was the case with the two asbestos scenarios, *expert knowledge* comes to the fore as an influence in determining acceptability of a decision.

Table 76. *Importance of Characteristics in Determining Acceptability of Decision*

Risk Characteristic (N=203)	Adjusted Rank (1-14)	Mean Rank (1-14)	Mean Weight	% Not at All Important
Volition	9	7.87	.066	32.2
Dread	6	7.38	.066	29.0
Trust in Institutions	10	7.93	.061	28.4
Expert Knowledge	3	6.84	.082	18.6
Equity	14	8.83	.050	35.5
Society's Knowledge	11	8.26	.058	31.1
Severity of Consequences	1	4.91	.124	10.4
Number of People Exposed	2	5.96	.095	15.8
Institutional Control	7	7.48	.068	23.5
Personal Control	12	8.46	.057	34.4
Benefit to Society	4	7.13	.083	20.8
Benefit to Individual	13	8.76	.048	37.2
Likelihood of Occurrence	5	7.31	.074	18.6
Riskiness of Decision	8	7.63	.067	23.0

Table 77 displays those characteristics which most greatly influenced perceived riskiness and the acceptability of the decision portrayed in Toxic Waste Incineration Scenario A.

Table 77. *Primary Determinants of Perceived Riskiness and Acceptability of Decision*

Perceived Riskiness	Acceptability of Decision
• Likelihood of occurrence	• Severity of consequences
• Severity of consequences	• Number of people exposed
• Societal benefit	• Expert knowledge
• Number of people exposed	• Societal benefit
	• Likelihood of occurrence

As discussed with the Asbestos scenarios, a person's perception of how acceptable society would find the decision may significantly influence their own degree of acceptance of the same decision. The Pearson Correlation Coefficient for these two variables is .63 suggesting a significant relationship although the causal nature is unclear.

<u>Judgment Strategies of Accepting and Unaccepting Groups</u>

As with the two asbestos scenarios, to compare the judgement strategies of the two groups (i.e. accepting and unaccepting), their risk profiles and mean importance rankings were compared for Incineration Scenario A using discriminant analysis.

Table 78 provides the risk profile for the two groups for this scenario while Table 79 provides the F values and the significance levels for each characteristic. These data indicate that the two groups perceived the risk portrayed in this scenario quite differently. Significantly different mean ratings ($p<.01$) existed for 8 of the 14 characteristics. Wilk's lambda is 0.628 with a $\chi 2$ of 81.53 with 14 degrees of freedom and an observed significance level of 0.0000.

Table 80 displays the mean importance rankings of the two groups for the various risk characteristics. This table indicates that those who found the decision to be acceptable placed greatest importance on the characteristics *severity of consequences*, *expert knowledge*, the *number of people exposed*, and *societal benefit*. As discussed earlier, with the exception of expert knowledge, each of these characteristics also played a significant role in determining the perceived level of risk.

Table 78. Risk Profiles for Accepting and Unaccepting Groups (Incineration Scenario A)

Characteristic	Accepting Group	Unaccepting Group
	Mean Rating	Mean Rating
Volition	5.83	6.01
Dread	5.37	5.95
Trust in Institutions	4.79	5.41
Expert Knowledge	2.95	3.91
Equity	4.92	5.62
Society's Knowledge	4.27	4.46
Severity of Consequences	5.06	5.50
Number of People Exposed	4.10	5.28
Institutional Control	2.73	3.99
Personal Control	5.38	5.74
Benefit to Society	3.08	4.93
Benefit to Individual	4.98	5.88
Likelihood of Occurrence	3.52	4.97
Overall Risk	3.92	5.52
Number of Respondents	63	121

Table 79. Comparison of Risk Profiles for Accepting and Unaccepting Groups (Incineration Scenario A).*

Characteristic	F	Significance	Function Coefficient**
Volition	.62	.432	-.100
Dread	6.36	.013	.195
Trust in Institutions	5.21	.024	.093
Expert Knowledge	14.41	.000	.217
Equity	8.43	.004	-.032
Society's Knowledge	.47	.494	.038
Severity of Consequences	3.98	.048	-.302
Number of People Exposed	22.18	.000	.099
Institutional Control	17.77	.000	.170
Personal Control	2.48	.117	.067
Benefit to Society	43.80	.000	.403
Benefit to Individual	13.39	.000	.041
Likelihood of Occurrence	44.41	.000	.095
Overall Risk	65.93	.000	.600

* Univariate F-ratio with 1 and 182 degrees of freedom.

** Standardised canonical discriminant function coefficients

By comparison, those who found the decision to be unacceptable indicated that the characteristics *severity of consequences*, the *number of people exposed*, and the degree of *dread* were most important in determining decision acceptability. Thus the characteristics severity of consequences and the number of people exposed were important to both groups in determining decision acceptability.

Table 80. *Mean Importance Ranks for Accepting and Unaccepting Groups*

Characteristic	Accepting Group	Unaccepting Group
	Mean Ranking	Mean Ranking
Volition	9.15	7.40
Dread	8.57	6.66
Trust in Institutions	7.71	8.11
Expert Knowledge	5.07	7.86
Equity	8.45	9.06
Society's Knowledge	8.77	7.68
Severity of Consequences	4.95	5.04
Number of People Exposed	5.55	6.03
Institutional Control	6.57	8.70
Personal Control	9.37	7.92
Benefit to Society	5.76	7.85
Benefit to Individual	9.49	8.49
Likelihood of Occurrence	7.13	7.37
Riskiness of Decision	7.96	7.51
Number of Respondents	62	118

The mean importance rankings of the two groups were then compared to determine whether or not the two groups were employing similar judgment strategies when assessing decision acceptability. Table 81 displays the F values and the standardised discriminant function coefficients for the two groups. Significant ($p<.01$) differences were found for the characteristics *volition, dread, expert knowledge* and *societal benefit*. The function coefficients suggest that the characteristics expert knowledge and societal benefit are of particular importance in explaining the differences between the two groups. Wilk's lambda is 0.757 with a $\chi 2$ of 47.61 with 14 degrees of freedom and an observed significance level of 0.0000.

Table 81. Comparison of Importance Rankings for Accepting and Unaccepting Groups (Incineration Scenario A).*

Characteristic	F	Significance	Function Coefficient**
Volition	7.15	.008	-.131
Dread	10.71	.001	-.211
Trust in Institutions	.42	.519	.103
Expert Knowledge	27.45	.000	.549
Equity	1.14	.288	.200
Society's Knowledge	3.69	.056	-.327
Severity of Consequences	.02	.881	.101
Number of People Exposed	.61	.434	.161
Institutional Control	2.83	.094	.321
Personal Control	6.71	.010	-.101
Benefit to Society	10.61	.001	.446
Benefit to Individual	2.72	.101	-.210
Likelihood of Occurrence	.19	.660	-.010
Riskiness of Decision	.60	.439	.005

* Univariate F-ratio with 1 and 178 degrees of freedom.

** Standardised canonical discriminant function coefficients

For this scenario, the judgment strategies of both groups had some elements in common. Both groups indicated that the characteristics severity of consequences and the number of people exposed were important in assessing decision acceptability. But there were also a number of differences in the two group strategies. The accepting group also placed great importance on the characteristics expert knowledge and societal benefit. By comparison, the level of dread was of considerable importance to those who found the decision unacceptable.

These differences appear to reflect the differences in the risk profiles provided by the two groups. With respect to the risk portrayed in this scenario, those who accepted the decision indicated that greater expert knowledge existed, that fewer people would be exposed and that there would be a greater benefit to society. The accepting group not only believed that some benefit would accrue to society but they also placed importance on this characteristic in determining acceptability. However those who found the decision unacceptable did not to believe societal benefit was an important consideration, nor did they believe that the incinerator siting would bring significant benefits to society.

Both groups indicated that the number of people was important to their assessment of decision acceptability. However the risk profile indicates that those who found the decision unacceptable believed that more people would be impacted by the decision. Although both groups had quite similar ratings for the characteristic dread in the risk profile, the unaccepting group also placed more importance on this characteristic as a determinant of decision acceptability.

Toxic Waste Incineration Scenario B - Upgrading of Biomedical Waste Incineration Technology

The Issue: *The continued 20 year operation of a waste incinerator is opposed by local residents. The incinerator is currently burning biomedical (i.e., hospital) waste and in years past was used to incinerate PCBs. The local residents want the government to shut down the incinerator permanently due to health concerns about air emissions and the facility's proximity to a residential area (i.e., less than 500 meters). The company contends that the incinerator is already safe even though it does not fully meet all the latest emission standards and is using older technology. However it proposes to upgrade its technology on the site so that the incinerator will become 99.9% effective in neutralizing toxic materials and meet all emission standards.*

The Environmental Protection Authority must decide whether or not to allow the incinerator to remain in operation by approving the company's proposal to upgrade its incineration technology so as to meet the latest emission standards.

<u>The Decision:</u> After meetings with local community groups and company officials, the Environmental Protection Agency decides to allow the incinerator to remain in operation at its present site provided its technology is upgraded. The company is given 2 years to upgrade its technology so as to meet today's air emission standards.

The Risk Profile

The risk profile (Table 82) for this risk issue is similar to that of Toxic Waste Incineration Scenario A. The only clear difference is with respect to the characteristic number of people exposed. Respondents indicated that more people would be exposed to a risk in Incineration Scenario B (mean rating 5.64) than would be in Incineration Scenario B (mean rating 4.76).

Respondents from the East Cannington sample were not included in this analysis as this scenario was similar to the risk issue which they are currently experiencing. Their responses are the subject of a separate analysis of NIMBY perceptions described in Chapter 9.

Table 82. *Risk Profile for Toxic Waste Incineration Scenario B*

Characteristic (N=201)	Mean Rating	Std Deviation
Volition	5.53	1.66
Dread	5.73	1.41
Trust in Institutions	5.22	1.59
Expert Knowledge	3.25	1.61
Equity	5.15	1.45
Society's Knowledge	4.09	1.63
Severity of Consequences	5.45	1.33
Number of People Exposed	5.64	1.38
Institutional Control	3.36	1.99
Personal Control	5.27	1.68
Benefit to Society	4.46	1.85
Benefit to Individual	5.47	1.61
Likelihood of Occurrence	4.50	1.51
Overall Level of Risk	4.90	1.50

Significant Predictors of Perceived Riskiness

As with the previous risk scenario, 'overall level of risk' correlated significantly with most of the other risk characteristics. As shown in Table 83, the characteristics *Likelihood of occurrence, Societal Benefit, Severity of consequences* have the strongest correlations. The regression analysis (Appendix F) indicated that each of these characteristics, as well as volition and institutional control, contributed significantly ($p<.01$) to prediction of overall level of risk.

Table 83. *Pearson Correlation Coefficients - Toxic Waste Incineration Scenario B*

Characteristic	Overall Level of Risk
Likelihood of occurrence	.70
Societal benefit	.53
Severity of consequences	.48
Individual benefit	.41
Number of people exposed	.40
Volition	.36
Equity	.35
Institutional control	.31

The degree of interdependence amongst the various risk characteristics is much greater for this scenario than for any of the 8 generic risk domains or the other 3 risk scenarios. An examination of partial correlations indicated that a significant relationship between the characteristics 'individual benefit' (.02) and overall level of risk does not exist when the influence of other characteristics is removed. The same is true for the characteristic 'equity' (-.04).

As shown in the risk profile, respondents believe that severe consequences could result from this involuntary hazard although the probability of that occurring was considered moderate. They also believe that society would benefit from the incinerator's continued operation even if those benefits did not extend to those exposed to the risks. Collectively these perceptions contribute to the moderate mean rating for perceived riskiness of 4.90.

Acceptability of Decision

Of the four risk scenarios, the decision portrayed in Incineration Scenario B was least acceptable to respondents (Table 84). Only 25% of respondents found the decision to allow the incinerator to continue to operate at least somewhat acceptable. However 65% found the decision to be at least somewhat unacceptable with 25% of all respondents belonging to the very unacceptable decision category.

Table 84. *Acceptability of Decision Regarding Incineration Scenario B*

	Mean Rating	Standard Deviation	Variance
Individual Acceptance	4.96	1.77	3.14
Society's Acceptance	4.99	1.62	2.61

The perceived levels of risk associated with the two incineration scenarios are very similar with a mean rating of 4.81 for Scenario A and a mean rating of 4.90 for Scenario B. Yet there is a significant difference in the acceptability of the decisions taken in the two scenarios ($t = -3.14$, $p = .002$, paired sample t-test). In Scenario A the decision would allow a hazard to be introduced to a population through the siting of the incinerator. The mean individual acceptance rating for this decision is 4.57. In the case of Scenario B the decision would allow a hazard to continue for a period of time until steps could be taken to reduce, if not eliminate, the risk to the surrounding population through the upgrading of incineration technology. The mean individual acceptance rating for this decision is 4.96. Why is one decision more acceptable than the other?

As shown in Table 85, the importance rankings and weights identified the most important determinants of acceptability to be *severity of consequences*, the *number of people exposed*, and the *likelihood of occurrence*. Severity of consequences and the number of people exposed were clearly the most important characteristics with close to 90% of respondents indicating that these two characteristics were of at least some importance in determining their acceptability of the decision.

Table 85. *Importance of Characteristics in Determining Decision Acceptance*

Risk Characteristic (N=200)	Adjusted Rank (1-14)	Mean Rank (1-14)	Mean Weight	% Not at All Important
Volition	8	7.53	.074	29.1
Dread	4	7.24	.070	26.8
Trust in Institutions	10	7.73	.071	26.3
Expert Knowledge	6	7.29	.068	22.3
Equity	14	8.96	.044	35.2
Society's Knowledge	11	8.35	.050	31.3
Severity of Consequences	1	5.29	.120	11.2
Number of People Exposed	2	5.50	.105	11.7
Institutional Control	5	7.27	.073	20.7
Personal Control	12	8.70	.051	33.5
Benefit to Society	9	7.64	.073	25.7
Benefit to Individual	13	8.86	.046	38.0
Likelihood of Occurrence	3	6.89	.081	18.4
Riskiness of Decision	7	7.33	.077	21.7

In terms of severity of consequences there is little difference between the risks portrayed in the two scenarios with a mean rating of 5.35 for Incineration Scenario A and 5.45 for Scenario B. The critical difference may be the number of people exposed. Respondents indicated that more people would be exposed to the risk portrayed in Scenario B (mean rating of 5.64) than the risk in Scenario A (mean rating of 4.76). For both scenarios, respondents indicated that the number of people exposed was also an important determinant of decision acceptability.

Of the three most important characteristics, the number of people exposed is the one that can best explain the differences in individual acceptance ratings for the decisions taken in Incineration Scenarios A and B. It was the only characteristic which demonstrated a significant difference for the two risk profiles ($t = -7.24$, $p = .000$, paired sample t-test). It also is the second most important of the characteristics in determining the acceptability of the two decisions.

Table 86 displays those characteristics which significantly influenced perceived riskiness and the acceptability of the decision portrayed in Toxic Waste Incineration Scenario B. As discussed with the other scenarios, perceived societal acceptance of the decision may play an important role in determining individual acceptance of the decision. A correlation of .67 suggests a significant relationship.

Table 86. *Primary Determinants of Perceived Riskiness and Acceptability of Decision*

Perceived Riskiness	Acceptability of Decision
• Likelihood of occurrence	• Severity of consequences
• Severity of consequences	• Number of people exposed
• Societal benefit	• Likelihood of occurrence
• Volition	
• Institutional control	

Another explanation for the differences in acceptability for the two incineration scenario is that the critical characteristic(s) was not measured in the survey. When respondents were asked if there were any other considerations that played a significant role in determining acceptability, 10 respondents indicated that the amount of time provided to upgrade the incineration technology was an important consideration. Even though this is a very small number of respondents there is the possibility that more respondents did use this consideration when determining their rating for acceptability but did not identify that fact in the open ended question. No additional considerations were identified. It would be interesting to know what effect this consideration would have had on the analysis if it had been included as a listed characteristic in the survey.

From the risk profile one might have anticipated that characteristics such as volition, trust and equity would be influential in determining the acceptability of the decision. People viewed the risks in this scenario as being involuntary, low in equity and indicated a low level of trust in the risk managers. However as with the previous incineration scenario, people did not indicate that they placed great relative importance on these characteristics. For example the characteristics volition, trust in risk managing institutions, and equity were not given great importance relative to other characteristics. In the case of volition 30% of respondents indicated that it played no role at all in their assessment of the acceptability of the government's decision.

Judgment Strategies of Accepting and Unaccepting Groups

As with the other risk scenarios, to compare the judgment strategies of the two groups, their risk profiles and their mean importance rankings were compared for Incineration Scenario B using discriminant analysis. Table 87 provides the risk profile for the two groups for this scenario while Table 88 provides the F values and significance levels. Wilk's lambda is 0.727 with a $\chi 2$ of 52.66 with 14 degrees of freedom and an observed significance level of 0.0000.

Table 87. Risk Profiles for Accepting and Unaccepting Groups (Incineration Scenario B)

Characteristic	Accepting Group	Unaccepting Group
	Mean Rating	Mean Rating
Volition	5.06	5.72
Dread	5.41	5.90
Trust in Institutions	4.69	5.22
Expert Knowledge	2.55	3.41
Equity	4.59	5.37
Society's Knowledge	3.69	3.96
Severity of Consequences	4.96	5.63
Number of People Exposed	5.25	5.77
Institutional Control	2.67	3.39
Personal Control	4.57	5.54
Benefit to Society	3.24	4.86
Benefit to Individual	4.53	5.76
Likelihood of Occurrence	3.65	4.72
Overall Risk	3.88	5.22
Number of Respondents	51	123

As was the case with Incineration Scenario A, these tables indicate that the two groups perceived the risk portrayed in this scenario quite differently. Significantly different group mean ratings ($p<.01$)were provided for 7 of the 14 characteristics. In comparison to those who rejected the decision, those who accepted keeping the incinerator open tended to perceive the risk in the scenario as being more equitable, providing more benefit to society, with a lower likelihood of negative consequences. In addition, experts were considered to have a greater understanding of the risks and any negative consequences were viewed as being less severe. The accepting group considered the overall level of risk to be significantly less than that reported by the unaccepting group.

Table 88. Comparison of Risk Profiles for Accepting and Unaccepting Groups (Incineration Scenario B).*

Characteristic	F	Significance	Function Coefficient**
Volition	6.26	.013	-.024
Dread	4.40	.037	.202
Trust in Institutions	3.96	.048	-.015
Expert Knowledge	11.45	.001	.243
Equity	11.40	.001	-.013
Society's Knowledge	1.06	.304	.053
Severity of Consequences	9.37	.003	.106
Number of People Exposed	5.51	.020	-.131
Institutional Control	5.27	.023	.008
Personal Control	12.03	.001	.292
Benefit to Society	33.49	.000	.408
Benefit to Individual	22.68	.000	.189
Likelihood of Occurrence	21.15	.000	-.062
Overall Risk	34.83	.000	.483

* Univariate F-ratio with 1 and 172 degrees of freedom.

** Standardised canonical discriminant function coefficients

Table 89 displays the mean importance rankings of the two groups for the various risk characteristics. This table indicates that those who found the decision to be acceptable placed greatest importance on the characteristics *severity of consequences*, *expert knowledge*, the *number of people exposed*, and *societal benefit*. These are the same characteristics identified by the accepting group for Incineration Scenario A.

By comparison, those who found the decision to be unacceptable indicated that the characteristics *severity of consequences*, the *number of people exposed* were most important in determining decision acceptability. Thus the characteristics severity of consequences and the number of people exposed were important to both groups in determining decision acceptability. The characteristics *volition* and *likelihood of occurrence* also received high mean importance rankings for the unaccepting group.

Table 89. *Mean Importance Ranks for Accepting and Unaccepting Groups*

Characteristic	Accepting Group	Unaccepting Group
	Mean Ranking	Mean Ranking
Volition	9.20	6.67
Dread	7.93	7.06
Trust in Institutions	7.83	7.66
Expert Knowledge	5.57	7.92
Equity	8.61	8.73
Society's Knowledge	8.68	8.44
Severity of Consequences	5.09	5.30
Number of People Exposed	6.22	5.36
Institutional Control	6.61	7.41
Personal Control	8.96	8.57
Benefit to Society	6.36	8.56
Benefit to Individual	9.59	8.59
Likelihood of Occurrence	6.58	6.89
Riskiness of Decision	7.59	7.18
Number of respondents	50	117

The mean importance rankings of the two groups were then compared to determine whether or not the two groups were employing similar judgment strategies in assessing decision acceptability. Table 90 displays the F values, significance and standardised discriminant function coefficients for the two groups. Significant ($p<.01$) differences between the groups were found for the characteristics *volition*, *expert knowledge* and *societal benefit*. Wilk's lambda is 0.767 with a $\chi 2$ of 41.83 with 14 degrees of freedom and an observed significance level of 0.0001.

As was the case for Incineration Scenario A, both groups relied heavily on two of the same characteristics when determining decision acceptability. These were the characteristics severity of consequences and the number of people exposed. But the groups differed in their reliance on the characteristics volition (unaccepting group), expert knowledge (accepting group) and societal benefit (accepting group).

Table 90. Comparison of Importance Rankings for Accepting and Unaccepting Groups (Incineration Scenario B).*

Characteristic	F	Significance	Function Coefficient**
Volition	12.49	.001	.679
Dread	1.64	.202	.050
Trust in Institutions	.07	.797	.237
Expert Knowledge	17.33	.000	-.461
Equity	.04	.845	-.148
Society's Knowledge	.17	.680	.486
Severity of Consequences	.11	.744	.050
Number of People Exposed	1.58	.211	.339
Institutional Control	1.97	.163	.026
Personal Control	.36	.549	-.080
Benefit to Society	11.21	.001	-.383
Benefit to Individual	2.60	.109	.478
Likelihood of Occurrence	.27	.604	.109
Riskiness of Decision	.36	.547	.131

* Univariate F-ratio with 1 and 165 degrees of freedom.

** Standardised canonical discriminant function coefficients

Once again the analysis indicates that an understanding of how individuals decide the acceptability of a decision taken in response to a risk cannot be derived solely by an examination of the profile of that risk. For instance, the characteristics equity and personal control received significantly different mean group ratings in the risk profile for this scenario but they were not considered important characteristics when determining decision acceptability. Similarly, the characteristics severity of consequences and the number of people exposed received similar ratings from both groups in the risk profile, yet both groups indicated that these characteristics were important in their judgments of decision acceptability.

Dominant Determinants of Decision Acceptability

Looking across the four scenarios we see that certain characteristics tend to be important in all scenarios and for both those who accepted the decisions and those who rejected the decisions portrayed in the risk scenarios (see Tables 91 & 92). Severity of consequences was an important determinant of both acceptance and nonacceptance of the decisions portrayed in each of the four risk scenarios. With the exception of the unaccepting group in Asbestos Scenario A, the same is true of the number of people exposed to the risk. Expert knowledge was an important characteristic for at least one of the groups in each scenario.

Table 91. Important Characteristics in Determining Decision Acceptability (Asbestos Scenarios A & B)

Asbestos A Accepting	Asbestos A Unaccepting	Asbestos B Accepting	Asbestos B Unaccepting
Severity	Volition	Number of People	Severity
Likelihood	Personal Control	Severity	Expert Knowledge
Expert Knowledge	Severity	Dread	Number of People
Number of People	Likelihood	Expert Knowledge	Riskiness of Decision

As predicted by the literature, societal benefit was an important determinant only for those supporting the maintenance or introduction of a risk (i.e., acceptance of the incineration decisions). Those that did not support the incineration decisions did not use societal benefit as part of their judgment strategy. Those that used societal benefit in determining decision acceptability (i.e. the accepting group) also viewed the benefits to society as being greater than did their counterparts.

Table 92. Important Characteristics in Determining Decision Acceptability (Incineration Scenarios A & B)

Incineration A Accepting	Incineration A Unaccepting	Incineration B Accepting	Incineration B Unaccepting
Severity Expert Knowledge Number of People Societal Benefit	Severity Number of People Dread	Severity Expert Knowledge Number of People Societal Benefit	Severity Number of People Volition Likelihood

Relationship Between Importance Ranks and Weights

The analyses in this chapter rely to a greater extent on the importance ranks than on the importance weights. A Spearman Rank Correlation analysis was conducted to examine the strength of relationship between the importance ranks and the importance weights.

Table 93. *Spearman Rank Correlations for Importance Ranks and Weights*

Characteristic	Asbestos Scenario A	Asbestos Scenario B	Incineration Scenario A	Incineration Scenario B
Volition	.67	.78	.78	.79
Dread of risk	.64	.79	.78	.80
Trust in Institution	.64	.65	.80	.83
Expert Knowledge	.57	.75	.82	.80
Equity	.67	.61	.69	.69
Society's Knowledge	.63	.67	.75	.72
Severity of Consequences	.50	.77	.79	.80
Number of People Exposed	.58	.74	.83	.78
Institutional Control	.53	.67	.81	.75
Personal Control	.54	.74	.78	.67
Benefit to Society	.63	.79	.79	.82
Benefit to Individual	.59	.76	.72	.67
Likelihood of Occurrence	.60	.81	.83	.78
Riskiness of decision	.64	.76	.72	.79

As shown in Table 93 the r-values ranged from a low of 0.50 to a high of 0.80. The lower r values for Asbestos Scenario A may reflect the fact that, as the first scenario presented in the questionnaire, respondents were less familiar with the ranking and weighting procedure when they completed this scenario.

Limitations of Analysis

Chapters 7 and 8 have explored the relationships between perceived risk, acceptability, and other risk characteristics. None of the results should be interpreted as presenting definitive models of perceived risk or acceptability. This is due to the fact that the same limited set of risk characteristics was applied to each analysis. Thus there is no way of knowing whether or not more influential characteristics existed for the various hazards and risk issues examined in the study. If for each risk issue, the list of characteristics had been modified to compliment the attributes of the particular risk issue or decision, then the analysis might have painted a somewhat different picture.

The analysis of judgment strategies focused on identifying specific strategies for those who accepted a decision and for those who rejected the same risk decision. There may in fact be more than two strategies that respondents have employed as a group in assessing the acceptability of the decisions portrayed in the risk scenarios. While a cluster analysis might have been one way to examine this possibility it would require a rationale for selecting possible strategies for the analysis. No such basis for identifying possible strategies existed.

Although it might be tempting to conclude from the analysis that respondents are employing simple strategies that involve a small number of considerations, that conclusion cannot be drawn. However such simple strategies would be consistent with attempts to reduce cognitive complexity and increase decision making efficiency. This seems reasonable for those individuals not directly affected by a decision. However, as discussed further in Chapter 9, this would not apply to those directly affected by a decision.

Test of Kraus and Slovic Findings

In their study of the hazard domain railroads, Kraus and Slovic (1988) found structural differences from the taxonomies reported for sets of heterogeneous hazards (e.g. Slovic et al. 1980). They found that specific railroad accident scenarios had their own unique factor structures. As reported in Chapter 6, factor analysis of the risks portrayed in the four risk scenarios of this study also revealed different factor structures.

Another way of looking at this issue is to compare the ratings provided for each of the listed risk characteristics. If significant differences in ratings were found this would confirm that respondents discriminated between the generic hazard domains (i.e., asbestos and toxic waste incineration) and specific risks that fall within those domains. A repeated measures analysis of variance using unique sums of squares was used to determine within-subject effects. In the absence of a repeated measures exercise to test response consistency, only those differences found to be significant at $p<.01$ are examined further. The tables below display those characteristics which revealed significant F values at the .01 level.

Asbestos Domain

Respondents' characteristic ratings for the generic asbestos domain were compared with their ratings for the asbestos risk described in Asbestos Scenario A. Of the 14 characteristics examined 6 revealed significant differences (Table 94). As shown in Table 95, a similar analysis comparing the ratings of the generic asbestos domain and Asbestos Scenario B revealed significant differences ($p<.01$) for 7 of the 14 characteristics. Tables 94 and 95 indicate that respondents did discriminate between the risks portrayed in the two asbestos risk scenarios and the generic asbestos domain.

Table 94. *Comparison of Characteristic Ratings for Generic Asbestos Domain and Asbestos Scenario A*

Characteristic	F value	Sig. of F
Volition	236.06	.000
Dread	52.30	.000
Expert Knowledge	22.80	.000
Society's Knowledge	97.86	.000
Personal Control	15.60	.000
Likelihood of Occurrence	16.21	.000
Number of Respondents	108	

Table 95. *Comparison of Characteristic Ratings for Generic Asbestos Domain and Asbestos Scenario B.*

Characteristic	F value	Sig. of F
Volition	15.83	.000
Dread	19.33	.000
Trust in Institutions	10.14	.002
Expert Knowledge	7.28	.008
Society's Knowledge	18.67	.000
Number of People Exposed	33.24	.000
Personal Control	60.75	.000
Number of Respondents	107	

A comparison of the ratings for the two asbestos risk scenarios also indicated that respondents considered the risks portrayed in the two scenarios to be different from one another. Significant differences (p<.01) were found for 10 of the characteristics including the overall level of risk (Table 96).

Table 96. *Comparison of Characteristic Ratings for Asbestos Scenario A and Asbestos Scenario B*

Characteristic	F value	Sig. of F
Volition	302.91	.000
Dread	126.71	.000
Trust in Institutions	12.40	.001
Society's Knowledge	27.95	.000
Severity of Consequences	21.10	.000
Number of People Exposed	40.85	.000
Institutional Control	18.91	.000
Personal Control	80.76	.000
Likelihood of Occurrence	74.17	.000
Overall Level of Risk	49.40	.000
Number of Respondents	211	

Toxic Waste Incineration Domain

A similar analysis was used to determine whether or not respondents viewed the risks portrayed in the two incineration scenarios as unique risks. Respondents' characteristic ratings for the generic toxic waste incineration domain were compared with those given for Toxic Waste Incineration Scenario A. Of the 14 characteristics examined 6 revealed significant differences (Table 97).

As shown in Table 98, a similar analysis comparing the ratings of the generic incineration domain and Incineration Scenario B revealed significant differences (.01

level) for 8 of the 14 characteristics. Tables 97 and 98 indicate that respondents did discriminate between the risks portrayed in the two incineration risk scenarios and the generic incineration domain.

Table 97. *Comparison of Characteristic Ratings for Generic Incineration Domain and Incineration Scenario A*

Characteristic	F value	Sig. of F
Trust in Institutions	9.31	.003
Equity	11.27	.001
Severity of Consequences	17.66	.000
Personal Control	12.91	.000
Societal Benefit	39.75	.000
Overall Level of Risk	35.57	.000
Number of Respondents	108	

Table 98. *Comparison of Characteristic Ratings for Generic Incineration Domain and Incineration Scenario B*

Characteristic	F value	Sig. of F
Trust in Institutions	9.37	.003
Equity	16.93	.000
Society's Knowledge	22.33	.000
Severity of Consequences	11.29	.001
Number of People Exposed	29.99	.000
Personal Control	7.15	.009
Societal Benefit	21.97	.000
Overall Level of Risk	27.73	.000
Number of Respondents	107	

However a comparison of the ratings for the two incineration risk scenarios revealed little discrimination between the two. Only two characteristics (i.e. the number of people exposed and societal benefit) revealed significantly different ratings (Table 99).

Table 99. *Comparison of Characteristic Ratings for Incineration Scenario A and Incineration Scenario B*

Characteristic	F value	Sig. of F
Number of People Exposed	56.19	.000
Societal Benefit	7.29	.007
Number of Respondents	211	

Since Incineration Scenario B was the risk scenario that directly affected respondents from the East Cannington sample, the analysis was re-run minus these 29 respondents. When this was done the characteristic societal benefit was no longer significant at the .01 level (F = 6.61; significance of F = .011).

That respondents did not discriminate between the risks portrayed in the two incineration scenarios was a surprising result as the researcher designed the two incineration scenarios to represent different risk issues. However the result should not be interpreted as saying that respondents did not view the risk issues as being different from one another. What the analysis does indicate is that, other than with respect to the number of people exposed to the risk, respondents did not discriminate with respect to the characteristics investigated. A different result may have been found if a different list of risk characteristics had been tested.

In summary, the repeated measures analysis of variance generally supported the Kraus and Slovic (1988) finding that individuals discriminate between risks that fall within a homogeneous hazard domain.

The Role of Hazard Prototypes

In Part A of the study questionnaire, respondents provided ratings for a list of characteristics for eight hazard domains. The researcher noted that respondents appeared to have little difficulty in providing ratings for the eight hazard domains despite the fact that no information was provided about any of the domains. Respondents seemed to have distinct images in their minds with respect to each of the hazard domains. The literature on attitude accessibility (see Chapter 3) and prototypes was examined to help explain this observation.

The attitude literature suggests that responses to attitude questions involve judgements that are either made on-line as information on the particular issue is received or by retrieving existing individual beliefs about the issue from memory or a combination of these two processes. Whether or not an individual's response reflects an on-line or memory-based judgement may be affected by factors such as whether the respondent has a pre-existing judgement toward the issue, whether the existing judgement is accessible, and whether the existing judgement maps onto the specific issue question (Tourangeau, Rasinski & D'Andrade 1991).

Consistent with a memory based view of attitudes and the concept of attitude accessibility is the idea of prototypes. Prototypes are normative conceptual schemata which organise information in memory. They can range from an abstract image to a collection of the most typical characteristics or features associated with a category label or object. A prototype acts as "a standard around which a body of input is compared and in relation to which new input is assimilated into the set of items remembered about a given experience or list of stimuli" (Cantor & Mischel 1977, p.38).

In this study, respondents appear to use prototypes of the various hazard domains when rating the domains on various characteristics. From the consistency in the ratings it appears that these images or prototypes of the hazard domains were largely shared by the respondents. The debriefing of pre-test respondents suggested that this was the case. For example in the case of dams, pre-test respondents indicated that their image of this hazard domain was of a large dam similar to those in the metropolitan area which supply water to the city. This is despite the fact that there are many types of dams including many small farm dams which are common in this geographic area. Thus the risk profiles generated for each of the eight hazard domains can be thought of as describing prototypes for those hazard domains.

Assuming that individuals have certain dominant images or prototypes that they associate with specific hazard domains, what role would these play in the interpretation of an issue that falls within a generic hazard domain? When presented with a specific risk issue, such as those presented in the four risk scenarios, will individuals rely on their prototype for that hazard domain for input that is not presented in the context of the risk issue?

As discussed in earlier chapters, respondents can discriminate between a generic hazard domain and a specific risk issue within that domain. Similar to Kraus and Slovic's (1988) study of railway accidents within the railroad hazard domain, this study found that the factor structures of specific risk issues differed from that of their generic hazard domains and from each other.

However this does not preclude the generic hazard domain having played a significant role in determining judgements about risk issues within that hazard domain. In what manner might this occur? If the prototype hazard is playing an important role in determining judgements about specific risks we would expect that respondents would rely upon the prototype for input not supplied by the context of the risk issue. In the case of the four risk scenarios in this study, some information is given or implied about certain of the tested risk characteristics. In other instances no information is provided. We would expect that when information about a characteristic is provided in the risk scenario then respondents would use this information in making their judgements regarding the risk profile for that issue. However for those characteristics for which no information is provided then respondents would rely upon their prototype for information to fill the gaps.

To test this the characteristics for which information was provided were identified for each risk scenario. These are the characteristics for which differences from the generic hazard profile would be expected. A comparison was then made of the risk profiles for the generic hazard domain and the specific risk issue.

Looking at Asbestos Scenario A, the risk issue highlighted or alluded to a number of the risk characteristics. These were: volition, dread, personal control, and society's knowledge (i.e., knowledge of those exposed). One would predict that respondents would, on the basis of the context of the risk issue, rate these characteristics in a manner which would reflect the context information rather than the generic asbestos hazard profile. The ratings of characteristics for which no context information was provided would be expected to remain close to those of the generic asbestos domain.

The repeated measures analysis of variance revealed significant differences in ratings for the characteristics volition, dread, expert knowledge, society's knowledge, personal control, and likelihood of occurrence. The ratings of volition, dread, personal control and society's knowledge clearly reflect the context of the risk issue (Table 100). The differences in mean ratings for expert knowledge and likelihood of occurrence were not predictable from the content of the risk issue.

With respect to Asbestos Scenario B, because the risk issue involved a risk to children one would expect a high level of dread and a low level of personal control. The description provided to respondents was of an involuntary risk to school children and staff. The repeated measures analysis revealed significant differences for these three characteristics in directions that are consistent with the context of Asbestos Scenario B. The other characteristics which revealed significant differences were: trust in institutions, expert knowledge, society's knowledge, and number of people exposed. None of their ratings are inconsistent with the specific risk issue but their differences from the generic asbestos profile were less easily predicted.

Table 100. *Risk Profile for the Generic Asbestos Domain and Asbestos Scenarios A and B*

	Asbestos Hazard Domain	Asbestos Scenario A	Asbestos Scenario B
Risk Characteristic	Mean Rating	Mean Rating	Mean Rating
Volition	4.69	1.55	5.60
Dread of risk	5.04	3.44	5.81
Trust in Institution	4.08	4.25	4.67
Expert Knowledge	2.76	2.06	2.31
Equity	5.18	4.79	5.47
Society's Knowledge	4.38	2.46	3.52
Severity of Consequences	6.06	6.22	5.77
Number of People Exposed	4.26	4.05	5.40
Institutional Control	3.06	3.35	2.85
Personal Control	3.39	2.45	5.02
Benefit to Society	5.08	5.55	5.37
Benefit to Individual	5.51	5.10	5.51
Likelihood of Occurrence	4.67	5.28	4.53
Overall Level of Risk	5.36	5.72	5.08

From the description of the risk issue in Incineration Scenario A one would expect possible differences in ratings for the characteristics volition, personal control, equity, societal benefit, and possibly the number of people exposed. The identification of a specific risk manager and decision maker might also affect the rating of the characteristic trust in institutions as appears to have been the case with Asbestos Scenario B. Although a number of the characteristics revealed statistically significant differences in the repeated measures analysis of variance, the differences from the generic toxic waste incineration domain were not as dramatic as those found with the asbestos scenarios. The characteristics trust in institutions, equity, severity of consequences, personal control, societal benefit and overall level of risk all demonstrated significant differences. With the exception of severity of consequences, these differences appear consistent with the context of the risk issue. However some characteristics which were highlighted by this risk issue did not differ in their ratings from the generic incineration domain (Table 101). This does not necessarily mean that the context was not used but that the prototype and the risk issue may be similar with respect to these particular characteristics (e.g., volition).

Table 101. *Risk Profile for the Generic Toxic Waste Incineration Domain and Incineration Scenarios A and B*

	Incineration Hazard Domain	Incineration Scenario A	Incineration Scenario B
Characteristic	Mean Rating	Mean Rating	Mean Rating
Volition	5.55	5.88	5.69
Dread of risk	5.50	5.68	5.74
Trust in Institution	4.38	5.13	5.09
Expert Knowledge	3.22	3.35	2.97
Equity	5.86	5.23	5.17
Society's Knowledge	4.68	4.20	3.79
Severity of Consequences	6.04	5.44	5.53
Number of People Exposed	4.56	4.68	5.59
Institutional Control	2.96	3.29	3.09
Personal Control	4.96	5.58	5.54
Benefit to Society	5.36	4.04	4.45
Benefit to Individual	5.76	5.49	5.60
Likelihood of Occurrence	4.58	4.30	4.50
Overall Level of Risk	5.80	4.85	4.98

For those characteristics for which no specific information was provided or alluded to (e.g., benefit to individual, institutional control), ratings tended to be very close to those of the generic risk profile for toxic waste incineration. This can be interpreted in two ways. That respondents inferred input for these characteristics from the context and found it to be consistent with the prototype or they relied on the prototype to fill in the gaps.

With respect to Incineration Scenario B, from the context of the scenario one would look to the characteristics volition, personal control, equity, societal benefit, and possibly the number of people exposed. The identification of a specific risk manager and decision maker might also affect the rating of the characteristic trust in institutions. These are the same characteristics highlighted in Incineration Scenario A although the problem facing decision makers is quite different.

The repeated measures analysis revealed significant differences for the characteristics: trust, society's knowledge, equity, severity of consequences, the number of people of exposed, societal benefit, personal control and overall level of risk. The ratings for these characteristics are consistent with the context of the risk issue. As with Incineration Scenario A, those highlighted characteristics which did not demonstrate a significant difference (e.g., volition) were still rated in a manner consistent with the context of the risk issue but were also consistent with the profile of the generic incineration domain. As with Incineration Scenario A, those characteristics for which no specific information was provided or alluded to (e.g., benefit to individual, institutional control) tended to be rated very similarly to those of the generic risk profile for toxic waste incineration.

It is difficult to draw conclusions from this analysis as the study was not designed to examine this question. In fact the risk scenarios were written so as to highlight many of the risk characteristics being examined in the study. Thus there were relatively few characteristics that would not be affected by the context of the risk scenario. Despite this limitation the analysis does suggest that individuals use the context of a particular risk issue in determining their perceptions. When characteristics of a particular risk context are different from those of their image or prototype for that hazard domain, they will apply the context specific information. However when the context does not provide information about certain characteristics then a person may rely upon their prototype image of the hazard domain to fill in the missing pieces for a specific risk issue. The role of prototypes in determining risk perceptions is an issue worthy of further investigation.

Along similar lines, Bostrom, Fischhoff, and Morgan (1992) used interview techniques to draw information from members of the community of their mental pictures of a hazard and then compared them with an influence diagram of the hazard derived through expert knowledge. In their opinion it is not so much a matter of lay persons missing information in their mental picture but of the importance of that missing information. In making that assessment they asked whether there were any decisions or substantive inferences that hinged on this missing knowledge. If the answer was no, then it was not important to introduce that information to the lay community. They contend that highlighting unimportant knowledge would waste the public's valuable attention by focusing on irrelevancies, which could also erode public respect for experts (i.e., why are they telling us this?). The gaps in lay knowledge that were assessed as being important would be those whose provision would have the greatest impact on recipient ability to make decisions in their own best interest. These pieces of information would become a focus of the risk communication effort.

Context Effects

In the case of the asbestos risk scenarios, respondents provided significantly different descriptions of the risks associated with the generic asbestos domain and the two specific asbestos risk issues. The risk profiles of the two asbestos scenarios also differed significantly from one another. In the case of the incineration domain, respondents discriminated between the generic incineration domain and each of the incineration risk issues, however, they did not significantly differentiate between the two incineration risk issues.

In designing the questionnaire, the issue of context effects did not appear to be a major concern for two reasons. First the researcher believed that the four risk scenarios represented clearly different risk situations and decisions. Secondly there were only four scenarios being tested. However, given that respondents did not significantly discriminate between the two incineration scenarios, the issue of possible context effects is re-examined.

Context effects are changes in the distribution of responses to a questionnaire item as a function of earlier items. Prior items can change how respondents interpret subsequent items, the specific beliefs that are retrieved from memory, which dimensions, standards or norms are applied in making judgements, and how answers are reported (Tourangeau, Rasinski & Bradburn 1989). Tourangeau and Rasinki (1988) reported that context sometimes pushes later responses in the direction of apparent consistency (i.e., carryover effects) but also can push them in the opposite direction (i.e., backfire effects).

Which beliefs are accessible can be affected by the content of prior questions. If prior questions trigger the retrieval of beliefs that are also relevant to following questions then they can alter the composition of the sample of beliefs retrieved in answering the later question (Tourangeau, Rasinski & Bradburn 1989). Directional context effects will result "when the context items serve as a kind of unconscious reminder of considerations that favour a particular position on the target issue" (p.405). Directional or carryover effects in attitude measurement appear to diminish in a short period of time and can be reduced by placing a few irrelevant items between the context and target items. They found that context effects were larger when the context items were presented in a block immediately before the relevant target. Studies by Tourangeau, Rasinski and D'Andrade (1991) also found that prior questionnaire items could facilitate or "prime" the retrieval of particular beliefs and thus affect the answers to subsequent target questions. Others have found that asking an attitude question is likely to increase the accessibility of linked attitudes only when the first attitude is relatively extreme and strong (Judd et al. 1991).

In the study questionnaire the two toxic waste incineration scenarios were presented one after the other as were the asbestos scenarios. In the case of Incineration B respondents characteristic ratings may have been influenced by their responses to the previous incineration scenario. The t test would suggest that respondents viewed the two risk issues very similarly at least with respect to the characteristics being examined in the study. Only the characteristic *the number of people exposed* demonstrated a significant difference at the .01 level. The rating for this characteristic was consistent with the context of the risk issue which implied that more people would be impacted in Incineration Scenario B than in Incineration Scenario A. It is possible that context effects played some role in the similarity of the risk profiles for these two issues. Another possible factor is fatigue as Incineration Scenario B was the last scenario in a lengthy and tiring questionnaire.

As noted earlier, the study questionnaire was not designed to address the issue of context effects. However given the results of this study, the potential for context effects should be given further consideration in future studies through design measures such as varying the order of scenario presentation.

Expert Versus Lay Perceptions

Much of the risk perception literature reinforces the message that lay persons employ a different definition of risk from that of the risk expert. While risk experts define risk as:

$$RISK = PROBABILITY \times CONSEQUENCES$$

and risk acceptability as:

$$RISK / BENEFIT = COST = ACCEPTABILITY$$

to produce mathematical values; lay persons are believed to utilise other risk characteristics or attributes in forming their judgements of the riskiness or acceptability of a particular hazard (e.g., Slovic et al. 1979).

Characteristics which reflect an expert or technical risk perspective were among the characteristics examined in this study. One would expect a person employing a technical risk model to utilise characteristics such as *severity of consequences*, *likelihood of occurrence*, the *number of people exposed* and *benefits* in assessing the riskiness of hazards and the acceptability of decisions taken to address such risks. But to what extent do lay persons rely on these same characteristics?

Table 102 identifies those characteristics which formed significant pathways to either perceived riskiness or risk acceptability (individual and societal acceptance) for the 8 hazard domains. The first observation is that not all of the risk characteristics examined in the study appear in the table. The two control characteristics (personal and institutional), as well as societal and expert knowledge, and the number of people exposed do not appear. While the characteristics equity (asbestos) and trust in institutions (dams) are each significant for only one hazard domain.

By comparison the characteristic *likelihood* of occurrence forms a significant pathway to perceived riskiness for each of the 8 hazard domains. Other dominant characteristics are dread, severity of consequences and the benefit characteristics (societal and individual).

The experts determine acceptability by considering the risks versus the benefits in a cost benefit manner. As shown in Table 102 lay persons also rely significantly on perceived risk and benefits in determining risk acceptability. Both benefits to those exposed to the risks or to society in general appear to play an important role.

In the second part of the study respondents were asked to indicate the level of risk associated with four risk scenarios and to judge the acceptability of the decisions

Table 102. *Significant Pathways to Perceived Riskiness and Individual or Societal Risk Acceptance*

Characteristic	Asbestos	Surfing	Bush Fires	Toxic Waste Incineration	Dams	Bicycles	Vaccinations	Sunbathing
Volition						^	*	
Dread				^	^	* ^		*
Trust					+			
Equity	* +							
Severity		*	+	*	*		*	
Societal Benefit				^	* ^		+	
Individual Benefit	*	+	+					+
Likelihood	*	*	*	*	*	* +	*	*
Overall Riskiness		+		+	^		+	+
Individual Acceptance			*				^	
Societal Acceptance	* +	+	* +	* +	+	+		+ *

* denotes significant pathway to overall level of risk
+ denotes significant pathway to individual acceptance
^ denotes significant pathway to societal acceptance

Table 103. *Primary Determinants of Perceived Riskiness in the Risk Scenarios*

Asbestos Scenario A	Asbestos Scenario B	Incineration Scenario A	Incineration Scenario B
Likelihood of occurrence	Likelihood of occurrence	Likelihood of occurrence	Likelihood of occurrence
Severity of consequences		Severity of consequences	Severity of consequences
Number of people exposed		Societal benefit	Societal benefit
Societal benefit		Number of people exposed	Volition
			Institutional control

Table 104. *Primary Determinants of Individual Acceptance of Decision*

Asbestos Scenario A	Asbestos Scenario B	Incineration Scenario A	Incineration Scenario B
Severity of consequences	Severity of consequences	Severity of consequences	Severity of consequences
Likelihood of occurrence	Number of people exposed	Number of people exposed	Number of people exposed
Number of people exposed	Expert knowledge	Expert knowledge	Likelihood of occurrence
Expert knowledge	Likelihood of occurrence	Societal benefit / Likelihood	

taken to address those risks. Tables 103 and 104 summarise the dominant characteristics with respect to perceived riskiness and decision acceptability. Again the characteristics likelihood of occurrence, severity of consequences and societal benefit are dominant as predictors of perceived riskiness. The number of people exposed to the risk is also an important consideration. With respect to the acceptability of the decisions portrayed in the risk scenarios, Table 104 indicates the importance of the characteristics expert knowledge and the number of people exposed in judging decision acceptability, along with the characteristics severity of consequences and likelihood of occurrence.

While lay persons no doubt consider a range of considerations in determining the level of risk and its acceptability or the acceptability of decisions taken to address the risks, those characteristics typical of a technical approach appear to also play a dominant role in the judgements of lay persons (i.e., severity, likelihood, the number of people exposed and benefits). This may be particularly true for the perceptions of lay persons who are not directly affected by the particular risk issue.

Popper (1983) and others have argued that people focus on the consequences side of the risk equation, however this study suggests that people also focus on probability when assessing riskiness. Of the various risk characteristics selected for previous psychometric studies, probability is often not included as a scaled item. More commonly it is evaluated as a separate exercise as is often similarly the case for perceived level of risk and perceived risk acceptability.

When probability has been included the risk perception studies the results have been mixed. Vlek and Stallen (1981) included aspects of probability in their study of 26 risky activities. Subjects were asked to rank a subset of 12 of the risky activities with respect to the probability of an accident occurring. They found that the average pairwise rank correlation was virtually zero indicating a lack of agreement among subjects' individual rank orderings. They concluded that most people are not able to give valid probability estimates and that probability does not easily enter everyday discussions and judgements about risky activities. They argued that the probability of an accident is subsumed under a broader concept reflecting the degree of human control over the possible consequences of an activity. Rather than seeking estimates of probability they believed that one should ask people to what extent they believe the risky activity to be under control.

One study that included fatality probability as an attribute was conducted by von Winterfeldt, John and Borcherding (1981). Subjects were asked, for fourteen risk stimuli, to make an overall judgement of risk and to give three estimates of fatality statistics: an individual fatality probability, the average number of fatalities per year, and the number of fatalities in a disaster. To estimate the individual fatality probability, subjects were asked to state the chances (i.e., the odds) that an individual would get killed as a direct consequence of pursuing the activity for a year. They found that individual fatality probability emerged as the best predictor of perceived risk ratings while average fatalities had no relationship with risk ratings. They also found that while the fatality probability estimates were in approximate ordinal agreement with actual risk statistics, high probabilities were underestimated while small probabilities were overestimated.

While this study did not examine whether or not respondents could accurately estimate the probability of outcomes, the study did suggest that people are comfortable using probability as part of their judgement of riskiness and acceptability. Contrary to the position of Vlek and Stallen (1981), the study did not show a significant relationship between the probability characteristic (i.e., likelihood of occurrence) and either perceived personal or institutional control over a risk.

Summary of Findings

The following general conclusions can be drawn:

- For any particular decision scenario, there are typically a number of characteristics which are considered to be important to both those supporting and those opposing a decision. For each scenario, both groups had at least two of their four most important characteristics in common.

- Those who support the introduction of a risk (e.g., a facility siting) or maintenance of some degree of risk (e.g., allowing an old technology to be upgraded) appear willing to consider benefits as part of their decision making strategy. Those who oppose such decisions do not factor benefits into their thinking.

- Severity appears as an important determinant of decision acceptability regardless of the context of the risk decision and whether or not a person supports the decision. The number of people potentially exposed to the risk is also a dominant characteristic independent of group. Expert knowledge appears to be an important determinant of decision acceptability for those supporting a decision.

- The importance of volition, personal control and private rights in Asbestos Scenario A demonstrates that although people may base their judgments largely on the characteristics of the risk issue, they may also place significant importance on aspects of the decision itself.

- That individuals discriminate among risks that fall within the same hazard domain. This result is consistent with the findings of Kraus and Slovic (1988) regarding homogeneous hazard domains.

- For the risks examined in this study it appears that in their risk judgements respondents often relied heavily on many of the same characteristics that a risk expert would. For instance the characteristics likelihood of occurrence and severity of consequences significantly influenced respondent perceptions of the overall level of risk for most hazard domains. For those risks that do not directly affect them, individuals may adopt judgement strategies not that dissimilar to those of the technical risk expert.

CHAPTER 9

NIMBY PERCEPTIONS AND STRATEGIES

Introduction

This chapter examines the risk perceptions and judgement strategies of respondents directly affected by one of the risk scenarios. These NIMBY respondents are members of a local residents group who over the past few years have opposed the continued operation of a nearby medical waste incinerator. Many of the East Cannington residents who live in close proximity to the incinerator are members of the residents group FRAG. Their situation formed the basis of Toxic Waste Incineration Scenario B.

Although the medical waste incinerator is situated on industrially zoned land, all parties to the issue agree that a less than ideal buffer distance separates the incinerator from nearby residents. Local residents are concerned about the possible contamination of groundwater due to the disposal of PCBs on the site many years ago and possible health effects from current stack emissions. As described in the risk scenario, the State's Environmental Protection Authority (EPA) has decided to allow the incinerator to remain in operation while its technology is upgraded over the next few years. Similar incinerators in the metropolitan have been or soon will be decommissioned leaving the incinerator as the only one of its type operating in the metropolitan region.

This analysis examines whether NIMBY individuals assess the acceptability of decisions in a manner different to that of non-NIMBYs (i.e., unaffected individuals). One possibility is that affected individuals respond to a decision in a manner similar to that of unaffected individuals who also reject the decision. In other words NIMBYs would employ a judgement strategy similar to that of the non-NIMBY 'unaccepting group' described in earlier analyses. Another possibility is that people employ completely different judgement strategies when faced with a decision that could directly affect them and their families than they otherwise would. This would be consistent with both Janis and Mann's concept of "hot cognitions" and cultural theories of risk (e.g. Renn et al.'s social amplification of risk, 1992) in which an individual's interactions with other members of their social group (e.g. the residents action group) influences their perception of a risk issue.

What form might a NIMBY style strategy take? Much of the NIMBY literature pertains to facility siting and has increasingly focused on issues of trust such as public perceptions of the trustworthiness and credibility of risk managers and decision makers (e.g., Bord & O'Connor 1992; Mitchell 1992; and Pijawka & Mushkatel 1991; Armour 1993; Hunter & Leyden 1995). Planners such as Armour contend that "social discourse about risk is more often than not a discourse about trust, power and equity" (1993, p. 192). A number of other risk characteristics are related to trust. The degree of personal control over a risk, the voluntary nature of exposure and the distribution of risks and benefits (i.e., equity issues) are all closely related to the issue of trust. One might anticipate that members of a NIMBY group would rely heavily on these characteristics when assessing the acceptability of a decision that would directly affect them as in the case of Incineration Scenario B.

As in Chapter 8, the comparisons of importance rankings and risk profiles in this analysis were conducted using multiple discriminant analysis. Prior probabilities were based on the sample proportion of cases in each group. When these results were compared with those obtained assuming that prior probabilities of group membership are equal it did not significantly change the findings. As described in Chapter 6, multivariate outliers were addressed through the use of Mahalanobis distances. The following analysis is constrained by the small sample size of 29 respondents.

NIMBY Risk Profile

Table 105 provides the risk profile for Toxic Waste Incineration Scenario B for the East Cannington (i.e., NIMBY) sample. The profile is based on the mean characteristic ratings provided by this group. Comparing this profile with that of the other respondents (Chapter 8) reveals that NIMBY respondents rated each of the risk characteristics less favourably. For instance they characterised the risk associated with this scenario as being more involuntary, as creating greater dread, as being less equitable, resulting in more severe consequences, and affecting more people, than did other respondents. In fact many of the mean ratings for this group were very extreme with 8 characteristics having mean ratings above 6.0 (Table 105).

The risk profiles of the three sample populations (i.e. Curtin students, Craigie, FRAG) were compared using discriminant analysis. Table 106 displays the univariate F-ratios and standardised canonical discriminant function coefficients for the comparison of the FRAG (i.e. NIMBY) sample with the Curtin student sample. The F ratios and a Wilk's lambda of 0.686 with a $\chi 2$ of 59.56 with 14 degrees of freedom and an observed significance level of 0.0000 indicate significant differences in the risk profiles of these two sample populations.

Table 105. *Risk Profile for Toxic Waste Incineration Scenario B*

Risk Characteristic (N=29)	Mean Rating (1-7)	Std Deviation
Volition	6.24	1.50
Dread of risk	6.31	0.89
Trust in Institutions	6.45	1.18
Expert Knowledge	4.36	1.93
Equity	5.68	1.42
Society's Knowledge	5.32	1.57
Severity of Consequences	6.25	0.97
Number of People Exposed	6.57	0.88
Institutional Control	5.00	2.29
Personal Control	5.79	1.69
Benefit to Society	5.59	1.74
Benefit to Individual	6.14	1.36
Likelihood of Occurrence	6.03	1.24
Overall Level of Risk	6.35	0.97

Table 106. Comparison of Risk Profiles for NIMBY and Curtin Populations

Characteristic	F*	Significance	Function Coefficient
Volition	6.88	.009	.271
Dread	3.37	.068	-.053
Trust in Institutions	14.18	.000	.146
Expert Knowledge	18.08	.000	.091
Equity	3.77	.054	-.149
Society's Knowledge	15.58	.000	.517
Severity of Consequences	10.77	.001	.246
Number of People Exposed	11.10	.001	.179
Institutional Control	26.31	.000	.387
Personal Control	2.20	.140	-.208
Benefit to Society	6.90	.009	-.006
Benefit to Individual	1.78	.184	-.147
Likelihood of Occurrence	25.16	.000	.496
Overall Risk	23.35	.000	.006

* Univariate F-ratio with 1 and 165 degrees of freedom.

A similar comparison of the NIMBY and Craigie suburb populations also indicated significant differences in the risk profiles for most risk characteristics (Table 107). The Wilk's lambda for this comparison is 0.555 with a $\chi 2$ of 41.16 with 14 degrees of freedom and an observed significance level of 0.0002.

Table 107. Comparison of Risk Profiles for NIMBY and Craigie Populations

Characteristic	F*	Significance	Function Coefficient
Volition	10.68	.002	.131
Dread	4.74	.033	-.032
Trust in Institutions	20.49	.000	.330
Expert Knowledge	4.25	.043	.130
Equity	10.96	.001	-.130
Society's Knowledge	11.07	.001	.348
Severity of Consequences	5.74	.019	-.347
Number of People Exposed	17.68	.000	.288
Institutional Control	6.95	.010	-.228
Personal Control	7.96	.006	.267
Benefit to Society	10.37	.002	-.219
Benefit to Individual	12.18	.001	.126
Likelihood of Occurrence	28.09	.000	.281
Overall Risk	27.44	.000	.620

* Univariate F-ratio with 1 and 77 degrees of freedom.

Yet the extreme ratings provided by NIMBY respondents to some of the characteristics was inconsistent with their discussions with the researcher after completing the questionnaire. For instance in discussions about the local incinerator issue, many acknowledged that the incinerator would meet a broader community need for medical waste management. Yet this view was not reflected in their survey data. They rated the societal benefit of the medical waste incinerator as being very low with a mean rating of 5.59 as compared with a mean of 4.46 for other respondents.

A study by Marks and von Winterfeldt (1984) of community perceptions of off-shore oil drilling may provide insight to the high (i.e., negative) characteristic ratings of the

NIMBY respondents. In their study respondents were drawn from two communities, one being directly affected by the drilling issue and constituting the 'backyard" or NIMBY community. The other community was unaffected by offshore drilling. The researchers found that respondents from the backyard community rated the risks associated with a drilling scenario as being higher and less beneficial than respondents from the community not affected by off-shore drilling. This was true even when the community described in the scenario was not the backyard community. While noting the need for further research, the researchers identified motivational concerns as a possible explanation for their results. The motive or goal for the affected community being to keep oil drilling out of their backyard. The expressed attitudes of the affected community respondents towards the oil drilling scenarios being a manifestation of that motive. They suggested that cognitive availability may also have played a role. For respondents from the affected community, the imaginability, vividness and salience of the situation described in the scenario would have been much greater than that of other respondents.

These factors may have played a role in determining the extreme characteristic ratings provided by members of FRAG. Another possible interpretation is that respondents were making their point about the high level of perceived risk by rating each of the characteristics very unfavourably. This may have occurred even though these respondents were told that the data would not be used for purposes other than research. Using the negative rating of the characteristic societal benefit as an example, respondents from the affected community (i.e., FRAG members) may have viewed any acknowledgement of societal benefit as being inconsistent with or as undermining their opposition to the incinerator's continued operation. Another possible explanation is that NIMBY respondents were not giving cognitive but emotional responses when rating the characteristics. This would be consistent with the high level of anxiety and stress that the risk issue had generated among group members.

NIMBY Judgement Strategies

All respondents who are members of the local resident group (N=29) considered the decision portrayed in the scenario to be unacceptable, with a mean acceptability rating of 6.37 (std. deviation 1.04) out of 7.00. They also indicated that the rest of society would deem the decision to be unacceptable (mean 6.15). While the majority of non-NIMBY respondents also found the decision to be unacceptable there was not on average as strong a rejection of the decision (mean 4.96). A One-Way ANOVA (between group F ratio of 12.01, df 2, F probability .000) indicated that members of the local residents group found the decision to be significantly less acceptable than other sample populations. The Bonferroni test (significance level .05) revealed that the acceptance ratings of NIMBY respondents differed significantly from those of both the Curtin and Craigie respondents.

The mean importance rankings (Table 108) indicate that the most important determinants of decision acceptability for this scenario are the number of people exposed, severity of consequences, dread and society's knowledge. In terms of the percentage of respondents ranking a characteristic amongst their four most important, trust in institutions also appears to be important with 45% or 13 respondents ranking trust as one of their four most important characteristics. By comparison only 24% or 7 respondents ranked society's knowledge among their four most important characteristics.

Table 108. *Importance of Characteristics in Determining Acceptability of Decision (Nimby Sample)*

Characteristic (N=29)	Adjusted Rank (1-14)	Mean Rank (1-14)	% Highly Ranked
Volition	10	8.38	17
Dread	3	5.62	48
Trust in Institutions	6	6.97	45
Expert Knowledge	9	7.88	21
Equity	14	10.41	10
Society's Knowledge	4	6.67	24
Severity of Consequences	2	5.53	55
Number of People Exposed	1	4.62	55
Institutional Control	13	9.33	10
Personal Control	12	8.85	14
Benefit to Society	5	6.79	38
Benefit to Individual	11	8.59	14
Likelihood of Occurrence	8	7.76	21
Riskiness of Decision	7	7.57	14

Table 109 compares the judgement strategies of the NIMBY sample (i.e., FRAG respondents) with those of non-NIMBY respondents. The non-NIMBY respondents have been separated into two groups: those that accept the decision and those who found the decision unacceptable. The similarities among the three groups were surprising. For all three groups, severity of consequences and the number of people exposed were identified by respondents as important determinants of decision acceptability. The NIMBY and unaccepting non-NIMBY groups also had the characteristic dread in common. Not surprisingly only the non-NIMBY respondents who accepted the decision considered benefits to society to be an important consideration.

Table 109. *Strategies For Determining Decision Acceptability*

Nimby Respondents	Non-Nimbys Accepting of Decision	Non-Nimbys Unaccepting of Decision
• Number of People • Severity of Consequences • Dread • Society's Knowledge / Trust in Institutions	• Severity of Consequences • Expert Knowledge • Number of People • Societal Benefit	• Number of People • Severity of Consequences • Volition • Dread

The study hypothesis that NIMBY individuals employ judgement strategies which are similar to those of not directly affected individuals who reject the same decision was examined more closely through discriminant analysis (Table 110). The Wilk's lambda for this comparison is 0.777 with a $\chi 2$ of 33.64 with 14 degrees of freedom and an observed significance level of 0.0023. However the F ratios indicate that at the .01 level there no significant differences in group means for any of the risk characteristics. Significant differences at the .05 level were found for the characteristics equity, society's knowledge and institutional control. This analysis suggests that NIMBY individuals and (non-NIMBY) unaccepting individuals were employing similar judgement strategies.

Another hypothesis was that NIMBY individuals would rely more heavily on those characteristics often associated in the risk literature with NIMBY situations. However, as shown in Table 109, the typical 'NIMBY characteristics" (i.e. trust, volition, personal control and equity) did not dominate the judgement strategies of NIMBY respondents. Given the literature on NIMBY conflicts and the researcher's personal experience with NIMBY communities this was a surprising result. As discussed below it is also somewhat inconsistent with comments made by FRAG members in discussions with the researcher.

Table 110. Comparison of Judgement Strategies for NIMBY and non-NIMBY Unaccepting Group

Characteristic	F*	Significance	Function Coefficient
Volition	1.99	.160	.334
Dread	3.52	.062	-.272
Trust in Institutions	2.73	.101	-.464
Expert Knowledge	.19	.664	.249
Equity	4.38	.038	.526
Society's Knowledge	5.02	.027	-.387
Severity of Consequences	.53	.468	.156
Number of People Exposed	.48	.489	-.051
Institutional Control	5.64	.019	.515
Personal Control	.05	.820	.119
Benefit to Society	2.38	.126	-.260
Benefit to Individual	.38	.541	.248
Likelihood of Occurrence	1.68	.198	.442
Overall Risk	.01	.923	-.053

* Univariate F-ratio with 1 and 140 degrees of freedom.

Discussions with NIMBY Group Members

Given the small sample size (N=29) and the fact that many of the NIMBY resident group members found the questionnaire methodology very difficult, especially the ranking and weight procedures, it is difficult to interpret the judgement strategies employed by this NIMBY community. The researcher attended a series of small group meetings with these respondents. At each meeting 5-6 members of the resident group completed the questionnaire. After completion of the questionnaires a general discussion of the local incinerator issue (similar to Incineration Scenario B) would occur, providing additional insights to the thinking of respondents. From these discussions a central issue emerged, the issue of trust or more precisely their lack of trust in both the operator of the incinerator and the regulatory agencies (i.e., the Health Department and the Department of Environmental Protection). While the issue of trust dominated discussions about the incinerator, this was not strongly reflected in the responses of these respondents to the questionnaire. While the risk profile indicates a very low level of trust (mean 6.45), the ranking procedure did not identify trust as a particularly influential determinant of decision acceptability for this group. Perhaps these NIMBY respondents believed that authorities could never be made 'trustworthy' and it was a given.

Because the respondents did not trust the risk managers or decision makers, they were sceptical of Department of Environmental Protection (DEP) assurances that tests had shown that any ground water contamination had not migrated significantly off-site. Nor were they prepared to believe assurances from the facility operator or his environmental consultants that previous operations or future emissions would not pose a health threat to residents and their families in the future.

The loss of faith in the regulatory agencies was most disillusioning for the NIMBY group. Many in society are sceptical of the credibility of industry sources, regardless of whether or not they have had any direct contact with industry. Thus the incinerator issue did not result in a significant loss of trust in industry as there was little to start with. However the resident group indicated that until the incinerator issue arose they believed that regulatory agencies existed to protect the public's interest. However as a result of their interactions with the Environmental Protection Authority (EPA) through the DEP, other regulatory agencies and politicians, they had lost their faith in these parties and no longer felt that these agencies would protect the residents' interests over those of industry. It appears that much of this loss in trust arose from poor communication on the part of these agencies. In April 1995, the State Ombudsman found that the DEP had contributed to suspicion and distrust among residents, who complained about the incinerator's operators. Finding that some DEP staff had been insensitive to the complaints of residents and 'in conjunction with other comments made by the departmental officers, had contributed to the development of a suspicious and distrusting attitude on the part of residents" (West Australian, 15 April 1995). In response, members of the local resident group turned to Greenpeace both for support and as a trusted source of information about incineration emissions.

Related to the issue of trust is the involuntary nature of what is viewed by residents as a health risk to them and their children. While they could choose to move to another location, as some area residents recently have, this would be both disruptive and costly. They also described a sense of powerlessness with a number of group members commenting that their lack of socio-economic status meant their complaints would not be heard or remedied. Others commented that they wanted to know what the operator was doing on the site and what was coming out of the stack but they felt that they were not getting adequate answers to these questions. The group had used the media as a means of getting their message out to the broader community and to get the attention of decision makers. While group members indicated that they had not been familiar with incineration technology prior to this issue arising, they had over time educated themselves regarding the risks associated with medical waste incineration.

None of the resident group members indicated that they were philosophically opposed to incineration as a technology or to governments making decisions about such issues. Many expressed the type of sentiment you would expect from non-NIMBY residents, that such a facility has to go somewhere. There was acknowledgement that such facilities do serve some benefit to the broader community even though those benefits may not be tangible at the individual level. However they do not believe that such a facility, even with the best of technologies, can be made safe enough to exist in close proximity to residential areas without some threat to the health of residents. Accidents can happen as a result of mechanical failure, human error or natural disasters. They also noted the inequities associated with closing hospital incinerators across the metropolitan area and having all medical waste go to the one remaining incinerator in their area. This meant that their neighbourhood would be exposed to certain risks so that the rest of society could maintain the benefit of having its medical waste treated. Interestingly, a number of the FRAG respondents commented that they had sympathy for the community portrayed in Incineration Scenario A. They felt that their own circumstances paralleled that of the rural community facing the prospect of an incinerator being introduced to their community. They characterised both incineration scenarios as representing the inequities associated with finding a home for a risk facility that had to go somewhere.

All of these comments fit the profile of a typical NIMBY community and are consistent with my experience over the past 10 years working with NIMBY communities in Canada and Australia. This includes: a lack of trust in the risk mangers and decision makers; a sense of little personal control over the risk and an inability to influence those who could exert control; and the belief that they are involuntarily being exposed to risks so that the rest of society can obtain a benefit. When these issues are involved any risk communications from industry or regulatory agencies stating how safe the facility is and how minuscule the risks will be ineffective if these other issues are not tackled as part of the risk management and communication process. In fact it is likely that much more emphasis needs to be placed on addressing these key NIMBY issues than on the technical risk message itself.

The Ranking and Weighting Methodology

Given that the ranking and weighting procedure may not have accurately reflected the thinking of respondents from the East Cannington NIMBY sample, does this put into question the results from the other respondent groups (i.e., Curtin students and Craigie residents)? There appears to have been no problem with the Curtin student sample as respondents were familiar with the ranking and weighting methodology from their course work. Like the East Cannington sample, the Craigie sample was drawn from a suburban population. They too tended to find the ranking and weighting methodology difficult but their results are not in question as the respondents were drawn from a larger pool of residents. Those who were unwilling or unable to do the methodology simply did not complete the questionnaire. Many times the number of actual respondents from this group were contacted as part of the survey process. With a large number of residents from which to draw we could afford to keep contacting additional people until we achieved our target number of completed questionnaires.

In the case of East Cannington NIMBY sample, the researcher did not have this luxury. Due to the small number of group members from which to draw respondents, every potential respondent had to be used, even if they struggled with the ranking and weighting methodology. Having the researcher attend small group sessions to administer the questionnaire reduced this problem by assisting respondents with the procedures. Some of these respondents indicated that they found completing the questionnaire to be stressful while most found it tiring. A few complained that their heads ached from thinking about the issues.

The ranking and weighting procedures requires that respondents critically analyse their own thinking. It is relatively easy to report whether or not you agree or disagree with a decision. It is also relatively easy to rate the degree of agreement or disagreement on a bipolar scale. However, asking people to dissect how they arrived at those conclusions is a difficult task. While someone might be able to recite what influenced their choice of a new automobile, for many other decisions especially decisions of a less personal nature the same individuals may have difficulty explaining their reasoning within the framework of the ranking and weighting procedure. The procedure is challenging in that it requires one to think about ones own thinking, something that many people are unaccustomed to doing for many of their decisions. Add on top of this the emotionally charged nature of a NIMBY issue it is not surprising that many members of the East Cannington sample struggled with the procedure. It does however put into question the usefulness of the methodology when dealing with emotion charged NIMBY issues at the local level.

CHAPTER 10

KEY RESEARCH FINDINGS

AND

FUTURE RISK COMMUNICATION EFFORTS

Introduction

This chapter summaries the key findings of the research program with respect to each of the research objectives described in Chapter 5. A number of areas for future research arising from this study are identified. The implications of the study's findings for future risk management and risk communication efforts are discussed.

Research Findings

Research Objective #1: Factor Structure of Generic Hazard Domains

Principal Axis Factor Analysis was used to examine the structure of 8 generic hazard domains (Chapter 6). While Fischhoff et al. (1978) and Slovic et al. (1980) reported stable factor structures applicable across large sets of heterogeneous hazards, this study revealed qualitatively different factor structures for the generic hazard domains. This result was consistent with the findings of Bishop and Syme (1992) which also used people rather than technology as their statistical unit of measure.

Although only eight hazard domains were examined in this study, a general factor structure representing the construct 'risk' which could be applied to all hazards was not evident. The study did however support Kraus and Slovic's (1988) conclusion that the dimensions of any hazard space are likely to be dependent on the nature of the set of hazards being described.

The extent to which the stable 3-factor structure reported by Slovic at al. (1980) is attributable to semantic similarities among the tested characteristics requires future study. By using mean characteristic values across a diverse set of hazards, structural information specific to individual risks may be cancelling each other out and all that remains are the semantic similarities of the characteristics. If one examines the factor structures produced by studies such as those by Slovic and Fischhoff for heterogeneous hazard sets, they are not dissimilar to what one would expect if you tried to group the characteristics on the basis of similar or related meanings.

Research Objective #2: Factor Structure of Homogeneous Hazard Domains

Kraus and Slovic (1988) examined whether or not the factor structure derived by Fischhoff and Slovic from a 'global' analysis across heterogeneous sets of hazards (Slovic et al., 1980), would also pertain to a 'local' set of hazards from the same hazard domain. Kraus and Slovic found structural differences from the previous taxonomy for heterogeneous domains, reporting that specific hazard scenarios had their own unique factor structures despite belonging to the same hazard domain.

In this study respondents were presented with 4 risk issues representing 2 hazard domains (i.e. asbestos and toxic waste incineration). The study design differed from most previous studies, including that of Kraus and Slovic (1988), in that the risk issues were based on real issues that had already received local media coverage rather than being hypothetical situations.

The Principal Axis Factor Analyses of the risks portrayed in the four risk scenarios generally supported the findings of Kraus and Slovic (1988). Within a single hazard domain, the factor structures of specific risks differed from one another and from the structures of their respective generic hazard domains. Just as Kraus and Slovic found that all railroad scenarios could not be adequately represented by a single point in the global factor space labelled railroads, the same appears to be true for asbestos scenarios and toxic waste incineration scenarios.

This study would suggest that regardless of whether one is considering a set of heterogeneous hazards or a set of homogeneous hazards, each hazard has it own factor structure. Given the results of these factor analyses, one must question whether the stable factor structures reported across a large number of heterogeneous hazard domains by Slovic, Fischhoff and others really reflects much about the general structure of risk that is meaningful to risk decision makers.

Research Objective #3: Relationships Among The Risk Characteristics

Previous researchers have reported, across a wide range of hazards, that some risk characteristics are highly correlated with each other and that some characteristics could by themselves be good predictors of perceived riskiness and risk acceptability (e.g. Slovic et al. 1980; Gregory & Mendelsohn 1993; Fischhoff et al. 1978; Kraus &

Slovic 1988). Slovic et al. (1980) reported that perceived risk was the best predictor of risk acceptability. They concluded that perceived risk and risk acceptance are quite predictable from knowledge of other risk characteristics.

However Gould et al. (1988) did not find a consistent pattern of dominant characteristics across a range of technologies and reported considerable differences among technologies with respect to the importance of various characteristics in predicting perceived risk. Similar to the Gould et al. (1988) study, this study examined the relationship between perceived risk and other risk characteristics for individual hazards rather than for combined sets of heterogeneous hazards. Correlation, regression and path analyses were used to explore the relationships between perceived risk, risk acceptability and other qualitative aspects of risk for each hazard domain.

The results of this study support the findings of Gould et al. (1988) in that for a specific hazard domain, many of the risk characteristics (e.g., dread) identified in previous studies as being highly inter-related and good predictors of perceived risk or risk acceptability did not correlate strongly with each other or with perceived risk or risk acceptability. As did the factor analyses, this highlighted the need to look at each risk as being unique. Despite this, the regression and path analysis indicated that certain characteristics (i.e. likelihood of occurrence and severity of consequences) significantly influenced perceived risk for most of the hazard domains included in this study.

The Influence of Risk Benefits

A number of studies have reported an inverse relationship between perceived risk and perceived benefit for a range of hazards (e.g., Alhakami & Slovic 1994). The results of this study also support the existence of an inverse relationship between perceived benefit and perceived riskiness for six of the eight generic hazard domains. The study indicated that benefits, either to society or the exposed individual, appear to be part of perceived riskiness as opposed to being separate. This is different from the way that risk experts consider benefits (i.e. as part of risk acceptability as opposed to perceived risk). When lay persons assess the riskiness of an activity or item, unlike risk experts, they consider the associated individual or societal benefits as part of that judgement. This suggestions that perceptions of risk are net rather than gross indicators of harm.

The study's findings supported Vlek and Stallen's (1981) report of a relationship between perceived benefit and risk acceptability. For the hazard domains in this study, there appears to be a significant relationship between either individual and or societal benefit and both perceived riskiness and individual acceptance.

Alhakami and Slovic (1994) reported that perceived risk and perceived societal benefit were almost unrelated when the risk level was considered low or moderate. By comparison this study found that while domains deemed to be high in risk were low in either societal or individual benefit, domains perceived as having low risk (i.e. vaccinations and dams) also demonstrated a strong inverse relationship with both societal and individual benefits.

Volition and Risk Acceptability

Previous research reported that involuntary risks are generally regarded as being less acceptable than voluntary risks (Slovic 1987). While the risk ratings in this study generally fit the pattern predicted by earlier research, there does not appear to be a strong relationship between volition and risk acceptance for the particular generic hazard domains examined in this study.

While the generic hazard domains did not reveal a strong relationship between volition and either perceived risk or risk acceptability, the analysis of the 4 risk scenarios produced different findings. For 3 of the 4 risk scenarios, those who disagreed with the decision portrayed in the scenario indicated that volition was an important consideration in determining the acceptability of the decision. This study also suggests that it is as much the voluntary or involuntary nature of the decision, rather than the risk, which was important to respondents in determining the degree of acceptance of the decision.

Sunbathing proved to be an interesting case in that it is considered both a voluntary risk and an unacceptable risk. This was consistent with Hansson's (1989) belief that society's reaction to highly voluntary risks is closely related to the degree of paternalism that is practised or recommended. Whereas 20 years ago most people would have considered sunbathing to be an acceptable activity, low in risk, this is no longer the case as a result of intense media campaigns to educate the public of the risks of skin cancer.

Societal and Individual Acceptance

A significant relationship may exist between societal acceptance and individual acceptance although further research is required to explore this relationship. The high correlation between these characteristics may mean that respondents did not discriminate between these variables. Alternatively, people may believe their perspective of acceptability is largely shared with the rest of society. It also suggests that in determining their own perceptions individuals consider how the rest of society would view the same hazard. This would be consistent with the position of cultural theorists (e.g. Douglas & Wildavsky 1982) that culture and our social environment provides the template against which individuals make their own judgements.

Technical versus Lay Perceptions

While lay persons consider a range of attributes in assessing the level of risk and its acceptability (or the acceptability of decisions taken to address the risks), those characteristics typical of a technical approach appear to also play a dominant role in the judgements of lay persons (i.e., severity, likelihood of occurrence, the number of people exposed and benefits). This may be particularly true for the perceptions of lay persons who are not directly affected by a specific risk issue.

The research findings do not support the position of researchers such as Popper (1983) and Vlek and Stallen (1981) who have argued that people focus on the consequences side of the risk equation rather than the probability side. This study suggests that people also focus on probability when assessing risking. While this study did not examine whether or not respondents could accurately estimate the probability of outcomes, the findings suggest that people are comfortable using the concept of probability (i.e. the characteristic likelihood of occurrence) in their judgements of perceived risk and acceptability.

Research Objective #4: Judgement Strategies in Assessing Perceived Risk and Decision Acceptability

While most previous research has focused on how people view the riskiness or acceptability of particular hazards, little attention has been paid to how people determine whether or not the decisions taken to address risk issues are acceptable. This study examined the judgement strategies individuals use to determine the acceptability of risk related decisions. Multiple Linear Regression Analysis and Pearson Correlation Coefficients were used to identify the most influential characteristics in predicting the level of perceived risk for each risk issue portrayed in the 4 risk scenarios. The outcomes of the regression analysis provided a type of judgement model for determining the overall level of risk attached to the risk issues. An analysis of the characteristics importance weightings and rankings provided a judgement model of how respondents determined decision acceptability for each risk decision. These judgement models were then compared with their corresponding models for perceived risk developed using a different methodology (i.e. regression analysis).

For each scenario a few characteristics proved to be the best indicators of both the perceived level of overall risk and decision acceptability. The characteristics 'likelihood of occurrence', 'number of people exposed' and 'severity of consequences' were common to both judgement strategies (i.e. perceived risk and decision acceptability). The characteristic 'expert knowledge' was a common feature of all judgement strategies in determining decision acceptability. However it was not as influential in judgements of the overall level of risk.

Group Differences

It might be tempting to conclude that individuals adopt quite similar judgement strategies when assessing both the perceived level of risk and the degree of decision acceptability. However this would not explain why some people accept risk decisions which others reject even when both agree on the overall level of risk. The second part of the analysis tested whether those who agree with a decision employ a different judgement strategy to those who find the same decision unacceptable. The findings of researchers who had examined the decision strategies used by different attitude groups suggested that this might be the case (e.g. Eiser & van der Pligt 1988, Otway, Maurer and Thomas 1978). For each risk decision, respondents were assigned to one of two groups on the basis of whether they found a scenario decision acceptable or unacceptable. Discriminant analysis was used to determine whether or not the two groups were employing different judgement strategies to assess decision acceptability.

For both asbestos scenarios, when the mean ratings of the risk characteristics for the two groups were compared, the risk profiles were very similar. Thus it was not readily evident from the risk profiles the reasons why one group accepted a decision while the other rejected it. In the case of Asbestos Scenario A, both groups relied on some of the same characteristics (i.e. likelihood of occurrence and severity of consequences) in determining decision acceptability. However those who accepted the Government decision to close the asbestos contaminated town also relied on the characteristics 'expert knowledge' and the 'number of people exposed' while those who rejected the decision placed greater importance on the characteristics 'volition' and 'personal control'. Those who accepted the decision appear to have used the characteristics of the asbestos risk to determine the acceptability of the decision, whereas those rejecting the Government's decision appear to have placed more reliance upon the characteristics of the decision rather than the risk.

In the case of Asbestos Scenario B, there do not appear to be great differences in the strategies employed by the two groups. Most of the important characteristics were common to both groups and the mean ratings from the risk profile provided few additional clues as to why one group found the decision to remove the school roofs acceptable and the other unacceptable. This might mean that considerations more important to determining decision acceptability were not among the listed risk characteristics.

For both of the toxic waste incineration scenarios, the groups perceived the risks differently from one another. For both scenarios the group risk profiles revealed significantly different group mean ratings for many of the characteristics. In the case of Toxic Waste Incineration Scenario A (i.e. siting of a new incinerator), the judgement strategies used by the two groups to assess decision acceptability had some common characteristics. Both indicated that the characteristics severity of consequences and the number of people exposed were important in assessing decision acceptability. However the accepting group also placed great importance on the characteristics expert knowledge and societal benefit while the level of dread was important to those who found the decision unacceptable.

These differences appeared to in part reflect differences in the risk profiles provided by the two groups. For instance the accepting group not only believed that some benefit would accrue to society but they also placed importance on this characteristic in determining decision acceptability. However those who found the decision unacceptable did not to believe societal benefit was an important consideration, nor did they believe that the incinerator siting would bring significant benefits to society.

For Toxic Waste Incineration Scenario B (i.e. decision to leave incinerator operational), both groups relied heavily on two of the same characteristics when determining decision acceptability (i.e. severity of consequences and the number of people exposed). But the groups differed in their reliance on the characteristics volition (unaccepting group), expert knowledge (accepting group) and societal benefit (accepting group). Again the analysis demonstrated that an understanding of how individuals decide the acceptability of a decision cannot be derived solely by an examination of the profile of that risk.

None of the results can be interpreted as definitive models of perceived risk or acceptability for the hazards examined in this study. This is due to the possibility that more influential characteristics exist for these hazards but were not included in the study. If for each risk issue, the list of characteristics had been modified to compliment the attributes of the particular risk issue or decision, then the analysis might have painted a quite different picture. In future research efforts it would be advantageous to develop a list of characteristics which compliment the features of the particular risks and decisions being investigated rather than selecting characteristics from the risk perception literature.

Although it might be tempting to conclude from the analysis that respondents are employing simple strategies that involve a small number of considerations, that conclusion cannot be drawn. However such simple strategies would be consistent with attempts to reduce cognitive complexity and increase decision making efficiency. This seems reasonable for those individuals not directly affected by a decision although, as discussed below, this probably would not apply to those directly affected by a decision.

While this study focused on identifying a strategy for each group, more than two strategies may have been used by respondents in assessing the acceptability of the decisions portrayed in the risk scenarios. This possibility represents another area for future research.

Research Objective #5: NIMBY Judgement Strategies

An objective of this study was to investigate whether those individuals directly affected by a risk related decision utilise similar or different judgement strategies to those not directly affected by the same decision. It was hoped this would assist in explaining the reasons why local communities often reject risk related decisions that the majority of the broader community consider acceptable.

To explore the nature of NIMBY (Not-In-My-Backyard) perceptions, one of the three sample populations was drawn from a resident action group that at the time of the study was opposing the risk decision described in Incineration Scenario B. Discriminant Analysis and a One-Way ANOVA was used to compare the decision acceptability ratings and importance rankings of NIMBY and non-NIMBY respondents.

The comparison of risk profiles for the three sample populations revealed that the mean characteristics ratings of the NIMBY respondents were different from one or both of the other groups for almost all characteristics. The characteristic ratings provided by the NIMBY respondents tended to be extremely unfavourable. These ratings were somewhat inconsistent with the qualitative analysis arising from respondent discussions with the researcher after they had completed the questionnaire. For instance during discussions many NIMBY respondents acknowledged that the incinerator would meet a broader community need for medical waste management. Yet this view was not reflected in their responses to the questionnaire regarding societal benefits. There are a number of possible explanations. Cognitive availability (Marks and von Winterfeldt 1984) may have played a role. For respondents from the affected community, the imaginability, vividness and salience of the situation described in the scenario would have been greater than for other respondents. Another possibility is that these respondents were making a political statement about their situation. Respondents from the affected (i.e. NIMBY) community may have viewed any acknowledgement of positive characteristics (e.g. societal benefit) as being inconsistent with or as undermining their opposition to the incinerator's continued operation. It is also possible that the NIMBY respondents did not give cognitive but emotional responses when rating the characteristics. This would be consistent with the high level of anxiety and stress that the risk issue had generated among group members.

On the basis of the importance rankings, the decision strategy adopted by NIMBY respondents appeared to be quite similar to that of non-NIMBY respondents who also rejected the scenario decision. Surprisingly the NIMBY respondents did not appear to rely heavily on the typical NIMBY characteristics identified in the literature such as trust, volition, personal control and equity when assessing the acceptability of a decision that affects them directly. Again this result was inconsistent with comments made by these respondents in discussions with the researcher.

During discussions with the NIMBY respondents, trust in institutions emerged as a central issue. Specifically their lack of trust in both the operator of the incinerator and the government regulatory agencies. While the issue of trust dominated discussions about the incinerator, this was not strongly reflected in the responses to the questionnaire. The NIMBY respondents also expressed a sense of having little personal control over the risk and an inability to influence those who could exert control. They also believed they were involuntarily being exposed to risks so that the rest of society could obtain a benefit. These discussions suggested that those directly affected by risk decisions do apply judgement strategies different to those of individuals not directly affected. The NIMBY respondents also displayed signs of groupthinking as group members reinforced shared beliefs. The findings of the qualitative analysis are consistent with Janis and Mann's (1977) concept of hot cognitions as well as the concept of social amplification of risk (Renn et al. 1992).

Implications For Risk Management and Communication

Each Risk Issue is Unique

One of the strongest messages from this research is that each risk issue must be considered on its own merits. While specific risk issues may share attributes with other issues, each risk issue and decision making environment is unique. The lack of a stable factor structure applicable to all hazards supports this position. The suggestion from previous research that the presence of certain risk characteristics or attributes can act as predictors of the degree of risk and acceptability that individuals will attach to risk issues is overly simplistic. While it may allow us to make global statements about the nature of risk perceptions, it is of limited use to a risk manager grappling with a specific risk issue. In fact some of the global findings could be misleading and suggest inappropriate courses of action when dealing with a specific risk issue. At best the risk characteristics identified in the literature provide risk managers with a list of possible influences. These can be used to initiate consideration about a particular risk issue but they only provide a starting point for further investigation.

The study findings also reinforces the position that risk communication must be an integral part of risk management, focusing not only on the risk message but all aspects of the risk management process. In order to do this, risk communicators must gain an understanding of how people are perceiving the particular risk issue and how they will be judging the acceptability of the risk proposal or decision. While an understanding of how a risk is perceived is important, the question of acceptability is more important. While two individuals may characterise a risk similarly, they may disagree as to the acceptability of the risk.

It would be helpful to risk decision makers to understand the judgement strategies of those who are accepting of a risk or decision, those who are undecided, and those who reject the risk or decision. This suggests that tailoring risk communication strategies to complement the decision strategies being employed by those who supporting and those who oppose or are uncomfortable with a risk decision would be prudent. There is however a potential danger in doing this. A communication targeting one group might be offensive or antagonistic to those holding a different view. For instance a communication reinforcing the societal benefits of a risk proposal might be well received by those who consider benefits as part of their decision making strategy. Yet the same message might be offensive to those who might object to an inequitable distribution of risks and benefits such as a NIMBY community.

Understanding group judgement strategies would also help establish some realistic objectives for risk communication efforts. For instance if the analysis revealed that some people tend to place importance on benefits when assessing the merits of a proposal then the risk communication could be designed to target the issue of benefits. However if people are rejecting a proposal or decision basically on philosophical grounds one would have to be less optimistic in being able to effectively influence the thinking of these people.

Given the possible role of hazard prototypes in determining the judgements of individuals regarding specific risks, it would be valuable to understand how a specific risk differed from its prototype. This would provide useful clues as to what aspects of the particular risk need to be made salient in communication efforts so that an inappropriate prototype is not used to fill information gaps.

The research also highlighted the importance of the attributes of the decision as opposed to the risk issue. As with the hypothetical decision to close the former asbestos mining town, the characteristics of the decision itself can affect its acceptability even if people otherwise agree about the characteristics of the risk issue and the level of risk. Risk managers need to pay close attention to how they are making decisions and what messages this is sending out to the public. This supports greater application of principles of procedural justice in risk management processes.

NIMBY Style Conflicts

While the survey data did not reveal significant differences in the judgement strategies of NIMBY and nonaffected respondents who rejected the same decision, the qualitative analysis based on respondent interviews suggested that differences do exist. While the reasons require further investigation, this study suggests that those directly affected by decisions rely on both emotional and cognitive processes in reaching and judging the acceptability of decisions. This would apply to both those affected by the decisions as well those who make the decisions, as both typically experience considerable stress. In contrast to these 'hot' cognitions, those not directly affected appear to take a more cognitive approach in assessing decision acceptability. In some respects their strategies are quite similar to the technical view of risk acceptability as reflected in the dominance of characteristics such as severity of consequences, the likelihood of negative outcomes, the number of people exposed, and the degree of benefit. This suggests that not directly affected individuals are asking some of the same basic questions that risk experts do. What is the probability of the risk being realised? What would be the consequences? Are there any offsetting benefits? This conclusion needs to be tested further with a list of characteristics that is tailored to reflect specific risk issues.

Despite this, it seems reasonable to suggest that those not directly affected by decisions use simple strategies that they can apply to many risk issues. This would reduce cognitive complexity and be more efficient for the individual. A more complex analysis of an issue would only be warranted when an issue or decision had personal implications. This may in part explain the often divergent views of NIMBYs and non-NIMBYs in reaction to particular risk issues such as the siting of risky facilities.

While those affected by decisions may consider the same factors as unaffected individuals when making judgements, they consider a number of additional factors.

These factors reflect the nature of NIMBY issues and conflicts. Potential NIMBY situations can be characterised as situations in which a risk is being imposed involuntarily, where those exposed can exert little personal control over the risk, where there is an inequitable distribution of costs and benefits, and often little trust in either the risk managers or the risk decision makers.

Discussions with members of the NIMBY resident action group highlighted the importance of trust and personal control in particular. In the absence of trust, the quality of the risk message is largely irrelevant as individuals will be unwillingly to accept any message from a source that they do not trust. The importance of trust reinforces the need to focus on procedural justice aspects of risk communication and the importance of adopting an integrated or process approach to risk communication that is not limited to the risk message itself. Risk management and communication efforts need to target the key aspects of the risk issue (e.g. trust, personal control, equity) if the rest of the risk message is to be heard.

NIMBYs are often accused of being emotional, ignorant and selfish. This may be true but looking out for one's self interest is only acting in a prudent fashion. This does not make a person irrational and should not be used to devalue their position. They are simply acting as many people would when placed in such a situation. Members of NIMBY groups may start out being ignorant about the particular risk issue but typically they quickly educate themselves as to the 'facts'. What decision makers are really objecting to is that these residents often interpret the facts differently. Risk communication can attempt to ensure that all parties are working from the same facts but it can never ensure how people will use that information in judging the riskiness or acceptability of a proposal. Nor should they.

The fact that processes such as the social amplification of risk and groupthinking are associated with NIMBY issues, points to the need to be proactive in addressing critical issues as soon as possible. Once positions become polarised it is difficult if not impossible to move parties from their positions. One of the most difficult challenges for those proposing or advocating the imposition of a risk is that they are a party to the risk issue. They typically have an emotional or ego investment in the outcome and are equally vulnerable to processes such as groupthinking. The use of outside risk management and communication experts can reduce this problem although those who work with industry often share their client's worldview and tend to want to persuade and educate the public regarding the wisdom of their client's position. To change the status quo, proponents must be willing to give up some control and allow for the possibility that outcomes other than their preferred solution may emerge.

Risk Decision Making

Conflicts over risk issues will by their nature remain among the toughest public problems to resolve. They will continue to elicit divergent opinions of the sort that make life difficult for decision makers. Tough problems sometimes require difficult choices. The use of decision making processes which employ procedural justice principles would help. This is particularly true for situations in which it may not be possible in the final analysis to fully resolve all community concerns.

Those negatively affected by decisions should not feel that they are victims of a number crunching exercise. Unfortunately the opposite has been happening as increasingly emphasis is being placed on 'objective' quantitative evaluations for exercises such as facility siting. Decision makers at all levels are seeking the comfort of being able to fall back on the numbers and the illusion of a value free decision. This belies the fact that the numbers are the product of numerous value judgements. Fearful of community backlash, decision makers are unwilling to clearly state what considerations have driven their decisions. Evaluations are portrayed as complex comprehensive analyses conducted in an objective fashion. However such studies typically hinge on several key considerations that are value laden.

The majority of the risk management and communication literature focuses attention on the public. The emphasis being on how to influence the public so that they will see the wisdom of the risk managers and decision makers and accept their decisions and the associated risks. However the decision makers might be equally well served by looking at themselves. There are two layers of decision making attached to many risk issues. There are the decisions arising from the technical studies as discussed above. These studies result in decisions which take the form of recommendations to the higher level of decision making, the political decision maker. Both require some changes if we are going to be more successful with these types of risk issues. The technical evaluators need to lift their game in order to reduce the judgement errors and biases often introduced to their studies. Ultimately risk decisions like many other decisions are political in nature. As such they are vulnerable to the weaknesses of political decision making.

Observations On The Study Methodology

The study questionnaire was designed to examine a number of risk characteristics which have been tested in other studies, thereby allowing comparison with previous research. For a real world risk issue this would not be the recommended approach as it places undue emphasis on some risk attributes while potentially ignoring more important characteristics. Alternatively focus groups could be conducted at the outset of a risk issue to identify the important characteristics of the risk and decision in question. This would allow the identification of a limited number of attributes which could then be canvassed more widely in the community through a questionnaire or other means.

The use of a MAUT style importance ranking and weighting procedure proved to be somewhat problematic. The procedure worked well with university students but was less effective with other respondents, particularly those having less education or experience with the procedure. Public involvement activities are often criticised for only catering to the well educated middle and upper classes. That criticism has some validity for this methodology although the methodology could be simplified if the list of characteristics was shortened and the characteristics carefully targeted to reflect the particular risk issue. Having to only respond to one issue as opposed to many would also make the task less daunting in a real world context.

In the case of directly affected respondents, questionnaires similar to that used in this study may be quite ineffective. As demonstrated by the extreme ratings of the action group members, emotional responses may dominate and create conflict for the respondent. Other than revealing the high level of emotional involvement of NIMBY residents, responses may reveal little about how these individuals actually perceive the particular risk. For NIMBY groups, qualitative analysis such as individual or small group discussions using structured interview techniques is probably a more effective means of obtaining an accurate picture of perceptions.

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APPENDIX A

Risk and Acceptability Questionnaire

R1 (1)

ID #________ (OFFICE USE ONLY) **(2-4)**

RISK AND ACCEPTABILITY

QUESTIONNAIRE

PART A

The following is a list of items which have elements of risk about them.

1. **Asbestos**
2. **Surfing**
3. **Bush fires**
4. **Toxic waste incineration**
5. **Dams**
6. **Bicycles**
7. **Vaccinations**
8. **Sunbathing**

Risks or hazards are sometimes described by their characteristics such as how controllable they are or the likelihood that the risk will occur. Using the scales provided on the following pages, please rate the degree to which each characteristic describes a particular risk item (eg. asbestos). For each risk characteristic, please **circle** the number on the scale which best represents that characteristic for that particular risk item.

NOTE: **It is important that you circle an answer for each risk characteristic. Even if you feel uncertain about your answer, please provide your best guess.**

If you find a particular item difficult - go on and come back to it. However please check that all are completed before returning the questionnaire.

Q1. ASBESTOS (5-11)

A. Volition
Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk
Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution
Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge
Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity
Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge
Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences
If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q2. SURFING (21-27)

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

SURFING (continued) **(28-36)**

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q3. BUSH FIRES (does not include controlled burns eg. CALM) (37-43)

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q4. TOXIC WASTE INCINERATION (53-59)

A. Volition
Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk
Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution
Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge
Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity
Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge
Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences
If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q5. DAMS (69-75)

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q6. BICYCLES

R2 (1)
(2-4)
(5-11)

Volition
Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk
Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution
Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge
Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity
Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge
Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences
If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

BICYCLES (Continued) **(12-20)**

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q7. VACCINATIONS (21-27)

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q8. SUNBATHING (37-43)

A. Volition
Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk
Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution
Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge
Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity
Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge
Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences
If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

SUNBATHING (Continued) **(44-52)**

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society by the item.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	Small amount of benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the activity

Not risky	1	2	3	4	5	6	7	Extremely risky

O. Acceptability of risk
Refers to the degree to which you feel the risk posed by the activity is acceptable.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

P. Societal acceptance of the risk
Refers to the degree to which the risk posed by the item is acceptable to society.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

ID#______(Office use only)

PART B

RISK DECISION-MAKING

Society today is faced with having to make difficult and in some cases controversial decisions about the types and amount of risk we are willing to accept either as individuals or as a society.

Part B of the questionnaire describes a number of risk scenarios for two types of risk issues: asbestos and toxic waste incineration. For both risk issues some general background information will be provided and then two decision scenarios will be described for each risk issue. After each risk decision scenario you will be asked to answer a number of questions on that scenario.

Risk Issue 1: ASBESTOS

Background

Because it is non-flammable and a poor heat conductor, asbestos has been used to make fireproof products such as safety clothing for fire fighters, many insulation products, building-construction materials, paints and in friction products such as brake linings. Exposure to asbestos particles, however, can cause asbestosis a disease of the lungs. After a latent period of up to 30 years and more it may lead to various cancers such as lung cancer and mesothelioma an inoperable cancer of the chest and abdominal lining. Because of the health risks posed by asbestos use, research into replacements for asbestos has been accelerated and the use of asbestos products is being phased out.

Two risk decisions (Scenarios A & B) pertaining to asbestos are described below. Following each scenario you will be asked to answer a number of questions.

Asbestos Scenario A:

The Issue: Due to concerns about potential health effects resulting from exposure to asbestos, the State Government is faced with deciding whether or not to close down a town located in close proximity to an asbestos mine which has ceased operation. While many of the town's residents have already moved from the area due to health concerns, others have stayed on because the town is their home. The remaining residents have indicated that they are willing to accept the risk of continued exposure to the local environment. A decision by the government to close down the town would effectively force the remaining residents to relocate and would prevent new residents from moving to the area.

RISK CHARACTERISTICS **(53-58)**

Q9. Listed below are a number of risk characteristics which are sometimes used to describe risks or hazards. Using the scales provided, please rate the degree to which each characteristic describes the risk or hazard described in <u>this scenario</u>. For each characteristic, please **circle** the most appropriate number on the scale.

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

(59-66)

G. Severity of consequences
If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed
Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control
Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control
Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society
Refers to the amount of benefit to society resulting from the risk.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the hazard described in the scenario.

Not risky	1	2	3	4	5	6	7	Extremely risky

NOTE: **Please be certain that you have completed this question before moving on to the next question.**

RISK ACCEPTABILITY **R3 (1)**

(2-4)

Asbestos Scenario A:

The Decision: Faced with the issue described above, the State Government made the following decision. It decided to close down the town due to its concerns about the potential health effects on residents associated with continued exposure to asbestos as a result of the former mining activities in the area. This decision was made despite opposition from the local residents.

In this section you will be asked questions about the **acceptability** of the State Government's decision to close down the town.

(5-6)

Q.10 How acceptable **to you** is the decision portrayed in **Asbestos Scenario A**? Circle the appropriate category on the scale below.

Very Acceptable 1 2 3 4 5 6 7 Very Unacceptable

Q.11 How acceptable do you believe **society** in general would find the decision described in **Asbestos Scenario A**? Circle the appropriate category on the scale below.

Very Acceptable 1 2 3 4 5 6 7 Very Unacceptable

NOTE: In the next exercise we want to know what role, if any, the 14 risk characteristics listed below played in determining **your opinion** as to the acceptability of the decision described in **Asbestos Scenario A**.

Carefully read the instructions on the following page before completing the exercise.

RANKING AND WEIGHTING CHARACTERISTICS

In the following section you will be presented with a list of 14 risk characteristics (e.g. volition) and be asked to indicate how important each of these characteristics was in determining ***your opinion*** as to how acceptable or unacceptable is the decision portrayed in the scenario (see Page 24).

This will be done in two ways - by "ranking" the characteristics and by giving them "importance weights". The steps for ranking and weighting the characteristics are presented below and must be followed in the order presented.

Step 1:
In the column labelled "**RANK**", please rank the characteristics from 1 to 14 in the order of their importance. The most important characteristic *to you* in determining the acceptability/unacceptability of the decision portrayed in the scenario should be ranked as #1. The least important characteristic should be ranked as #14. Ties are acceptable.

Step 2:
Having ranked the 14 characteristics, please move to the far right hand column, labelled "**IMPORTANCE WEIGHT**". In this column we would like you to indicate how important each characteristic is in comparison to the other characteristics. For example, you might believe that a particular characteristic (eg. "dread of risk") is twice as important as another characteristic (eg. "personal control") or vice versa.

Please assign weights to each characteristic in the following manner:

A. Place a zero (0) by any characteristics which in *your opinion* played no role in determining the acceptability of the decision portrayed in the scenario. In other words, if a characteristic was not important to you then give it a zero (0).

B. Of the remaining characteristics (i.e. those not given a zero value), identify the one that is least important and give it a value of 10. You may decide that you want to give more than one characteristic a value of 10.

C. Having completed Step 2B, consider the remaining characteristics. Please indicate how important each of these characteristics is relative to the characteristic(s) which you gave a value of 10 to in the previous step. For example if you feel that a particular characteristic is twice as important as a characteristic given a value of 10 it should be given a value of 20 (i.e. 2X10). Similarly if the characteristic is 50 times as important it should receive a score of 500 (i.e. 50X10).

Repeat this step for each of the remaining characteristics.

AN EXAMPLE IS PROVIDED ON THE NEXT PAGE

EXAMPLE CASE: Purchasing a Car

*The task described above is not an easy one, especially for those who have not done this type of evaluation before. The following is an example using a non-risk issue - in this case purchasing a car. The 4 characteristics in this example are the **price, colour, mileage** and **power** of the car.*

CHARACTERISTIC	*RANK*	*IMPORTANCE WEIGHT*
1. Colour	*4*	*0*
2. Power	*2*	*20*
3. Price	*1*	*50*
4. Mileage	*3*	*10*

*Looking at the column labelled "**Rank**", we find that in this example the car's **price** was the most important characteristic (ranked #1). The **colour** of the car was least important so it was ranked the lowest (ranked #4)*

*Shifting to the column labelled "**Importance Weight**", we find that the **colour** of the car played no role in the person's decision to purchase the car and thus received a zero importance weight.*

*Of the remaining characteristics, **mileage** was considered to be of the least importance and thus was given an importance weight of 10.*

*The remaining characteristics, **power** and **price**, were then compared with the characteristic given a value of 10 - in this example the characteristic **mileage**. The **power** of the car was considered to be two times as important as the **mileage** and thus was given an importance value of 20 (i.e. 2 X 10). By comparison the **price** of the car was deemed to be 5 times as important as the mileage. Thus the characteristic '**price**' was given an importance weight of 50.*

(7-104)

Q.13 Think about what role, if any, the 14 characteristics listed below played in determining **your opinion** as to the acceptability/unacceptability of the decision in **Asbestos Scenario A**. Reread the scenario and following the steps described above, provide rankings and importance weights for the characteristics listed.

CHARACTERISTIC	A. RANK	B. IMPORTANCE WEIGHT
1. Volition	_____	_____
2. Dread of risk	_____	_____
3. Trust in Institutions	_____	_____
4. Expert Knowledge	_____	_____
5. Equity	_____	_____
6. Society's Knowledge	_____	_____
7. Severity of Consequences	_____	_____
8. Number of People Exposed	_____	_____
9. Institutional Control	_____	_____
10. Personal Control	_____	_____
11. Benefit to Society	_____	_____
12. Benefit to Affected Individual	_____	_____
13. Likelihood of Occurrence	_____	_____
14. Riskiness of the decision	_____	_____

(105-112)

Q.14 Are there any other characteristics or considerations which played an important role in determining your opinion but which were not listed? If yes, what are those characteristics or considerations:

Asbestos Scenario B:

The Issue: The Education Department is faced with requests from concerned parents to remove asbestos from the roofs of schools. The parents are concerned that the health of their children may be impacted by the asbestos in the roofs of the schools. However the evidence from risk experts is that there is a greater health risk created for the workers who would remove the asbestos than that faced by students and teachers if the asbestos was left undisturbed.

R4 (1)
(2-4)
(5-8)

RISK CHARACTERISTICS

Q.15 As for the previous scenario, listed below are a number of risk characteristics which are sometimes used to describe risks or hazards. Using the scales provided, please rate the degree to which each characteristic describes the risk or hazard described in **Asbestos Scenario B**. For each characteristic, please **circle** the most appropriate number on the scale.

A. Volition
Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk
Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution
Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge
Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity **(9-16)**

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed

Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control

Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control

Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society

Refers to the amount of benefit to society resulting from the risk.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

L. Benefit to individual

Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

(17-20)

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the hazard described in the scenario.

Not risky	1	2	3	4	5	6	7	Extremely risky

NOTE: **Please be certain that you have completed this question before moving on to the next question.**

RISK ACCEPTABILITY

***Asbestos Scenario B*:**

The Decision: Faced with the issue described above, the Education Department made the following decision. It decided to remove the asbestos from the school roofs despite the risks to the workers who would remove the materials.

In this section you will be asked questions about the acceptability of the Education Department's decision to remove asbestos from the school roofs.

Q.16 How acceptable **to you** is the decision portrayed in **Asbestos Scenario B**? Circle the appropriate category on the scale below.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

Q.17 How acceptable do you believe **society** in general would find the decision described in **Asbestos Scenario B**? Circle the appropriate category on the scale below.

Very Acceptable	1	2	3	4	5	6	7	Very Unacceptable

(21-126)

Q.18 Similar to the previous scenario, in this exercise we want to know what role, if any, the 14 risk characteristics listed below played in determining **<u>your opinion</u>** as to the acceptability/unacceptability of the decision described in **Asbestos Scenario B**.

Following the same steps as for the previous scenario, please rank and provide an importance weight for each of the characteristics. You may want to reread the steps described on **Page 22** before proceeding.

CHARACTERISTIC	A. RANK	B. IMPORTANCE WEIGHT
1. Volition	_____	_____
2. Dread of risk	_____	_____
3. Trust in Institutions	_____	_____
4. Expert Knowledge	_____	_____
5. Equity	_____	_____
6. Society's Knowledge	_____	_____
7. Severity of Consequences	_____	_____
8. Number of People Exposed	_____	_____
9. Institutional Control	_____	_____
10. Personal Control	_____	_____
11. Benefit to Society	_____	_____
12. Benefit to Affected Individual	_____	_____
13. Likelihood of Occurrence	_____	_____
14. Riskiness of the decision	_____	_____

Q.19 Are there any other characteristics or considerations which played an important role in determining the acceptability of the decision in your opinion but which were not listed above. If yes, what are those characteristics or considerations:

____

____

____

Risk Issue 2: TOXIC WASTE INCINERATION

Background

Sanitary landfills and incineration are the most common methods of disposing of solid waste. Although landfill is the cheapest means, there are some wastes, such as hospital (biomedical) wastes and PCBs, which due to their toxic nature need to be incinerated prior to disposal of any residue to a landfill. Toxic or hazardous wastes are wastes that pose a potential hazard to humans or other living organisms due to characteristics such as being nondegradable or being potentially lethal. Incinerators burn these waste materials at very high temperatures to produce non-toxic substances which can then be disposed to a landfill. With improvements in technology, incinerators have become increasingly effective in neutralising toxic materials.

State environmental protection agencies are typically responsible for specifying air quality standards for hazardous or toxic substances. These standards are in the form of concentration levels that are believed by the authorities and risk experts to be low enough to protect public health. Source emission standards (i.e. emissions from specific facilities) are usually specified through licences to limit the discharge of pollutants into the air.

Toxic Waste Incineration
Scenario A:

The Issue: A private waste management firm hires a team of specialist consultants to carry out an environmental impact study (EIS) to select the best site for a new toxic waste incinerator. The site recommended by the consultants and chosen by the company is in a rural agricultural area selected to avoid major population centres. The company indicates that all government emission standards will be met by the incinerator. However local residents and farmers oppose the proposal due to their concerns about the possible long term effects of emissions on human health and agricultural production in the area. The Environmental Protection Agency must decide whether or not to approve the establishment of the incinerator on the proposed site.

RISK CHARACTERISTICS *R5 (1)*

(2-4)

Q.20 As in Part A, listed below are a number of risk characteristics which are sometimes used to describe risks or hazards. Using the scales provided, please rate the degree to which each characteristic describes the risk or hazard described in this scenario. For each characteristic, please **circle** the most appropriate number on the scale.

(5-10)

A. Volition

Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk

Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution

Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

(11-18)

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed

Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control

Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control

Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

K. Benefit to society

Refers to the amount of benefit to society resulting from the risk.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

L. Benefit to individual

Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

M. Likelihood of occurrence

Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk

Refers to the overall riskiness of the hazard described in the scenario.

Not risky	1	2	3	4	5	6	7	Extremely risky

NOTE: **Please be certain that you have completed this question before moving on to the next question.**

RISK ACCEPTABILITY

Toxic Waste Incineration
Scenario A:

The Decision: The Environmental Protection Agency approves the construction of the incinerator stating that based on the environmental impact study (EIS) the facility should be able to meet all emission standards and its operation will be monitored.

In this section you will be asked questions about the **acceptability** of the Environmental Protection Agency's decision to approve the establishment of the incinerator at the proposed site.

(19-20)

Q.21 How acceptable **to you** is the decision portrayed in **Incineration Scenario A**? Circle the appropriate category on the scale below.

Very Acceptable 1 2 3 4 5 6 7 Very Unacceptable

Q.22 How acceptable do you believe **society** in general would find the decision described in **Incineration Scenario A**? Circle the appropriate category on the scale below.

Very Acceptable 1 2 3 4 5 6 7 Very Unacceptable

Q.23 Similar to the previous scenario, in this exercise we want to know what role, if any, the 14 risk characteristics listed below played in determining **your opinion** as to the acceptability/unacceptability of the decision described in **Incineration Scenario A.**

Following the same steps as for the previous scenarios, please rank and provide an importance weight for each of the characteristics. Again you may want to review the steps described on **Page 22.** **(21-126)**

CHARACTERISTIC	A. RANK	B. IMPORTANCE WEIGHT
1. Volition	_____	_____
2. Dread of risk	_____	_____
3. Trust in Institutions	_____	_____
4. Expert Knowledge	_____	_____
5. Equity	_____	_____
6. Society's Knowledge	_____	_____
7. Severity of Consequences	_____	_____
8. Number of People Exposed	_____	_____
9. Institutional Control	_____	_____
10. Personal Control	_____	_____
11. Benefit to Society	_____	_____
12. Benefit to Affected Individual	_____	_____
13. Likelihood of Occurrence	_____	_____
14. Riskiness of the decision	_____	_____

Q.24 Are there any other characteristics or considerations which played an important role in determining the acceptability of the decision in your opinion but which were not listed above? If yes, what are those characteristics or considerations:

____

____

____

Toxic Waste Incineration
Scenario B:

The Issue: The continued 20 year operation of a waste incinerator is opposed by local residents. The incinerator is currently burning biomedical (ie. hospital) waste and in years past was used to incinerate PCBs. The local residents want the government to shut down the incinerator permanently due to health concerns about air emissions and the facility's proximity to a residential area (ie. less than 500 metres). The company contends that the incinerator is already safe even though it does not fully meet all the latest emission standards and is using older technology. However it proposes to upgrade its technology on the site so that the incinerator will become 99.9% effective in neutralising toxic materials and meet all emission standards.

The Environmental Protection Authority must decide whether or not to allow the incinerator to remain in operation by approving the company's proposal to upgrade its incineration technology so as to meet the latest emission standards.

R6 (1)
(2-4)
(5-7)

RISK CHARACTERISTICS

Q.25 As in Part A, listed below are a number of risk characteristics which are sometimes used to describe risks or hazards. Using the scales provided, please rate the degree to which each characteristic describes the risk or hazard described in this scenario. For each characteristic, please **circle** the most appropriate number on the scale.

A. Volition
Refers to the degree to which people face the risk voluntarily (i.e. by their own choice).

Risk is assumed voluntarily	1	2	3	4	5	6	7	Risk is assumed involuntarily

B. Dread of risk
Refers to how much people dread a risk or its consequences.

People do not dread this risk	1	2	3	4	5	6	7	People greatly dread this risk

C. Trust in institution
Refers to what degree people trust the institution(s) responsible for managing the risk (e.g. government, medical profession, industry, etc).

High level of trust in institution	1	2	3	4	5	6	7	Low level of trust in institution

(8-14)

D. Expert knowledge

Refers to how much the experts know about the risks that may be associated with a particular activity.

Experts understand the risks well	1	2	3	4	5	6	7	Experts have little understanding of the risks

E. Equity

Refers to the distribution of risks and benefits. For some activities the risks and benefits are evenly distributed: everyone who benefits also assumes their share of the risks. For other activities the risks and benefits are not evenly distributed.

Risk and benefits distributed equally	1	2	3	4	5	6	7	Risks and benefits distributed unequally

F. Society's knowledge

Refers to how much those exposed know about the risks that may be associated with a particular activity.

Those exposed know much about the risks	1	2	3	4	5	6	7	Those exposed know little about the risks

G. Severity of consequences

If a mishap or illness results from this activity how severe (e.g. nonfatal, fatal) will be the consequence.

Consequences would not be severe	1	2	3	4	5	6	7	Consequences would be severe.

H. Number of people exposed

Refers to how many people are exposed to the risk.

Very few	1	2	3	4	5	6	7	Many

I. Institutional Control

Refers to the degree to which the risk managing institution can control the occurrence of an accident or undesired outcome and take steps to lessen its impact.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

J. Personal control

Refers to the degree to which those potentially exposed to a risk can take steps to lessen or eliminate the risk to themselves from the activity.

High level of control possible	1	2	3	4	5	6	7	Low level of control possible

(15-18)

K. Benefit to society
Refers to the amount of benefit to society resulting from the risk.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

L. Benefit to individual
Refers to the amount of benefit to the individual affected.

Large amount of benefit	1	2	3	4	5	6	7	No benefit

M. Likelihood of occurrence
Refers to the likelihood that the undesired outcome would occur

Highly unlikely	1	2	3	4	5	6	7	Highly likely

N. Overall level of risk
Refers to the overall riskiness of the hazard described in the scenario.

Not risky	1	2	3	4	5	6	7	Extremely risky

NOTE: **Please be certain that you have completed this question before moving on to the next question.**

RISK ACCEPTABILITY

<u>***Toxic Waste Incineration***</u>
<u>***Scenario B***</u>

<u>***The Decision:***</u> After meetings with local community groups and company officials, the Environmental Protection Agency decides to allow the incinerator to remain in operation at its present site provided its technology is upgraded. The company is given 2 years to upgrade its technology so as to meet today's air emission standards.

In this section you will be asked questions about the acceptability of the Environmental Protection Agency's decision to allow the incinerator to remain open and be ugraded.

(19-20)

Q.26 How acceptable **to you** is the decision portrayed in **Incineration Scenario B**? Circle the appropriate category on the scale below.

Very Acceptable 1 2 3 4 5 6 7 Very Unacceptable

Q.27 How acceptable do you believe **society** in general would find the decision described in **Incineration Scenario B**? Circle the appropriate category on the scale below.

Very Acceptable 1 2 3 4 5 6 7 Very Unacceptable

Q.28 Similar to the previous scenario, in this exercise we want to know what role, if any, the 14 risk characteristics listed below played in determining **your opinion** as to the acceptability/unacceptability of the decision described in **Incineration Scenario B**.

Following the same steps as for the previous scenarios, please rank and provide an importance weight for each of the characteristics. The steps are described on **Page 22**.

(21-126)

CHARACTERISTIC	A. RANK	B. IMPORTANCE WEIGHT
1. Volition	_____	_____
2. Dread of risk	_____	_____
3. Trust in Institutions	_____	_____
4. Expert Knowledge	_____	_____
5. Equity	_____	_____
6. Society's Knowledge	_____	_____
7. Severity of Consequences	_____	_____
8. Number of People Exposed	_____	_____
9. Institutional Control	_____	_____
10. Personal Control	_____	_____
11. Benefit to Society	_____	_____
12. Benefit to Affected Individual	_____	_____
13. Likelihood of Occurrence	_____	_____
14. Riskiness of the decision	_____	_____

Q.29 Are there any other characteristics or considerations which played an important role in determining the acceptability of the decision in your opinion but which were not listed above? If yes, what are those characteristics or considerations:

____

____

____

R7 (1)
(2-4)
(5-7)

DEMOGRAPHICS

Q.30 To assist in our analysis we would like to know how old you are.

______ years of age.

Q.31 Please note your gender by circling the appropriate category.

FEMALE .... 1 MALE 2

THANK YOU FOR YOUR ASSISTANCE WITH THIS RESEARCH PROJECT. IT IS MOST APPRECIATED.

JO ANN BECKWITH

APPENDIX B

TESTS OF UNIVARIATE AND MULTIVARIATE NORMALITY

Tests of Univariate and Multivariate Normality

Windows PRELIS 2.03 (Joreskog & Sorbom 1992) was used to examine the univariate and multivariate normality of the survey data. This appendix contains the univariate summary statistics for the survey variables as well as the univariate and multivariate tests of normality.

Key to Variables

A. Volition
B. Dread of risk
C. Trust in institution
D. Expert knowledge
E. Equity
F. Society's knowledge
G. Severity of consequences
H. Number of people exposed
I. Institutional control
J. Personal control
K. Benefit to society
L. Benefit to individual
M. Likelihood of occurrence
N. Overall level of risk
O. Individual acceptability of risk
P. Societal acceptance of risk

Generic Hazard Domain: Asbestos

LISTWISE DELETION
TOTAL EFFECTIVE SAMPLE SIZE = 110

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q1A	4.691	1.728	-0.400	-1.004	1.000	3	7.000	17
Q1B	5.045	1.455	-0.572	-0.458	1.000	1	7.000	17
Q1C	4.082	1.649	-0.171	-1.110	1.000	5	7.000	5
Q1D	2.764	1.374	0.912	0.621	1.000	18	7.000	2
Q1E	5.182	1.363	-0.602	-0.307	2.000	6	7.000	18
Q1F	4.382	1.459	-0.042	-1.023	2.000	13	7.000	7
Q1G	6.055	1.305	-2.221	5.482	1.000	3	7.000	50
Q1H	4.264	1.674	-0.117	-0.855	1.000	6	7.000	11
Q1I	3.064	1.534	0.730	-0.421	1.000	12	7.000	2
Q1J	3.391	1.637	0.549	-0.573	1.000	11	7.000	5
Q1K	5.082	1.533	-0.529	-0.575	1.000	2	7.000	22
Q1L	5.518	1.451	-0.799	-0.139	1.000	1	7.000	36
Q1M	4.673	1.293	-0.533	-0.469	2.000	9	7.000	4
Q1N	5.364	1.217	-1.231	1.826	1.000	1	7.000	14
Q1O	5.582	1.295	-0.803	-0.175	2.000	2	7.000	30
Q1P	5.173	1.439	-0.459	-0.940	2.000	3	7.000	21

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q1A	-1.728	0.042	-3.865	0.000	17.926	0.000
Q1B	-2.470	0.007	-0.979	0.164	7.058	0.029
Q1C	-0.737	0.231	-4.843	0.000	23.995	0.000
Q1D	3.942	0.000	1.434	0.076	17.593	0.000
Q1E	-2.602	0.005	-0.490	0.312	7.010	0.030
Q1F	-0.180	0.429	-4.022	0.000	16.210	0.000
Q1G	-9.594	0.000	4.585	0.000	113.078	0.000
Q1H	-0.504	0.307	-2.811	0.002	8.155	0.017
Q1I	3.152	0.001	-0.854	0.197	10.667	0.005
Q1J	2.371	0.009	-1.411	0.079	7.613	0.022
Q1K	-2.284	0.011	-1.421	0.078	7.237	0.027
Q1L	-3.450	0.000	-0.026	0.490	11.901	0.003
Q1M	-2.302	0.011	-1.018	0.154	6.335	0.042
Q1N	-5.316	0.000	2.752	0.003	35.839	0.000
Q1O	-3.471	0.000	-0.119	0.453	12.060	0.002
Q1P	-1.985	0.024	-3.375	0.000	15.328	0.000

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
24.074	0.000	2.867	0.002	587.756	0.000

Generic Hazard Domain: Surfing

LISTWISE DELETION

TOTAL EFFECTIVE SAMPLE SIZE = 108

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q2A	1.296	0.846	4.207	20.938	1.000	89	7.000	1
Q2B	2.185	1.086	1.048	0.914	1.000	30	6.000	1
Q2C	3.972	1.688	0.056	-0.861	1.000	8	7.000	8
Q2D	2.556	1.410	1.077	0.598	1.000	24	7.000	1
Q2E	3.194	1.857	0.397	-0.943	1.000	28	7.000	6
Q2F	2.519	1.329	1.018	0.818	1.000	25	7.000	1
Q2G	4.713	1.374	-0.236	-0.727	2.000	7	7.000	10
Q2H	4.352	1.871	-0.169	-1.140	1.000	8	7.000	17
Q2I	5.602	1.440	-1.088	0.158	2.000	5	7.000	32
Q2J	2.704	1.665	0.905	-0.206	1.000	31	7.000	2
Q2K	4.954	1.790	-0.497	-0.846	1.000	4	7.000	29
Q2L	2.306	1.315	1.477	2.338	1.000	30	7.000	2
Q2M	3.472	1.322	0.210	-0.096	1.000	7	7.000	2
Q2N	4.148	1.359	-0.251	-0.393	1.000	3	7.000	4
Q2O	2.833	1.371	0.706	0.043	1.000	17	7.000	1
Q2P	2.713	1.326	0.546	-0.392	1.000	21	6.000	4

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q2A	18.011	0.000	6.699	0.000	369.276	0.000
Q2B	4.487	0.000	1.820	0.034	23.448	0.000
Q2C	0.241	0.405	-2.811	0.002	7.962	0.019
Q2D	4.613	0.000	1.392	0.082	23.216	0.000
Q2E	1.700	0.045	-3.353	0.000	14.132	0.001
Q2F	4.360	0.000	1.698	0.045	21.894	0.000
Q2G	-1.012	0.156	-2.078	0.019	5.343	0.069
Q2H	-0.723	0.235	-5.104	0.000	26.575	0.000
Q2I	-4.658	0.000	0.643	0.260	22.108	0.000
Q2J	3.874	0.000	-0.197	0.422	15.047	0.001
Q2K	-2.129	0.017	-2.725	0.003	11.956	0.003
Q2L	6.324	0.000	3.121	0.001	49.728	0.000
Q2M	0.897	0.185	0.084	0.467	0.812	0.666
Q2N	-1.075	0.141	-0.747	0.228	1.713	0.425
Q2O	3.024	0.001	0.404	0.343	9.310	0.010
Q2P	2.336	0.010	-0.743	0.229	6.007	0.050

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
29.401	0.000	5.583	0.000	895.568	0.000

Generic Hazard Domain: Bush Fires

LISTWISE DELETION

TOTAL EFFECTIVE SAMPLE SIZE = 108

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q3A	5.463	1.677	-0.971	-0.174	1.000	2	7.000	39
Q3B	6.000	1.160	-1.610	2.677	2.000	3	7.000	42
Q3C	2.852	1.552	0.818	-0.237	1.000	20	7.000	1
Q3D	2.028	1.219	2.219	5.903	1.000	38	7.000	2
Q3E	5.306	1.785	-0.895	-0.196	1.000	6	7.000	38
Q3F	2.815	1.607	0.900	-0.222	1.000	21	7.000	2
Q3G	6.176	1.084	-1.750	3.094	2.000	1	7.000	52
Q3H	4.676	1.588	-0.407	-0.665	1.000	3	7.000	13
Q3I	4.000	1.834	0.111	-1.243	1.000	7	7.000	11
Q3J	3.704	1.709	0.234	-1.107	1.000	8	7.000	5
Q3K	6.222	1.187	-1.913	3.875	1.000	1	7.000	62
Q3L	6.269	1.344	-2.295	4.872	1.000	2	7.000	70
Q3M	4.861	1.370	-0.322	-0.539	1.000	1	7.000	12
Q3N	6.056	1.183	-1.629	2.930	1.000	1	7.000	49
Q3O	5.500	1.626	-0.890	-0.222	1.000	2	7.000	42
Q3P	5.528	1.638	-0.870	-0.452	1.000	1	7.000	44

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q3A	-4.155	0.000	-0.112	0.455	17.280	0.000
Q3B	-6.894	0.000	3.340	0.000	58.677	0.000
Q3C	3.501	0.000	-0.281	0.390	12.336	0.002
Q3D	9.499	0.000	4.686	0.000	112.200	0.000
Q3E	-3.832	0.000	-0.169	0.433	14.714	0.001
Q3F	3.853	0.000	-0.241	0.405	14.905	0.001
Q3G	-7.493	0.000	3.580	0.000	68.960	0.000
Q3H	-1.744	0.041	-1.784	0.037	6.226	0.044
Q3I	0.476	0.317	-6.439	0.000	41.691	0.000
Q3J	1.001	0.158	-4.750	0.000	23.561	0.000
Q3K	-8.189	0.000	3.962	0.000	82.757	0.000
Q3L	-9.824	0.000	4.356	0.000	115.489	0.000
Q3M	-1.378	0.084	-1.260	0.104	3.488	0.175
Q3N	-6.973	0.000	3.489	0.000	60.798	0.000
Q3O	-3.810	0.000	-0.238	0.406	14.574	0.001
Q3P	-3.725	0.000	-0.944	0.173	14.764	0.001

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
32.272	0.000	8.213	0.000	1108.964	0.000

Generic Hazard Domain: Toxic Waste Incineration

LISTWISE DELETION

TOTAL EFFECTIVE SAMPLE SIZE = 109

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q4A	5.541	1.625	-1.019	0.035	1.000	2	7.000	42
Q4B	5.532	1.636	-1.034	-0.088	1.000	1	7.000	40
Q4C	4.413	2.096	-0.232	-1.472	1.000	10	7.000	22
Q4D	3.229	1.824	0.613	-0.766	1.000	19	7.000	7
Q4E	5.844	1.409	-1.398	1.671	1.000	2	7.000	48
Q4F	4.688	1.643	-0.455	-0.817	1.000	3	7.000	13
Q4G	6.046	1.182	-1.943	4.897	1.000	2	7.000	46
Q4H	4.569	1.781	-0.325	-0.900	1.000	6	7.000	19
Q4I	2.963	1.748	0.683	-0.545	1.000	28	7.000	4
Q4J	4.945	1.865	-0.677	-0.797	1.000	6	7.000	25
Q4K	5.339	1.770	-0.826	-0.314	1.000	4	8.000	1
Q4L	5.743	1.674	-1.175	0.313	1.000	3	7.000	58
Q4M	4.596	1.454	-0.351	-0.414	1.000	2	7.000	10
Q4N	5.798	1.215	-1.337	2.299	1.000	1	7.000	36
Q4O	5.780	1.589	-1.478	1.485	1.000	4	7.000	50
Q4P	5.633	1.538	-1.089	0.355	1.000	1	7.000	44

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q4A	-4.382	0.000	0.385	0.350	19.348	0.000
Q4B	-4.445	0.000	0.101	0.460	19.768	0.000
Q4C	-0.997	0.159	-12.815	0.000	165.225	0.000
Q4D	2.638	0.004	-2.289	0.011	12.197	0.002
Q4E	-6.011	0.000	2.613	0.004	42.955	0.000
Q4F	-1.959	0.025	-2.569	0.005	10.435	0.005
Q4G	-8.356	0.000	4.377	0.000	88.982	0.000
Q4H	-1.399	0.081	-3.076	0.001	11.417	0.003
Q4I	2.936	0.002	-1.292	0.098	10.290	0.006
Q4J	-2.914	0.002	-2.456	0.007	14.523	0.001
Q4K	-3.553	0.000	-0.507	0.306	12.884	0.002
Q4L	-5.053	0.000	0.933	0.175	26.404	0.000
Q4M	-1.511	0.065	-0.822	0.206	2.958	0.228
Q4N	-5.749	0.000	3.102	0.001	42.676	0.000
Q4O	-6.356	0.000	2.443	0.007	46.368	0.000
Q4P	-4.682	0.000	1.007	0.157	22.936	0.000

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
29.848	0.000	6.705	0.000	935.844	0.000

Generic Hazard Domain: Dams

LISTWISE DELETION
TOTAL EFFECTIVE SAMPLE SIZE = 109

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q5A	3.697	2.025	0.205	-1.320	1.000	19	7.000	11
Q5B	2.798	1.654	0.704	-0.497	1.000	30	7.000	2
Q5C	2.523	1.531	1.099	0.653	1.000	32	7.000	3
Q5D	2.294	1.279	1.108	1.037	1.000	34	7.000	1
Q5E	3.807	2.002	0.009	-1.151	1.000	23	7.000	13
Q5F	3.642	1.642	0.274	-1.027	1.000	7	7.000	4
Q5G	4.853	1.621	-0.635	-0.161	1.000	5	7.000	19
Q5H	3.826	2.027	0.079	-1.319	1.000	18	7.000	13
Q5I	2.771	1.757	0.995	0.018	1.000	30	7.000	6
Q5J	4.165	2.141	-0.213	-1.457	1.000	18	7.000	16
Q5K	2.128	1.348	1.426	1.966	1.000	46	7.000	2
Q5L	2.495	1.549	0.998	0.385	1.000	38	7.000	3
Q5M	2.780	1.606	0.954	0.044	1.000	23	7.000	3
Q5N	2.908	1.506	0.523	-0.587	1.000	22	7.000	1
Q5O	2.761	1.666	0.730	-0.425	1.000	32	7.000	3
Q5P	2.615	1.683	0.867	-0.203	1.000	39	7.000	3

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q5A	0.881	0.189	-7.887	0.000	62.988	0.000
Q5B	3.027	0.001	-1.113	0.133	10.405	0.006
Q5C	4.726	0.000	1.477	0.070	24.517	0.000
Q5D	4.767	0.000	1.973	0.024	26.612	0.000
Q5E	0.041	0.484	-5.267	0.000	27.738	0.000
Q5F	1.177	0.120	-4.031	0.000	17.636	0.000
Q5G	-2.733	0.003	-0.081	0.468	7.475	0.024
Q5H	0.339	0.367	-7.861	0.000	61.914	0.000
Q5I	4.278	0.000	0.348	0.364	18.422	0.000
Q5J	-0.917	0.180	-12.098	0.000	147.197	0.000
Q5K	6.133	0.000	2.857	0.002	45.771	0.000
Q5L	4.292	0.000	1.058	0.145	19.538	0.000
Q5M	4.103	0.000	0.405	0.343	16.995	0.000
Q5N	2.249	0.012	-1.461	0.072	7.193	0.027
Q5O	3.140	0.001	-0.860	0.195	10.600	0.005
Q5P	3.727	0.000	-0.193	0.424	13.926	0.001

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
29.300	0.000	7.038	0.000	908.036	0.000

Generic Hazard Domain: Bicycles

LISTWISE DELETION
TOTAL EFFECTIVE SAMPLE SIZE = 110

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q6A	1.618	1.157	2.528	6.795	1.000	73	7.000	1
Q6B	2.545	1.506	1.076	0.424	1.000	29	7.000	2
Q6C	3.382	1.550	0.150	-0.895	1.000	14	7.000	1
Q6D	1.964	1.116	1.564	3.143	1.000	45	7.000	1
Q6E	3.182	2.010	0.664	-0.866	1.000	27	7.000	11
Q6F	2.309	1.254	1.353	1.721	1.000	29	6.000	5
Q6G	4.782	1.541	-0.591	-0.405	1.000	3	7.000	12
Q6H	5.464	1.657	-1.155	0.460	1.000	4	7.000	36
Q6I	3.855	1.686	0.116	-1.126	1.000	7	7.000	5
Q6J	2.064	1.251	1.768	3.790	1.000	43	7.000	2
Q6K	2.945	1.555	0.822	-0.064	1.000	18	7.000	2
Q6L	2.136	1.430	1.826	3.078	1.000	43	7.000	3
Q6M	3.655	1.309	0.217	-0.460	1.000	3	7.000	2
Q6N	3.527	1.359	0.087	-0.651	1.000	7	7.000	1
Q6O	2.445	1.385	1.075	0.318	1.000	28	6.000	5
Q6P	2.482	1.464	0.975	0.039	1.000	32	6.000	7

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q6A	10.923	0.000	4.955	0.000	143.871	0.000
Q6B	4.649	0.000	1.126	0.130	22.884	0.000
Q6C	0.648	0.258	-3.063	0.001	9.802	0.007
Q6D	6.755	0.000	3.628	0.000	58.783	0.000
Q6E	2.869	0.002	-2.879	0.002	16.518	0.000
Q6F	5.845	0.000	2.664	0.004	41.259	0.000
Q6G	-2.555	0.005	-0.797	0.213	7.162	0.028
Q6H	-4.988	0.000	1.185	0.118	26.280	0.000
Q6I	0.501	0.308	-5.014	0.000	25.393	0.000
Q6J	7.640	0.000	3.946	0.000	73.938	0.000
Q6K	3.553	0.000	0.157	0.438	12.650	0.002
Q6L	7.886	0.000	3.592	0.000	75.099	0.000
Q6M	0.939	0.174	-0.987	0.162	1.855	0.396
Q6N	0.374	0.354	-1.744	0.041	3.183	0.204
Q6O	4.643	0.000	0.943	0.173	22.446	0.000
Q6P	4.214	0.000	0.395	0.347	17.915	0.000

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
31.182	0.000	7.454	0.000	1027.860	0.000

Generic Hazard Domain: Vaccinations

LISTWISE DELETION
TOTAL EFFECTIVE SAMPLE SIZE = 110

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q7A	3.109	1.983	0.522	-1.172	1.000	32	7.000	5
Q7B	3.482	1.816	0.283	-1.070	1.000	17	7.000	6
Q7C	1.900	1.459	1.947	2.742	1.000	61	7.000	1
Q7D	1.936	1.273	2.107	4.765	1.000	49	7.000	2
Q7E	3.373	2.221	0.423	-1.344	1.000	33	7.000	15
Q7F	4.264	1.866	-0.039	-1.332	1.000	5	7.000	15
Q7G	4.873	1.563	-0.725	-0.027	1.000	5	7.000	14
Q7H	5.491	1.851	-1.254	0.339	1.000	7	7.000	43
Q7I	2.227	1.512	1.647	2.150	1.000	42	7.000	3
Q7J	3.764	2.205	0.118	-1.530	1.000	24	7.000	16
Q7K	1.673	1.408	2.549	5.560	1.000	76	7.000	2
Q7L	1.591	1.258	2.956	8.918	1.000	77	7.000	3
Q7M	2.727	1.526	0.710	-0.553	1.000	26	6.000	8
Q7N	2.645	1.338	0.817	-0.169	1.000	19	6.000	4
Q7O	2.536	1.795	1.141	0.227	1.000	43	7.000	6
Q7P	2.573	1.815	1.138	0.214	1.000	41	7.000	7

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q7A	2.254	0.012	-5.549	0.000	35.869	0.000
Q7B	1.221	0.111	-4.445	0.000	21.246	0.000
Q7C	8.412	0.000	3.399	0.000	82.320	0.000
Q7D	9.101	0.000	4.342	0.000	101.675	0.000
Q7E	1.828	0.034	-8.487	0.000	75.376	0.000
Q7F	-0.168	0.433	-8.213	0.000	67.477	0.000
Q7G	-3.132	0.001	0.246	0.403	9.869	0.007
Q7H	-5.417	0.000	0.981	0.163	30.301	0.000
Q7I	7.115	0.000	3.005	0.001	59.654	0.000
Q7J	0.509	0.305	-17.224	0.000	296.935	0.000
Q7K	11.012	0.000	4.610	0.000	142.519	0.000
Q7L	12.771	0.000	5.414	0.000	192.419	0.000
Q7M	3.066	0.001	-1.333	0.091	11.179	0.004
Q7N	3.530	0.000	-0.104	0.459	12.469	0.002
Q7O	4.929	0.000	0.776	0.219	24.899	0.000
Q7P	4.916	0.000	0.751	0.226	24.731	0.000

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
35.245	0.000	9.203	0.000	1326.884	0.000

Generic Hazard Domain: Sunbathing

LISTWISE DELETION

TOTAL EFFECTIVE SAMPLE SIZE = 110

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q8A	1.609	1.126	3.022	10.347	1.000	68	7.000	2
Q8B	3.600	1.704	0.137	-1.108	1.000	13	7.000	3
Q8C	2.991	1.437	0.583	-0.205	1.000	15	7.000	2
Q8D	1.691	1.002	1.993	4.440	1.000	60	6.000	1
Q8E	4.855	2.027	-0.701	-0.838	1.000	12	7.000	28
Q8F	2.618	1.440	0.886	0.092	1.000	26	7.000	1
Q8G	5.500	1.247	-1.055	1.258	1.000	1	7.000	23
Q8H	6.164	1.238	-2.179	5.285	1.000	2	7.000	57
Q8I	5.091	1.706	-0.687	-0.698	1.000	3	7.000	25
Q8J	1.518	1.002	2.540	6.371	1.000	75	6.000	1
Q8K	5.900	1.433	-1.764	3.037	1.000	4	7.000	48
Q8L	4.855	1.929	-0.594	-0.845	1.000	9	7.000	28
Q8M	5.145	1.262	-0.670	0.236	1.000	1	7.000	13
Q8N	5.345	1.252	-1.027	0.714	2.000	5	7.000	15
Q8O	4.773	1.749	-0.494	-0.741	1.000	5	7.000	21
Q8P	4.336	1.682	-0.111	-0.958	1.000	4	7.000	13

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q8A	13.054	0.000	5.659	0.000	202.442	0.000
Q8B	0.594	0.276	-4.822	0.000	23.607	0.000
Q8C	2.520	0.006	-0.199	0.421	6.391	0.041
Q8D	8.612	0.000	4.220	0.000	91.974	0.000
Q8E	-3.028	0.001	-2.707	0.003	16.497	0.000
Q8F	3.827	0.000	0.508	0.306	14.903	0.001
Q8G	-4.559	0.000	2.224	0.013	25.729	0.000
Q8H	-9.414	0.000	4.522	0.000	109.079	0.000
Q8I	-2.966	0.002	-1.963	0.025	12.652	0.002
Q8J	10.972	0.000	4.845	0.000	143.850	0.000
Q8K	-7.620	0.000	3.570	0.000	70.807	0.000
Q8L	-2.567	0.005	-2.747	0.003	14.140	0.001
Q8M	-2.893	0.002	0.793	0.214	8.997	0.011
Q8N	-4.435	0.000	1.566	0.059	22.120	0.000
Q8O	-2.132	0.016	-2.174	0.015	9.271	0.010
Q8P	-0.479	0.316	-3.503	0.000	12.500	0.002

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
28.886	0.000	5.447	0.000	864.065	0.000

Asbestos Scenario A

LISTWISE DELETION

TOTAL EFFECTIVE SAMPLE SIZE = 227

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q9A	2.383	1.819	1.305	0.489	1.000	104	7.000	12
Q9B	3.996	1.876	-0.014	-1.178	1.000	25	7.000	23
Q9C	4.489	1.835	-0.264	-1.077	1.000	13	7.000	37
Q9D	2.520	1.678	1.070	0.258	1.000	84	7.000	8
Q9E	4.952	1.800	-0.698	-0.499	1.000	14	7.000	53
Q9F	3.308	1.933	0.576	-0.941	1.000	41	7.000	20
Q9G	6.233	1.036	-1.685	3.101	2.000	3	7.000	118
Q9H	4.670	1.978	-0.298	-1.250	1.000	13	7.000	61
Q9I	3.863	2.042	0.045	-1.323	1.000	40	7.000	28
Q9J	3.079	2.074	0.607	-1.039	1.000	75	7.000	21
Q9K	5.467	1.676	-0.970	-0.118	1.000	6	7.000	83
Q9L	5.088	1.802	-0.650	-0.730	1.000	9	7.000	66
Q9M	5.264	1.201	-0.275	-0.173	1.000	1	7.000	43
Q9N	5.780	1.142	-1.068	1.336	2.000	5	7.000	70

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q9A	3.417	0.000	1.506	0.066	13.946	0.001
Q9B	-0.143	0.443	-9.573	0.000	91.658	0.000
Q9C	-1.773	0.038	-7.407	0.000	58.014	0.000
Q9D	3.210	0.001	0.961	0.168	11.224	0.004
Q9E	-2.764	0.003	-1.839	0.033	11.022	0.004
Q9F	2.564	0.005	-5.406	0.000	35.803	0.000
Q9G	-3.686	0.000	4.649	0.000	35.194	0.000
Q9H	-1.892	0.029	-11.842	0.000	143.806	0.000
Q9I	0.453	0.325	-15.339	0.000	235.499	0.000
Q9J	2.619	0.004	-6.766	0.000	52.635	0.000
Q9K	-3.107	0.001	-0.171	0.432	9.681	0.008
Q9L	-2.689	0.004	-3.351	0.000	18.459	0.000
Q9M	-1.813	0.035	-0.371	0.355	3.423	0.181
Q9N	-3.207	0.001	2.945	0.002	18.959	0.000

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
24.426	0.000	6.496	0.000	638.843	0.000

Asbestos Scenario B

LISTWISE DELETION
TOTAL EFFECTIVE SAMPLE SIZE = 212

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q15A	5.340	1.711	-1.033	0.110	1.000	9	7.000	64
Q15B	5.759	1.405	-1.395	1.700	1.000	4	7.000	79
Q15C	4.896	1.672	-0.633	-0.556	1.000	7	7.000	36
Q15D	2.670	1.538	1.034	0.393	1.000	49	7.000	5
Q15E	5.241	1.449	-0.616	-0.035	1.000	4	7.000	51
Q15F	3.981	1.779	0.069	-1.128	1.000	15	7.000	18
Q15G	5.788	1.390	-1.443	1.880	1.000	3	7.000	81
Q15H	5.557	1.558	-0.918	-0.036	1.000	3	7.000	83
Q15I	3.113	1.724	0.635	-0.589	1.000	39	7.000	9
Q15J	4.656	1.862	-0.465	-0.999	1.000	13	7.000	37
Q15K	5.189	1.785	-0.787	-0.447	1.000	10	7.000	65
Q15L	5.274	1.875	-0.921	-0.370	1.000	12	7.000	75
Q15M	4.401	1.532	-0.170	-0.565	1.000	7	7.000	20
Q15N	5.033	1.478	-0.707	0.049	1.000	5	7.000	34

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q15A	-3.130	0.001	0.557	0.289	10.105	0.006
Q15B	-3.441	0.000	3.311	0.000	22.802	0.000
Q15C	-2.623	0.004	-2.078	0.019	11.200	0.004
Q15D	3.130	0.001	1.264	0.103	11.398	0.003
Q15E	-2.596	0.005	0.124	0.451	6.753	0.034
Q15F	0.660	0.255	-8.027	0.000	64.867	0.000
Q15G	-3.476	0.000	3.504	0.000	24.361	0.000
Q15H	-3.007	0.001	0.121	0.452	9.057	0.011
Q15I	2.627	0.004	-2.269	0.012	12.049	0.002
Q15J	-2.308	0.010	-5.899	0.000	40.122	0.000
Q15K	-2.848	0.002	-1.498	0.067	10.354	0.006
Q15L	-3.010	0.001	-1.137	0.128	10.353	0.006
Q15M	-1.333	0.091	-2.129	0.017	6.311	0.043
Q15N	-2.737	0.003	0.381	0.351	7.635	0.022

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
26.897	0.000	8.439	0.000	794.635	0.000

Toxic Waste Incineration Scenario A

LISTWISE DELETION
TOTAL EFFECTIVE SAMPLE SIZE = 222

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q20A	5.847	1.526	-1.465	1.467	1.000	6	7.000	106
Q20B	5.779	1.456	-1.476	1.721	1.000	4	7.000	87
Q20C	5.185	1.733	-0.878	-0.253	1.000	9	7.000	58
Q20D	3.568	1.621	0.293	-0.688	1.000	22	7.000	11
Q20E	5.360	1.530	-0.823	0.000	1.000	4	7.000	63
Q20F	4.333	1.792	-0.225	-1.088	1.000	14	7.000	25
Q20G	5.396	1.393	-0.797	-0.007	1.000	2	7.000	53
Q20H	4.820	1.676	-0.306	-0.967	1.000	4	7.000	46
Q20I	3.541	1.928	0.406	-1.060	1.000	33	7.000	23
Q20J	5.518	1.491	-1.151	0.768	1.000	5	7.000	64
Q20K	4.189	1.947	0.083	-1.274	1.000	16	7.000	42
Q20L	5.514	1.605	-0.929	0.007	1.000	5	7.000	87
Q20M	4.432	1.481	-0.048	-0.658	1.000	4	7.000	21
Q20N	4.914	1.423	-0.295	-0.724	2.000	13	7.000	34

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q20A	-3.523	0.000	3.091	0.001	21.968	0.000
Q20B	-3.531	0.000	3.392	0.000	23.976	0.000
Q20C	-2.989	0.001	-0.671	0.251	9.383	0.009
Q20D	1.865	0.031	-2.990	0.001	12.420	0.002
Q20E	-2.922	0.002	0.228	0.410	8.591	0.014
Q20F	-1.609	0.054	-7.484	0.000	58.597	0.000
Q20G	-2.888	0.002	0.207	0.418	8.383	0.015
Q20H	-1.907	0.028	-5.654	0.000	35.602	0.000
Q20I	2.194	0.014	-7.002	0.000	53.837	0.000
Q20J	-3.271	0.001	2.042	0.021	14.871	0.001
Q20K	0.784	0.217	-12.592	0.000	159.174	0.000
Q20L	-3.048	0.001	0.250	0.401	9.350	0.009
Q20M	-0.482	0.315	-2.784	0.003	7.983	0.018
Q20N	-1.872	0.031	-3.261	0.001	14.137	0.001

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
25.949	0.000	8.108	0.000	739.110	0.000

Toxic Waste Incineration Scenario B

LISTWISE DELETION

TOTAL EFFECTIVE SAMPLE SIZE = 223

UNIVARIATE SUMMARY STATISTICS FOR CONTINUOUS VARIABLES

VARIABLE	MEAN	ST. DEV.	SKEWNESS	KURTOSIS	MINIMUM	FREQ.	MAXIMUM	FREQ.
Q25A	5.587	1.628	-1.084	0.082	1.000	3	7.000	88
Q25B	5.771	1.378	-1.344	1.553	1.000	3	7.000	84
Q25C	5.274	1.603	-0.891	0.037	1.000	6	7.000	59
Q25D	3.363	1.641	0.464	-0.684	1.000	24	7.000	10
Q25E	5.211	1.438	-0.613	-0.272	1.000	3	7.000	45
Q25F	4.143	1.638	-0.015	-1.004	1.000	9	7.000	16
Q25G	5.502	1.304	-0.834	0.163	2.000	8	7.000	55
Q25H	5.709	1.362	-0.969	0.152	1.000	1	7.000	82
Q25I	3.475	2.040	0.454	-1.119	1.000	43	7.000	29
Q25J	5.327	1.686	-1.038	0.200	1.000	10	7.000	64
Q25K	4.502	1.843	-0.206	-1.208	1.000	12	7.000	36
Q25L	5.498	1.588	-1.011	0.192	1.000	5	7.000	77
Q25M	4.583	1.531	-0.208	-0.602	1.000	5	7.000	28
Q25N	4.987	1.502	-0.379	-0.698	1.000	1	7.000	43

TEST OF UNIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

	SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
	Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
Q25A	-3.212	0.001	0.477	0.317	10.545	0.005
Q25B	-3.437	0.000	3.201	0.001	22.057	0.000
Q25C	-3.008	0.001	0.344	0.365	9.164	0.010
Q25D	2.332	0.010	-2.972	0.001	14.272	0.001
Q25E	-2.619	0.004	-0.749	0.227	7.422	0.024
Q25F	-0.159	0.437	-6.167	0.000	38.062	0.000
Q25G	-2.939	0.002	0.705	0.240	9.133	0.010
Q25H	-3.095	0.001	0.676	0.249	10.035	0.007
Q25I	2.309	0.010	-8.120	0.000	71.271	0.000
Q25J	-3.166	0.001	0.806	0.210	10.676	0.005
Q25K	-1.528	0.063	-10.284	0.000	108.101	0.000
Q25L	-3.139	0.001	0.785	0.216	10.467	0.005
Q25M	-1.534	0.062	-2.426	0.008	8.240	0.016
Q25N	-2.126	0.017	-3.076	0.001	13.984	0.001

TEST OF MULTIVARIATE NORMALITY FOR CONTINUOUS VARIABLES

SKEWNESS		KURTOSIS		SKEWNESS AND KURTOSIS	
Z-SCORE	P-VALUE	Z-SCORE	P-VALUE	CHI-SQUARE	P-VALUE
26.892	0.000	8.845	0.000	801.406	0.000

APPENDIX C

Demographic Considerations

Demographic Considerations

Introduction

Previous psychometric studies have resulted in mixed findings with regard to the influence of demographic considerations such as gender, age, income, race and education. Slovic (1992) and Pilisuk and Acredolo (1988) have each reported that women tend to perceive greater risks from technology than do men. Savage (1993) reported that women indicated higher levels of dread which he attributed to perceptions about personal exposure to hazards. He found that women as well as blacks, the young, those with lower incomes and education, have feelings of heightening personal exposure to risks and have more dread of them. However, Gardner and Gould (1989) found that people's perceptions of risks and acceptability were more influenced by the attributes of the hazard domains than by sociodemographic characteristics.

As discussed in Chapter 5, due to difficulties in obtaining a suitably large sample size, it was not possible to perform the types of quota sampling in this study which would allow a better examination of the effect of socio-demographic variables on risk judgements. This limitation should be kept in mind when considering the following analysis of the effect of gender and age of risk judgements.

Influence of Gender

A One-Way ANOVA procedure was used to assess the influence of gender on perceptions of the 8 hazard domains. Table C.1 provides the F statistic, significance level, and mean ratings of those characteristics which revealed significant differences at the .01 level. Of the 8 hazard domains, only two (i.e., dams and sunbathing) revealed significant differences ($p<.01$) with respect to gender.

Table C.1. *Influence of Gender on Perceptions of Hazard Domains*

Domain	Characteristic	F ratio	F significance	Mean rating	
				Female	Male
Dams	Dread	8.60	.0041	3.08	2.14
	Trust	8.66	.0040	2.81	1.92
	Likelihood	8.10	.0053	3.10	2.19
	Individual acceptance	14.81	.0002	3.18	1.94
	Societal acceptance	16.94	.0001	3.07	1.75
Sunbathing	Number of people	8.27	.0049	6.40	5.70

The domain dams demonstrated the greatest number of significant differences between male and female groups with 5 characteristics (i.e., dread, trust, likelihood of occurrence, individual acceptance and societal acceptance) displaying significant differences ($p<.01$). Female respondents viewed each of the 5 characteristics less favourably than did the male respondents. Males demonstrated a high level of trust in the risk managers, a low level of dread and low probability of an accident, as well as high levels of individual and societal acceptance of dams. With respect to sunbathing, female respondents indicated that a greater number of people would be exposed to the risks.

Of the four risk scenarios, only Asbestos Scenario B and Incineration Scenario B revealed any significant differences ($p<.01$) in the mean ratings of the various risk characteristics (Table C.2). Female respondents perceived fewer individual benefits to

Table C.2. *Influence of Gender on Perceptions of Risk Scenarios*

Scenario	Variable	F ratio*	F sig.	Mean Female rating	Mean Male rating
Asbestos B	Individual benefit	9.36	.0025	5.56	4.74
Incineration B	Number of people	8.50	.0039	5.83	5.24

* df = 2

be associated with Asbestos Scenario B and also indicated that more people would be exposed to risk with Toxic Waste Incineration Scenario B.

This analysis suggests that that gender may have some but not a major influence on risk perceptions. Relatively few of the characteristics examined in the study revealed significant differences at the .01 level. However for those characteristics which revealed differences at either the .01 or .05 levels, female respondents as a group consistently rated the characteristics less favourably than did male respondents.

Influence of Age

A One-Way ANOVA was used to determine the effect of age on risk perceptions. The Bonferroni test was the multiple comparison procedure used in this analysis to determine the significance of difference. Respondents were assigned to the following age groups: 25 years and younger, 26-35 years, 36-45 years, 46-55 years, and over 55 years.

Only Curtin University students completed the first part of the survey involving the eight hazard domains. For these domains the influence of age on risk perceptions could be tested for only three age groups since no students fell in the 55+ years category and only 3 fell in the 46-55 years category. Of the Curtin University students, 66% were 17-25 years of age with an additional 22% falling in the 26-35 years of age category.

The ANOVA test revealed significant differences ($p<.05$) for those characteristics and age groups shown in Table C.3.

Table C.3. *Influence of Age on Perceptions of Hazard Domains*

Domain	Characteristic	F ratio*	F sig.	Age Group	Mean Value	Age Group	Mean value
Asbestos	Personal Control	2.74	.0474	26-35	2.87	36-45	4.67
Surfing	Overall Riskiness	3.41	.0204	<=25	3.87	36-45	5.11
Bush Fires	Institutional Control	2.98	.0348	<=25	3.89	36-45	5.56
Bicycles	Number of People	3.36	.0216	<=25	5.69	26-35	4.57
Vaccinations	Trust	2.68	.0500	<=25	1.67	36-45	3.00
	Expert Knowledge	3.34	.0224	<=25	1.76	36-45	3.11

* df = 3

The analysis of the influence of age for the four risk scenarios included all respondents. Table C.4 displays the results of the ANOVA test (df = 5) of the four risk scenarios. Generally, for those characteristics which differed by age group, the youngest age group (i.e., <=25 years) was more positive in its perceptions and the oldest groups (i.e., over 45 years) were the most negative. There was no obvious pattern regarding which characteristics would reveal differences based on age. This may be due to the relatively small number of risks examined in this study.

Table C.4. *Influence of Age on Perceptions of Risk Scenarios*

Risk Scenario	Variable	F ratio	F sig.	Age Group	Mean Value	Age Group	Mean value
Asbestos Scenario A	Volition	13.59	.0000*	55+	4.44	<=25	1.83
				55+	4.44	26-35	2.33
				55+	4.44	36-45	2.18
				46-55	4.50	<=25	1.83
				46-55	4.50	26-35	2.33
				46-55	4.50	36-45	2.18
	Expert Knowledge	6.60	.0001*	<=25	1.90	26-35	2.88
				<=25	1.90	46-55	3.27
	Society's Knowledge	7.78	.0000*	46-55	5.07	<=25	2.74
				46-55	5.07	26-35	3.42
				46-55	5.07	36-45	2.86
	Number of People	3.09	.0170	46-55	5.87	26-35	4.23
	Personal Control	4.14	.0030*	55+	4.67	<=25	2.70
				55+	4.67	26-35	2.60
Asbestos Scenario B	Trust	3.49	.0080*	<=25	4.50	26-35	5.33
	Equity	2.56	.0397	36-45	5.64	46-55	4.27
	Society's Knowledge	2.70	.0316	<=25	3.63	26-35	4.56
Incineration Scenario A	Number of People	3.87	.0047*	36-45	4.25	55+	6.11
	Institutional Control	4.55	.0015*	<=25	2.98	55+	5.11
	Societal Benefit	3.60	.0074*	46-55	5.60	26-35	3.54
				46-55	5.60	<=25	4.08
	Likelihood	5.19	.0005*	46-55	5.60	26-35	4.06
	Overall Riskiness	4.65	.0013*	46-55	5.80	26-35	4.51
				46-55	5.80	<=25	4.64
				55+	6.00	26-35	4.51
				55+	6.00	<=25	4.64
Incineration Scenario B	Society's Knowledge	3.77	.0056*	55+	5.33	<=25	3.77
	Severity	3.71	.0062*	46-55	6.47	<=25	5.25
				46-55	6.47	26-35	5.35
	Institutional Control	4.56	.0015*	26-35	3.90	<=25	2.82

* Denotes significance ($p<.01$)

The only risk scenario which revealed any significant difference in the overall level of risk was Incineration Scenario A for which the older age groups 46-55 years and 55+ years perceived a higher level of overall risk than did the two youngest age groups. A similar analysis revealed no differences among the age groups in terms of the degree of individual or societal acceptance of the decisions portrayed in the risk scenarios.

APPENDIX D

CORRELATION MATRICES

Correlation Matrices

<u>Key to Variables</u>

A. Volition
B. Dread of risk
C. Trust in institution
D. Expert knowledge
E. Equity
F. Society's knowledge
G. Severity of consequences
H. Number of people exposed
I. Institutional control
J. Personal control
K. Benefit to society
L. Benefit to individual
M. Likelihood of occurrence
N. Overall level of risk
O. Individual acceptability of risk
P. Societal acceptance of risk

Generic Hazard Domain: Asbestos (N = 109)

	Q1A	Q1B	Q1C	Q1D	Q1E	Q1F	Q1H
Q1A	1.00000						
Q1B	.15168	1.00000					
Q1C	.07119	.18925	1.00000				
Q1D	-.02977	-.02945	.13493	1.00000			
Q1E	.20551	-.03913	.11119	-.01143	1.00000		
Q1F	.16321	-.00223	.06971	.19817	.03050	1.00000	
Q1H	.06460	.08212	.18528	.10216	.05719	.14948	1.00000
Q1I	-.25738	-.05647	.14714	.09792	-.00263	-.09480	.06080
Q1J	.13442	.02791	.09089	.13103	.09725	.08232	.15157
Q1K	-.00634	.07755	.12721	-.09678	.25147	.05241	.06684
Q1L	-.03442	.01417	.06246	-.07681	.21598	.02387	.00180
Q1M	.05246	.08523	.19241	.02754	.17740	.22664	.26446
Q1N	.06070	.12062	.11218	-.00098	.34391	.06321	.20694
Q1O	.28575	.24561	.19260	.05584	.37516	.10586	.04277
Q1P	.21093	.13389	.20748	-.04944	.31116	-.07660	.12532
Q1GSQ	.11712	.10216	.16720	-.02013	.14323	.13045	.16024

	Q1I	Q1J	Q1K	Q1L	Q1M	Q1N	Q1O
Q1I	1.00000						
Q1J	.31125	1.00000					
Q1K	-.04132	.13426	1.00000				
Q1L	.03710	.22412	.50979	1.00000			
Q1M	-.02391	.13075	.32320	.23662	1.00000		
Q1N	.02007	.21827	.37624	.37247	.42470	1.00000	
Q1O	-.08932	.17050	.20469	.31617	.21282	.35131	1.00000
Q1P	-.14747	.06808	.24253	.13992	.13257	.34098	.56094
Q1GSQ	-.03485	.21577	.15190	.20708	.07524	.15724	.12822

	Q1P	Q1GSQ
Q1P	1.00000	
Q1GSQ	.10963	1.00000

Generic Hazard Domain: Surfing (N = 108)

Correlation Matrix:

	Q2B	Q2C	Q2D	Q2E	Q2F	Q2G	Q2H
Q2B	1.00000						
Q2C	.26272	1.00000					
Q2D	.18848	.16755	1.00000				
Q2E	.07001	-.02509	-.05950	1.00000			
Q2F	.12707	.05231	.15409	.15571	1.00000		
Q2G	.01715	.14961	.02037	.02940	.10272	1.00000	
Q2H	-.07373	-.04422	.04921	.05275	-.09661	.15230	1.00000
Q2I	-.13164	.17610	-.06036	-.05117	-.15972	.14950	.04554
Q2J	.21148	-.10273	-.00088	.08533	-.11579	.22392	.14780
Q2K	-.10129	.07071	.02510	.01117	-.06447	.02114	-.22392
Q2L	.19558	.08809	.25045	.23195	.22944	.19901	.05087
Q2M	.15982	.06039	.01839	.08029	.01892	.36344	.11736
Q2N	.15215	.24623	.11273	.03292	-.00671	.43328	.05281
Q2O	.19038	.03030	.13059	.23686	.06328	.17283	-.06802
Q2P	.17998	-.06623	-.02389	.17852	.05874	.02104	-.12843
Q2A1	.34814	-.02131	.14634	.16191	.16818	-.02749	-.07423

	Q2I	Q2J	Q2K	Q2L	Q2M	Q2N	Q2O
Q2I	1.00000						
Q2J	.17645	1.00000					
Q2K	.17409	-.08306	1.00000				
Q2L	-.06843	.10154	.13715	1.00000			
Q2M	.11935	.29781	.18711	.32497	1.00000		
Q2N	.13548	.13938	.03358	.11043	.50700	1.00000	
Q2O	.06550	.11333	.13398	.27750	.33277	.29937	1.00000
Q2P	-.00168	.05003	.12037	.17411	.16873	.12755	.61114
Q2A1	-.04132	.25874	-.08354	.22663	.05597	.14714	.19905

	Q2P	Q2A1
Q2P	1.00000	
Q2A1	.26633	1.00000

Generic Hazard Domain: Bush Fires (N = 106)

Correlation Matrix:

	Q3A	Q3B	Q3C	Q3E	Q3F	Q3H	Q3I
Q3A	1.00000						
Q3B	.03745	1.00000					
Q3C	-.01804	.06597	1.00000				
Q3E	.33725	.04663	.04406	1.00000			
Q3F	-.11579	-.24434	.14732	-.02412	1.00000		
Q3H	.00110	.04141	.08432	-.00045	-.04914	1.00000	
Q3I	-.21790	-.03590	.08945	.11498	-.01017	.14975	1.00000
Q3J	.18036	-.01476	.14462	.22245	-.04570	.03516	.32726
Q3M	-.03319	.05692	.01859	.04229	-.09193	.30318	.08287
Q3N	.16922	.29501	.05178	.25477	-.20102	.12897	.04444
Q3O	.14547	.32887	.14307	.36327	-.06984	.00553	.08251
Q3P	.29945	.35449	.16412	.37108	-.07308	.00843	-.11797
Q3DLG10	-.23729	-.18666	.41492	-.04390	.36444	.09591	.30818
Q3GSQ	.03047	.42275	.10853	.13764	-.36622	.10199	.16660
Q3KSQ	.06394	.33845	.08133	.41876	-.12680	-.03696	.09469
Q3LSQ	.04752	.21526	.06962	.30474	-.09872	.02418	.05534

	Q3J	Q3M	Q3N	Q3O	Q3P	Q3DLG10	Q3GSQ
Q3J	1.00000						
Q3M	.06741	1.00000					
Q3N	-.08409	.32026	1.00000				
Q3O	-.00721	.14027	.53129	1.00000			
Q3P	-.05445	.11486	.46570	.77607	1.00000		
Q3DLG10	.09901	-.01795	-.22429	-.14404	-.23042	1.00000	
Q3GSQ	.00944	.04459	.26343	.42392	.35365	-.12268	1.00000
Q3KSQ	.13042	.07341	.24788	.46478	.42465	.00877	.32860
Q3LSQ	.07917	.13300	.28886	.53418	.43693	-.07464	.26466

	Q3KSQ	Q3LSQ
Q3KSQ	1.00000	
Q3LSQ	.84114	1.00000

Generic Hazard Domain: Toxic Waste Incineration (N = 109)

Correlation Matrix:

	Q4A	Q4B	Q4C	Q4D	Q4E	Q4F	Q4H
Q4A	1.00000						
Q4B	.31211	1.00000					
Q4C	.14043	.18375	1.00000				
Q4D	.10458	-.10023	.43522	1.00000			
Q4E	.05745	.08454	.26347	.21585	1.00000		
Q4F	.06385	-.07548	.29326	.43516	.21486	1.00000	
Q4H	-.02738	-.09209	.02084	-.03482	.07257	.13714	1.00000
Q4I	.05598	.00365	.25191	.23506	.13680	.29272	.12573
Q4J	.24522	.15229	.20484	.03097	.17643	.16360	.07640
Q4K	.10615	.21838	.26634	.02728	.16994	.04312	.08795
Q4L	.16731	.23285	.36293	.13165	.30472	.09179	-.05610
Q4M	-.11049	-.01007	.28920	.18541	.08652	.24923	.32904
Q4N	.05115	.25004	.16386	-.00399	.13826	.09339	.16469
Q4O	.19005	.33393	.23049	.02398	.07138	.12953	.11988
Q4P	.13215	.41326	.21984	-.06216	-.00957	.05691	.00254
Q4GSQ	.16826	.31993	.34835	.12545	.28483	.16169	.17585

	Q4I	Q4J	Q4K	Q4L	Q4M	Q4N	Q4O
Q4I	1.00000						
Q4J	.18971	1.00000					
Q4K	.09086	.29177	1.00000				
Q4L	-.04122	.32750	.71691	1.00000			
Q4M	.16905	-.02876	.24443	.04069	1.00000		
Q4N	.04007	.11350	.38931	.35189	.33599	1.00000	
Q4O	.14377	.09897	.43497	.30217	.16960	.52807	1.00000
Q4P	.06386	.11236	.45441	.34067	.05324	.45545	.63740
Q4GSQ	.22151	.11809	.17537	.35008	.12446	.46328	.22189

	Q4P	Q4GSQ
Q4P	1.00000	
Q4GSQ	.09398	1.00000

Generic Hazard Domain: Dams (N = 108)

Correlation Matrix:

	Q5A	Q5B	Q5C	Q5D	Q5E	Q5F	Q5G
Q5A	1.00000						
Q5B	.24929	1.00000					
Q5C	.14167	.26450	1.00000				
Q5D	.12245	.15003	.54477	1.00000			
Q5E	-.12407	-.03071	.21316	.19378	1.00000		
Q5F	.28820	-.00943	.30757	.37829	.15811	1.00000	
Q5G	.07298	.09502	.00364	.01437	.02410	.22385	1.00000
Q5H	.24400	.16290	-.07178	.07008	-.14181	.20350	.13549
Q5I	-.01053	.13191	.61998	.37050	.23170	.28430	.04710
Q5J	.47992	.13100	-.05735	.09471	-.10212	.25259	.14947
Q5K	.24022	.34747	.36519	.25680	.10107	.13861	.11664
Q5L	.25822	.42429	.28542	.24480	.07643	.06359	.17607
Q5M	.08631	.22875	.28122	.14888	-.00812	.01717	-.14626
Q5N	.18899	.45311	.30269	.17233	.05428	.22013	.17436
Q5O	.28354	.48922	.36178	.32836	.15775	.19435	.08179
Q5P	.24291	.50368	.28031	.22018	.05477	.05910	.03805

	Q5H	Q5I	Q5J	Q5K	Q5L	Q5M	Q5N
Q5H	1.00000						
Q5I	.02766	1.00000					
Q5J	.44453	.02867	1.00000				
Q5K	.05100	.20971	.20519	1.00000			
Q5L	.06959	.09772	.23356	.78892	1.00000		
Q5M	.25573	.19239	.14487	.31815	.33685	1.00000	
Q5N	.22856	.26269	.18506	.50325	.41291	.46457	1.00000
Q5O	.16558	.16362	.21279	.44178	.40977	.21694	.41238
Q5P	.15829	.12274	.16923	.46356	.46685	.25730	.46541

	Q5O	Q5P
Q5O	1.00000	
Q5P	.86616	1.00000

Generic Hazard Domain: Bicycles (N = 109)

Correlation Matrix:

	Q6B	Q6C	Q6E	Q6F	Q6G	Q6H	Q6I
Q6B	1.00000						
Q6C	.30858	1.00000					
Q6E	.02592	-.03877	1.00000				
Q6F	-.06180	.03878	.18605	1.00000			
Q6G	.19696	.01467	-.05528	-.06180	1.00000		
Q6H	-.20162	-.05222	.04685	-.12947	.03424	1.00000	
Q6I	.03185	.25656	-.04935	.00430	-.21337	-.15285	1.00000
Q6K	.02651	-.09581	-.04157	.00735	.14640	-.09524	.04651
Q6M	.25802	.01321	.04697	.08135	.19388	-.12043	-.11417
Q6N	.43795	.21603	-.10065	.12504	.21063	-.12347	.04153
Q6O	.33466	-.09166	.11038	.19929	.11154	-.01756	.00469
Q6P	.35113	-.01843	.09130	.10131	.13803	-.01317	.00838
Q6AMED	.50778	.18207	.18186	.22977	.07142	-.26196	.00329
Q6DLG10	.15396	.33284	.05395	.35813	-.16368	-.20968	.26464
Q6JLG10	.32967	.07797	.17925	.03884	.06401	-.16360	.29794
Q6LLG10	.08235	-.10222	.13214	.17326	.17680	.04504	-.09110

	Q6K	Q6M	Q6N	Q6O	Q6P	Q6AMED	Q6DLG10
Q6K	1.00000						
Q6M	.09173	1.00000					
Q6N	-.04952	.52329	1.00000				
Q6O	.15042	.23119	.26031	1.00000			
Q6P	.12553	.17556	.23418	.93524	1.00000		
Q6AMED	.00818	.18227	.20352	.26509	.28519	1.00000	
Q6DLG10	-.04186	-.08346	.13275	.04696	.08225	.17274	1.00000
Q6JLG10	.10206	.23900	.31717	.25351	.21138	.25621	.00012
Q6LLG10	.51017	.13221	.07870	.16386	.07628	.11307	.12418

	Q6JLG10	Q6LLG10
Q6JLG10	1.00000	
Q6LLG10	.21496	1.00000

Generic Hazard Domain: Vaccinations (N = 109)

Correlation Matrix:

	Q7A	Q7B	Q7C	Q7E	Q7F	Q7G	Q7H
Q7A	1.00000						
Q7B	.33762	1.00000					
Q7C	.27154	.34871	1.00000				
Q7E	.15502	.07409	.03571	1.00000			
Q7F	.15327	-.01270	.24887	.02564	1.00000		
Q7G	.19816	.22761	.14938	.11434	.23026	1.00000	
Q7H	.03573	.08396	.02139	.11876	.06743	.03176	1.00000
Q7I	.05078	.13073	.31953	.18255	.01803	.27506	.07257
Q7J	.30711	-.06885	.04768	.26892	.18267	.12343	-.00817
Q7M	.03748	.37164	.08651	-.11211	-.24793	.04562	-.01182
Q7N	.29882	.47817	.31191	.07711	-.03321	.28539	-.01177
Q7O	.17586	.33397	.15810	.08792	-.01553	.17655	-.12254
Q7DLG10	.16832	-.00875	.29435	.27109	.12852	.15575	.00333
Q7KLG10	.36319	.15374	.31045	.02044	-.02858	-.05045	-.12611
Q7LLG10	.45892	.18858	.33441	.22229	.11716	.10685	-.04516
Q7P	.15757	.32493	.18440	.12472	.02869	.20275	-.10198

	Q7I	Q7J	Q7M	Q7N	Q7O	Q7DLG10	Q7KLG10
Q7I	1.00000						
Q7J	.25081	1.00000					
Q7M	-.00701	-.25606	1.00000				
Q7N	.10466	-.06905	.56232	1.00000			
Q7O	.09441	-.10766	.26283	.54019	1.00000		
Q7DLG10	.13926	.18559	.09165	.26116	.09818	1.00000	
Q7KLG10	.18206	.10150	.26547	.23736	.32552	.17296	1.00000
Q7LLG10	.31126	.28815	.15799	.26078	.29824	.42692	.75140
Q7P	.09433	-.06285	.21696	.46758	.93228	.08618	.24107

	Q7LLG10	Q7P
Q7LLG10	1.00000	
Q7P	.22890	1.00000

Generic Hazard Domain: Sunbathing (N = 110)

Correlation Matrix:

	Q8B	Q8C	Q8E	Q8F	Q8G	Q8I	Q8L
Q8B	1.00000						
Q8C	-.18140	1.00000					
Q8E	.18759	.06256	1.00000				
Q8F	-.14137	.15797	.10970	1.00000			
Q8G	.13818	-.11522	.01815	-.09197	1.00000		
Q8I	-.17048	.16882	.04102	.14128	.03019	1.00000	
Q8L	.12449	-.02034	.33948	-.03009	.05339	.07097	1.00000
Q8M	.03583	.16768	.11952	.16209	.26811	-.00620	.11802
Q8N	.30191	-.01354	.08868	.03821	.26442	.02382	.17672
Q8O	.24942	-.11403	.17698	-.08215	.20825	-.02992	.34092
Q8P	.17219	-.17710	.08982	-.13207	.25143	.02122	.12544
Q8ALG10	.10569	.12002	-.07384	-.09918	-.00430	-.18459	-.07588
Q8DLG10	.02844	.39643	.00200	.17662	-.17836	-.08702	.00985
Q8HMED	.13731	-.06974	.20103	.02239	.12458	-.11982	.05960
Q8JMED	.03453	.09987	.03958	.15475	.03931	-.12854	-.13120
Q8KSQ	.02886	-.01971	.23519	-.05948	-.03582	.24165	.52319

	Q8M	Q8N	Q8O	Q8P	Q8ALG10	Q8DLG10	Q8HMED
Q8M	1.00000						
Q8N	.50197	1.00000					
Q8O	.21462	.48873	1.00000				
Q8P	.10635	.32758	.59997	1.00000			
Q8ALG10	.07426	-.01566	-.01696	.00454	1.00000		
Q8DLG10	.07696	.02766	-.01303	-.06527	.14229	1.00000	
Q8HMED	.09714	.04831	-.10499	-.12137	.10477	.00742	1.00000
Q8JMED	-.01695	-.14236	-.11263	-.12554	.24986	.32429	-.04439
Q8KSQ	.03910	.19845	.23707	.09172	-.25926	.00884	-.10732

	Q8JMED	Q8KSQ
Q8JMED	1.00000	
Q8KSQ	-.25640	1.00000

Asbestos Scenario A

Number of Cases = 226

Correlation Matrix:

	Q9A	Q9B	Q9C	Q9D	Q9E	Q9F	Q9G
Q9A	1.00000						
Q9B	.46759	1.00000					
Q9C	.22967	.05056	1.00000				
Q9D	.37978	.25445	.29089	1.00000			
Q9E	.06589	-.00525	.11037	.09129	1.00000		
Q9F	.47126	.28613	.22975	.39879	.12924	1.00000	
Q9G	-.08555	-.02169	.08617	-.07173	.05909	.02093	1.00000
Q9H	.26001	.20626	.17381	.14115	.02633	.30374	.15975
Q9I	.10458	-.04872	.09206	.24718	-.02061	.06767	.03037
Q9J	.36222	.09380	.17429	.21983	.02475	.19818	-.03223
Q9K	-.05422	-.12757	.17019	-.05723	.01816	-.06197	.17914
Q9L	.07244	-.01493	.14292	.03473	.21160	.18734	.23152
Q9M	-.09502	-.08819	.12211	-.12729	.13869	-.01425	.29602
Q9N	-.00779	.03221	.07684	-.11820	.08202	.07739	.51567

	Q9H	Q9I	Q9J	Q9K	Q9L	Q9M	Q9N
Q9H	1.00000						
Q9I	.11663	1.00000					
Q9J	.21051	.34216	1.00000				
Q9K	.11683	.07661	.01380	1.00000			
Q9L	.24361	.02684	.00345	.41571	1.00000		
Q9M	.18843	-.01533	-.00785	.24712	.27878	1.00000	
Q9N	.29941	.03457	.01928	.32385	.27122	.51653	1.00000

Asbestos Scenario B

Number of Cases = 209

Correlation Matrix: ASBESTOS SCENARIO B

	Q15A	Q15B	Q15C	Q15D	Q15E	Q15F	Q15G
Q15A	1.00000						
Q15B	.19993	1.00000					
Q15C	.15122	.20943	1.00000				
Q15D	-.08021	-.07660	.25594	1.00000			
Q15E	.21061	.17070	.01976	.01625	1.00000		
Q15F	.07031	-.03611	.26771	.31842	.06718	1.00000	
Q15G	.19284	.19780	.09396	.01050	.21676	.07693	1.00000
Q15H	.18167	.23085	.13718	-.00813	.16100	.11010	.31994
Q15I	-.00219	.08233	.23509	.25994	-.00518	.23794	.09634
Q15J	.38767	.09328	.19726	.02564	.17225	.21833	.09907
Q15K	.30772	.02835	-.06572	-.07828	.23062	-.02801	.16913
Q15L	.27080	.11677	-.03815	-.04836	.26286	-.02896	.19706
Q15M	.01377	.25022	.01836	.02819	.21407	-.11990	.25172
Q15N	.00774	.24421	.04160	-.00765	.13229	-.13131	.24682

	Q15H	Q15I	Q15J	Q15K	Q15L	Q15M	Q15N
Q15H	1.0000						
Q15I	-.00897	1.00000					
Q15J	.17507	.17181	1.00000				
Q15K	.13278	-.08408	.18890	1.00000			
Q15L	.15836	.03106	.18227	.77741	1.00000		
Q15M	.41166	.04840	.01464	.03502	.07911	1.00000	
Q15N	.36401	.10576	-.02399	.10233	.06869	.70926	1.00000

Toxic Waste Incineration Scenario A

Number of Cases = 220

Correlation Matrix:

	Q20A	Q20B	Q20C	Q20D	Q20E	Q20F	Q20G
Q20A	1.00000						
Q20B	.36039	1.00000					
Q20C	.21812	.23093	1.00000				
Q20D	-.01542	.05426	.19259	1.00000			
Q20E	.33425	.15499	.27600	.19421	1.00000		
Q20F	.04512	-.00527	.12724	.24260	.07382	1.00000	
Q20G	.15240	.23976	.23211	.11196	.16098	-.07410	1.00000
Q20H	.07310	.11215	.07616	.11908	.12910	-.01254	.26875
Q20I	.09204	.02568	.24032	.39780	.22573	.30077	.13780
Q20J	.39638	.25081	.27278	.04102	.30744	.06341	.13981
Q20K	-.00128	.08663	.06092	.13852	.17785	-.06948	.19814
Q20L	.23922	.23176	.17938	.06966	.34580	.07377	.10532
Q20M	.12518	.23609	.14612	.19451	.23948	-.08043	.34601
Q20N	.14517	.20044	.19318	.23745	.28934	-.01736	.46459

	Q20H	Q20I	Q20J	Q20K	Q20L	Q20M	Q20N
Q20H	1.00000						
Q20I	.26580	1.00000					
Q20J	.05493	.21780	1.00000				
Q20K	.33932	.11553	.04617	1.00000			
Q20L	.16986	.03854	.32650	.49440	1.00000		
Q20M	.42656	.30614	.15636	.43339	.23308	1.00000	
Q20N	.46971	.28822	.08560	.47794	.26994	.70424	1.00000

Toxic Waste Incineration Scenario B

Number of Cases = 219

Correlation Matrix:

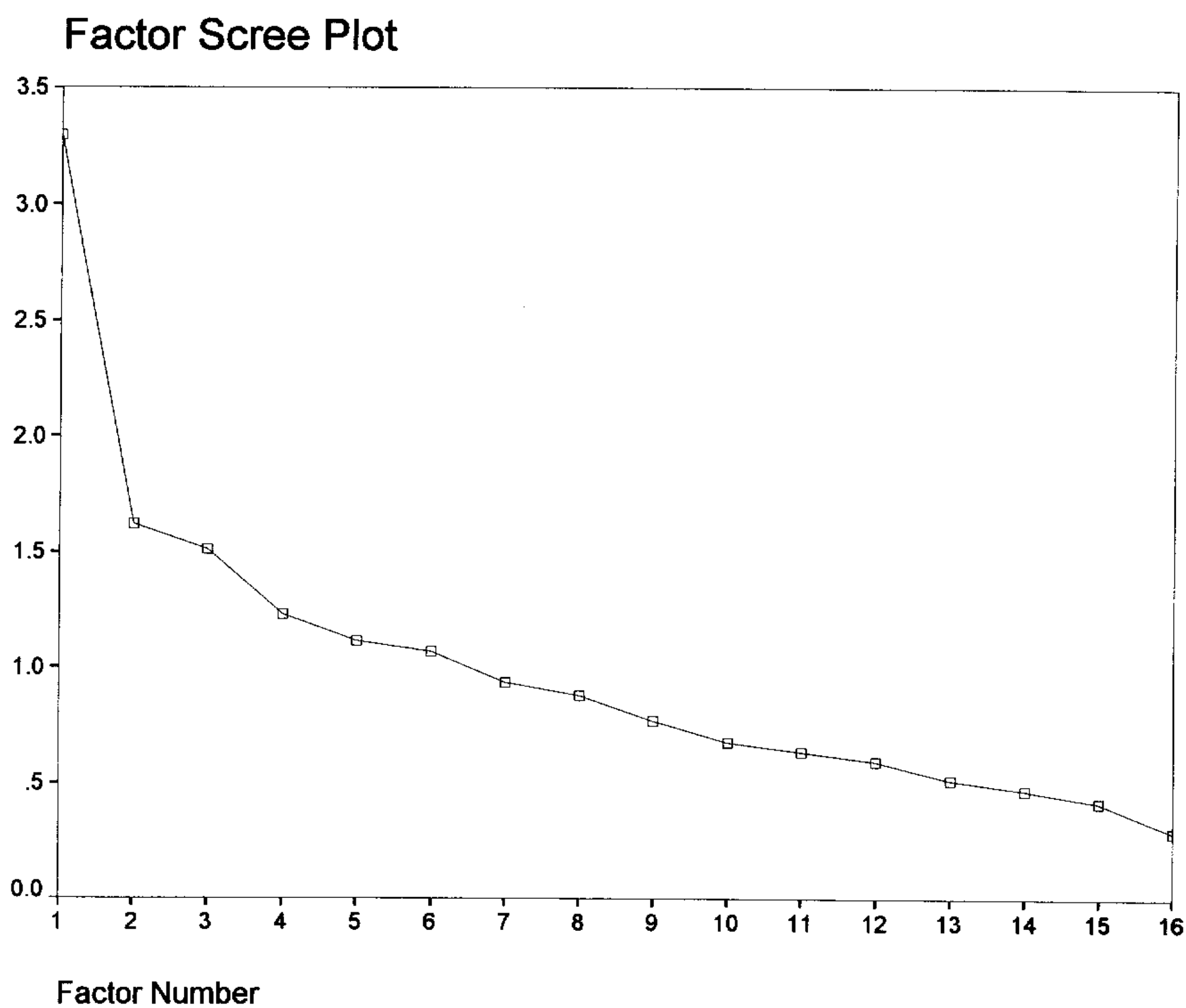
	Q25A	Q25B	Q25C	Q25D	Q25E	Q25F	Q25G
Q25A	1.00000						
Q25B	.48038	1.00000					
Q25C	.20097	.27592	1.00000				
Q25D	.05996	-.00149	.26177	1.00000			
Q25E	.26087	.25140	.21843	.27344	1.00000		
Q25F	-.06497	-.11695	.18086	.35054	.10981	1.00000	
Q25G	.18809	.31328	.29409	.12563	.32411	-.16174	1.00000
Q25H	.36008	.34358	.30757	.09077	.28328	-.02610	.39381
Q25I	.00764	.05819	.38567	.46296	.19129	.24934	.19579
Q25J	.43327	.12328	.21935	.20512	.30304	.12800	.14786
Q25K	.22597	.08509	.18255	.19573	.24498	.09084	.27304
Q25L	.30326	.24812	.19914	.10122	.37807	.05648	.25036
Q25M	.27960	.18146	.20072	.30581	.44688	.08858	.47290
Q25N	.35822	.26296	.24189	.25825	.35365	.07434	.47928

	Q25H	Q25I	Q25J	Q25K	Q25L	Q25M	Q25N
Q25H	1.00000						
Q25I	.17707	1.00000					
Q25J	.23479	.22687	1.00000				
Q25K	.32387	.14897	.10157	1.00000			
Q25L	.29268	.05589	.27650	.61859	1.00000		
Q25M	.39502	.25605	.23120	.52588	.42774	1.00000	
Q25N	.39817	.31050	.18384	.53180	.40991	.69704	1.00000

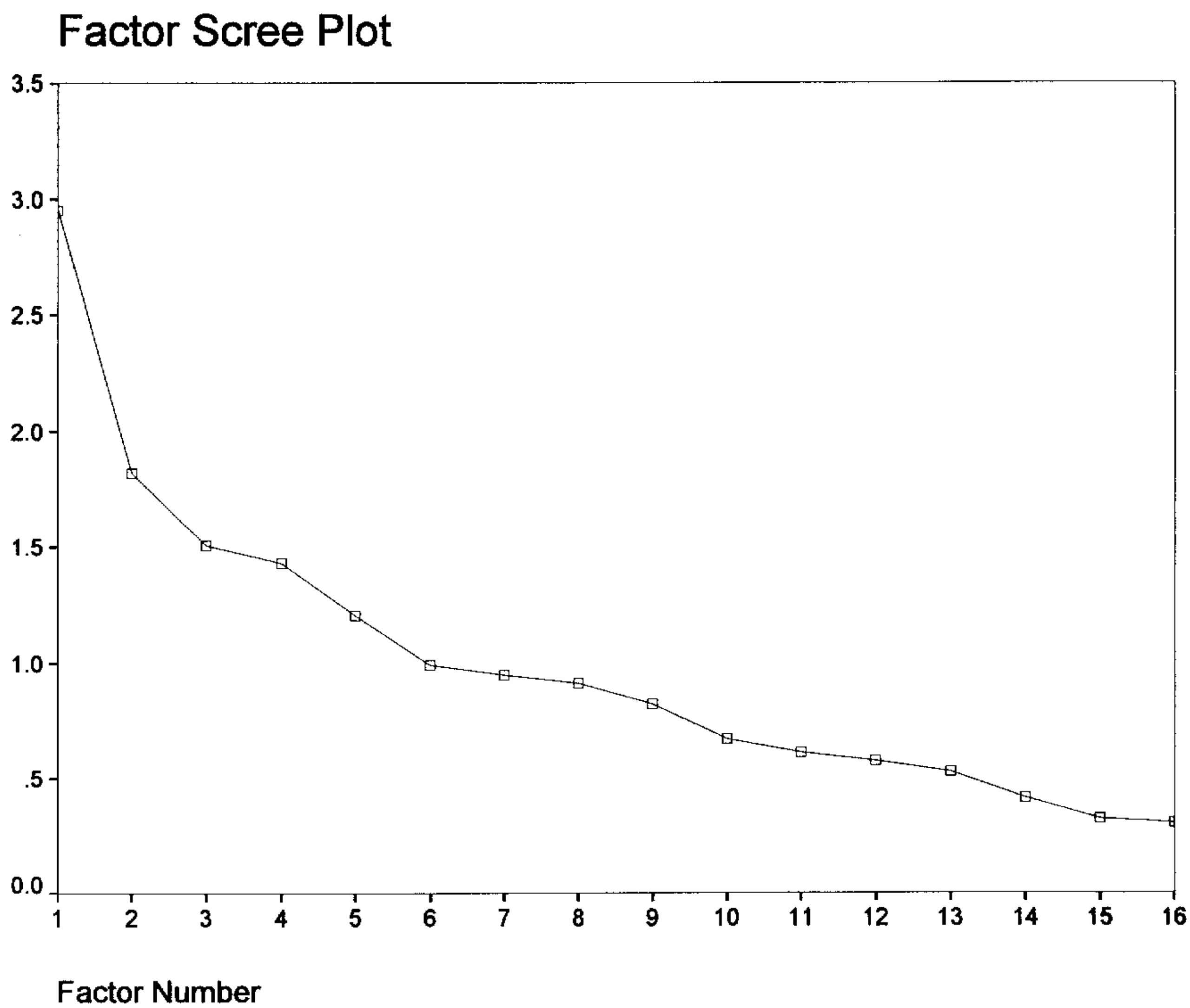
APPENDIX E

FACTOR ANALYSIS SCREE TESTS

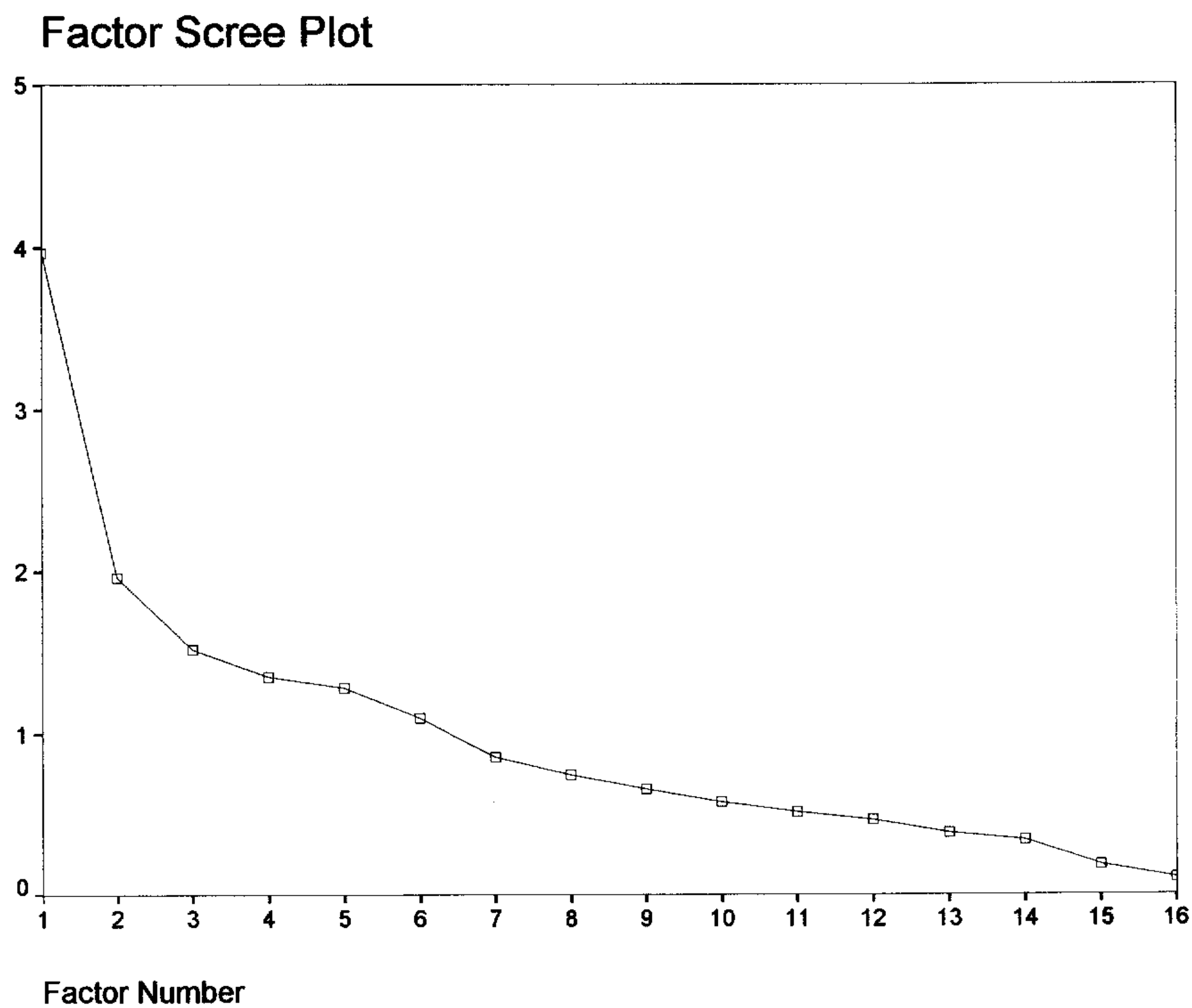
Generic Hazard Domain: Asbestos



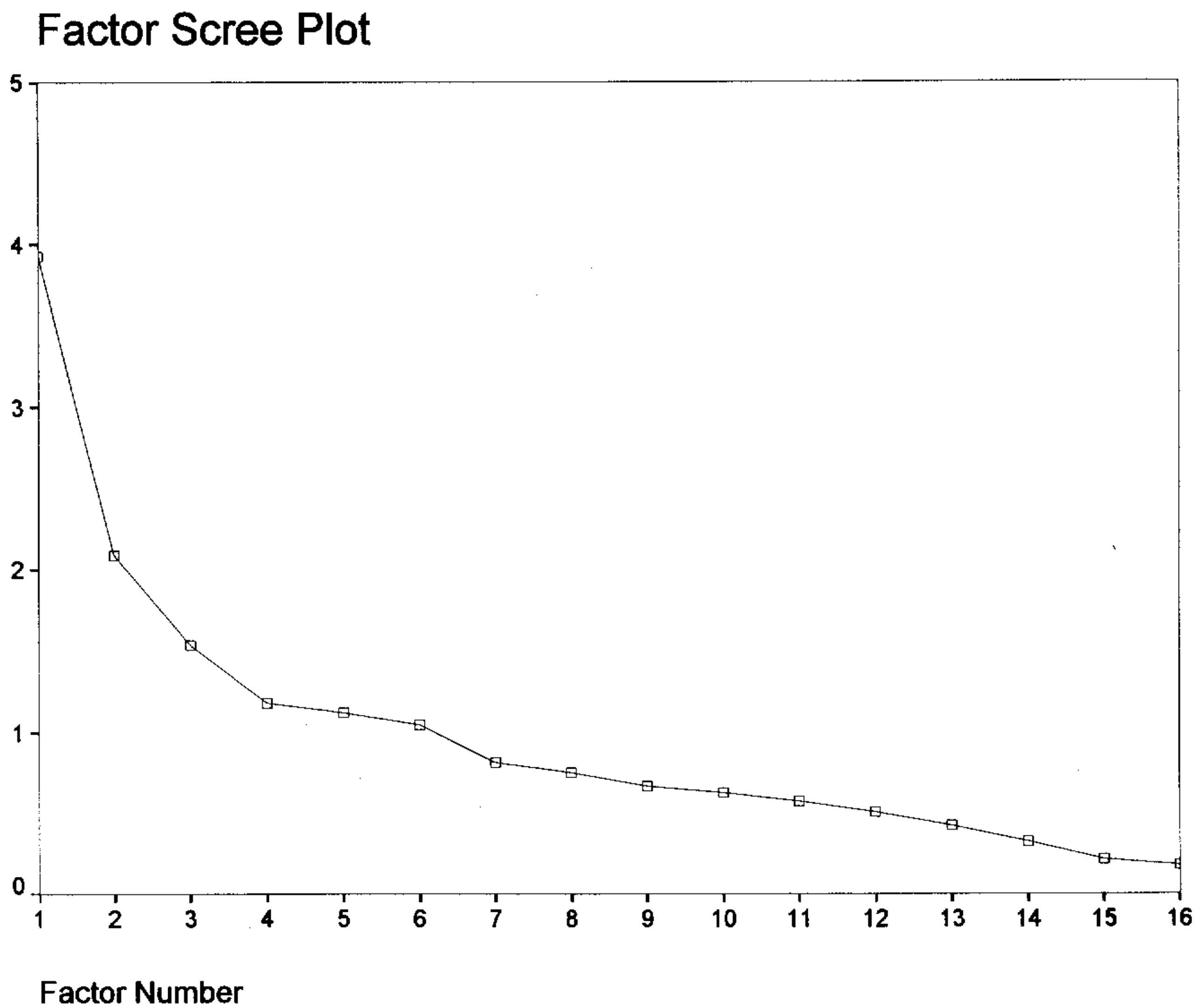
Generic Hazard Domain: Surfing



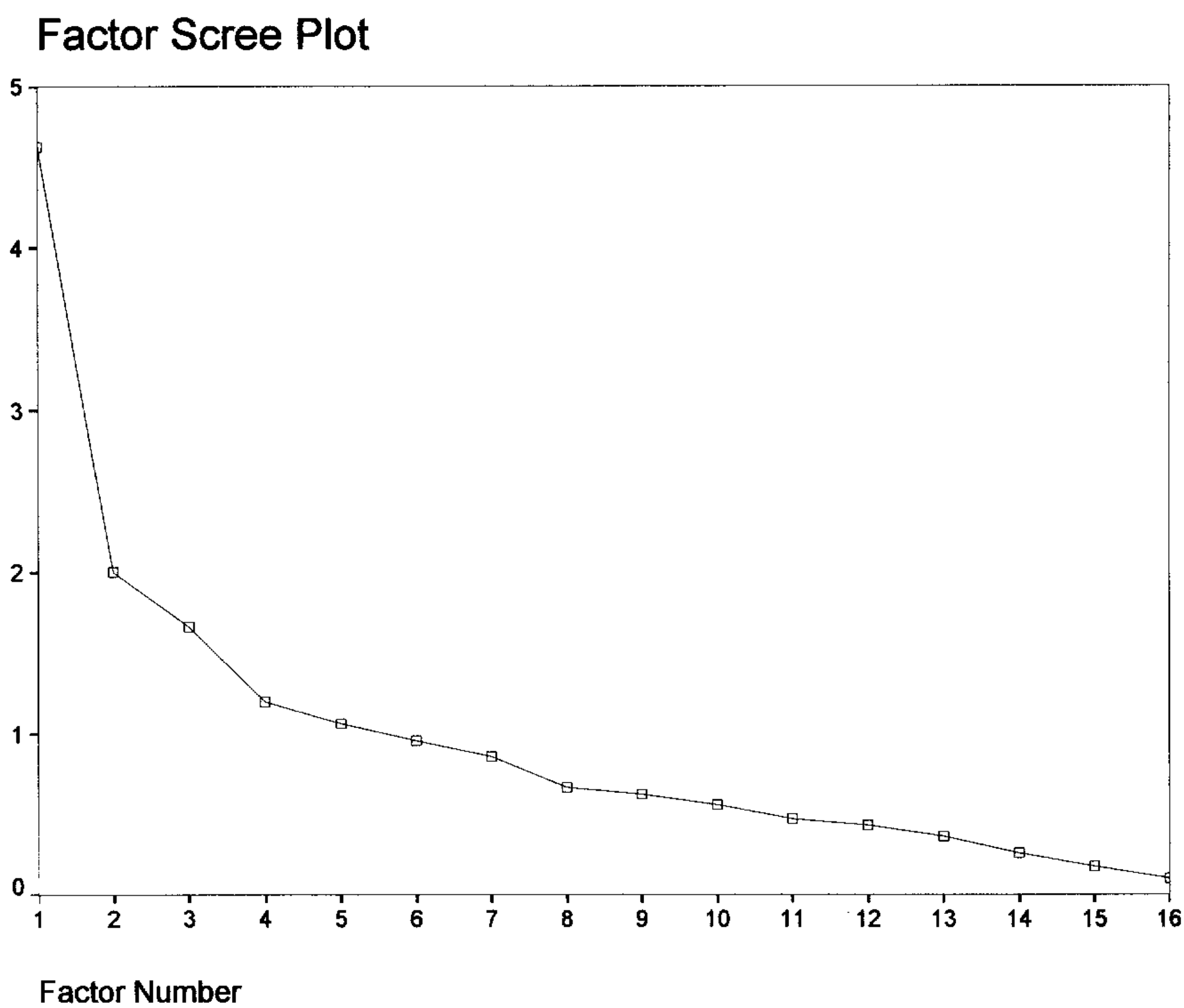
Generic Hazard Domain: Bush Fires



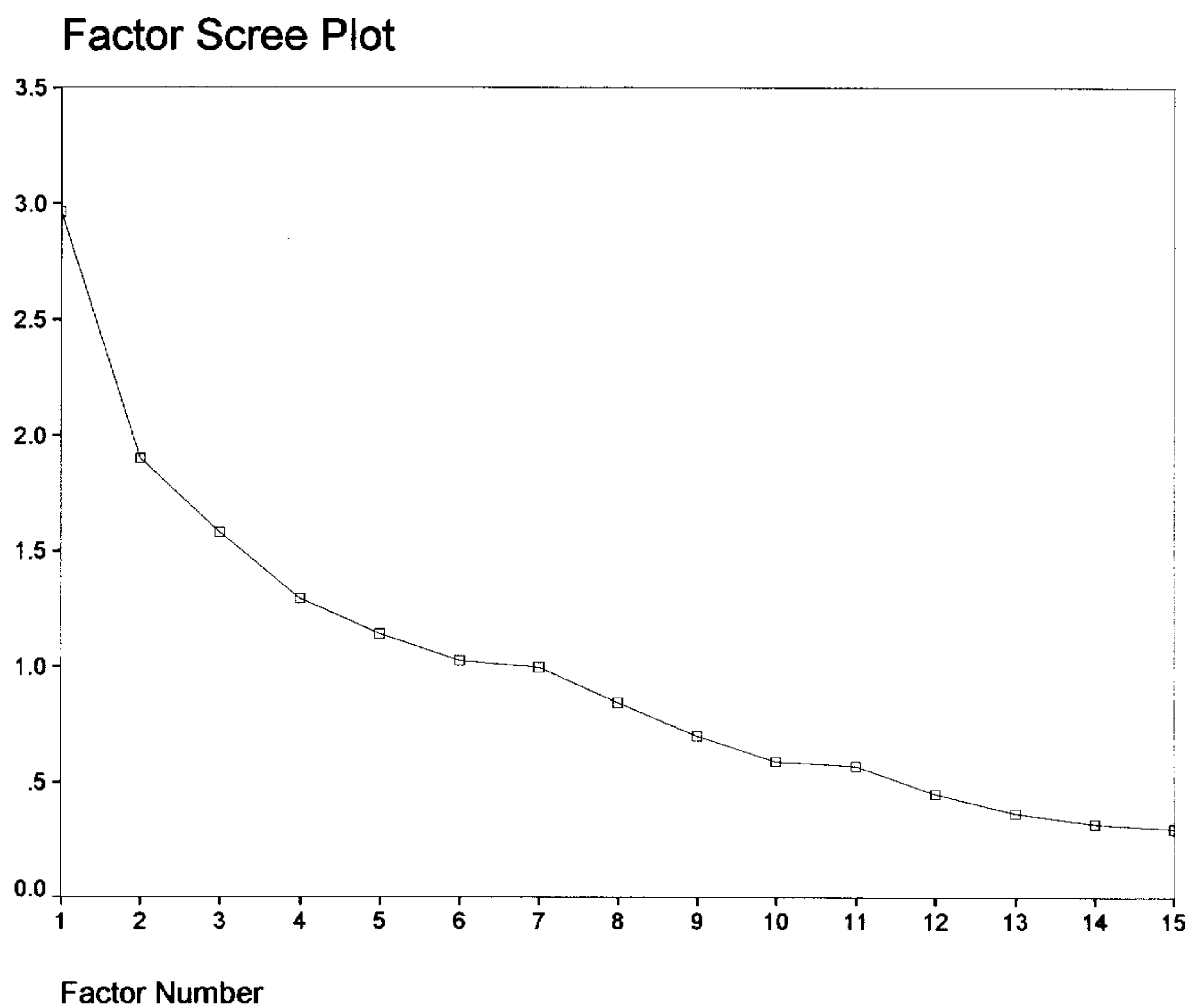
Generic Hazard Domain: Toxic Waste Incineration



Generic Hazard Domain: **Dams**

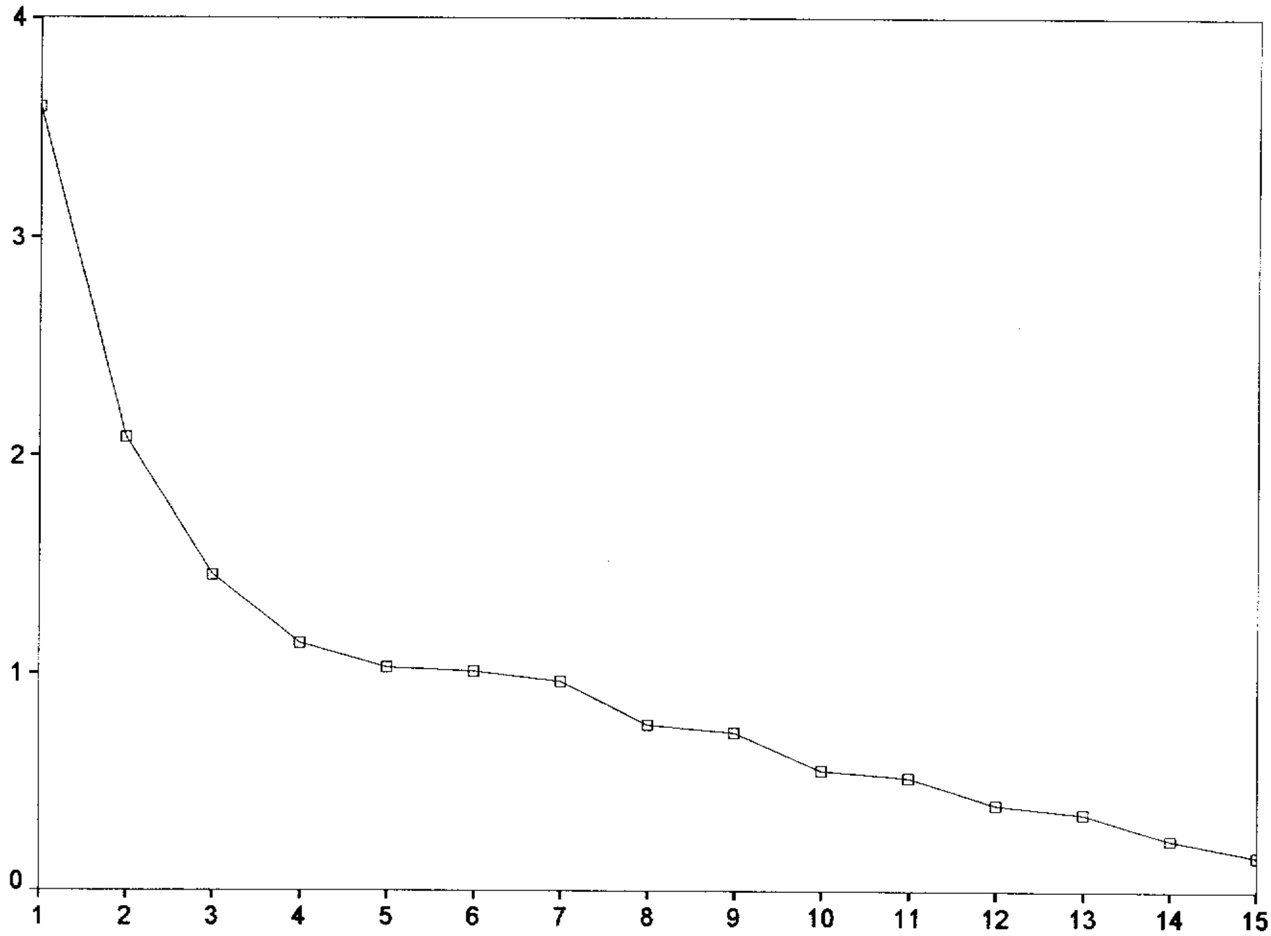


Generic Hazard Domain: Bicycles

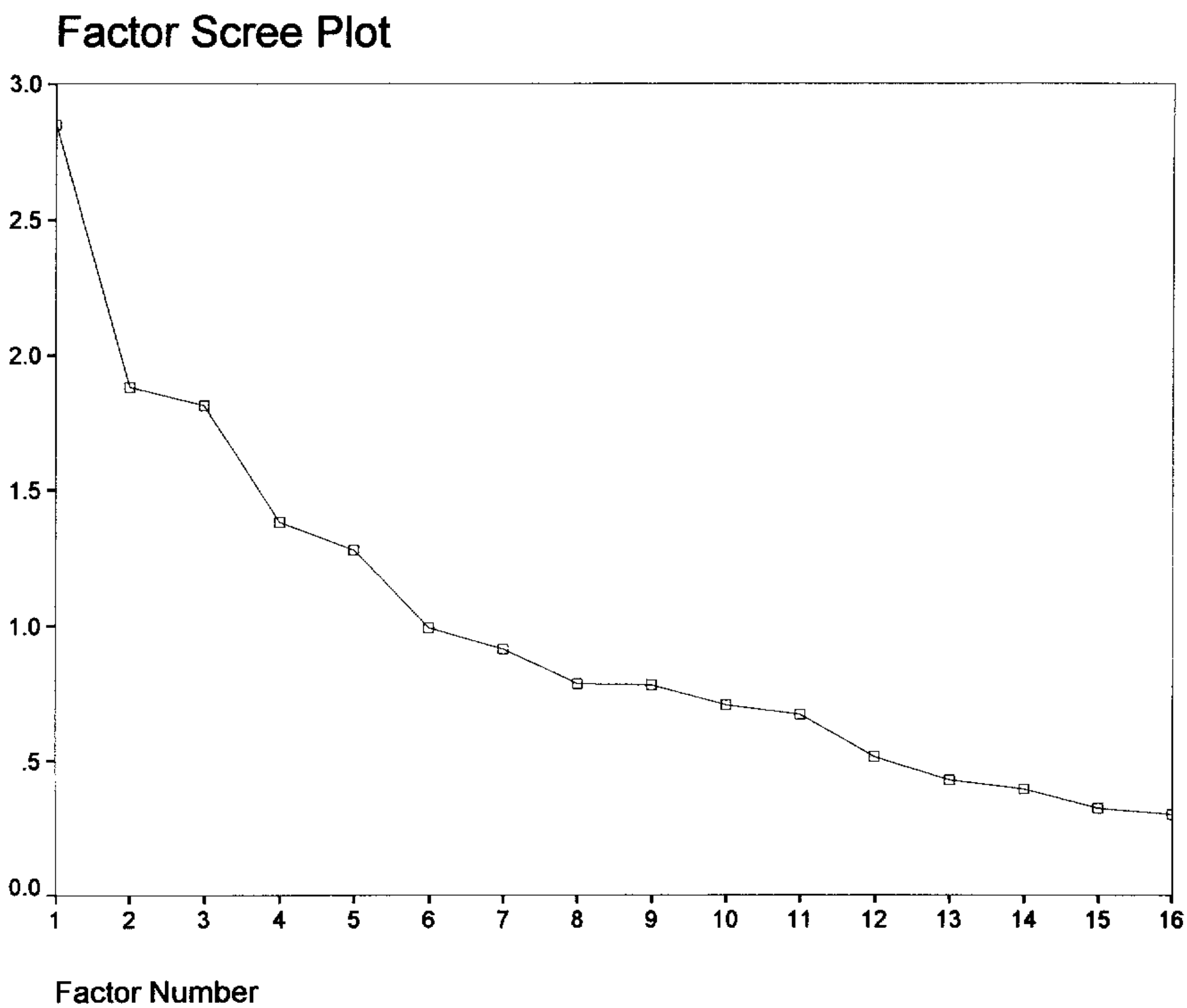


Generic Hazard Domain: Vaccinations

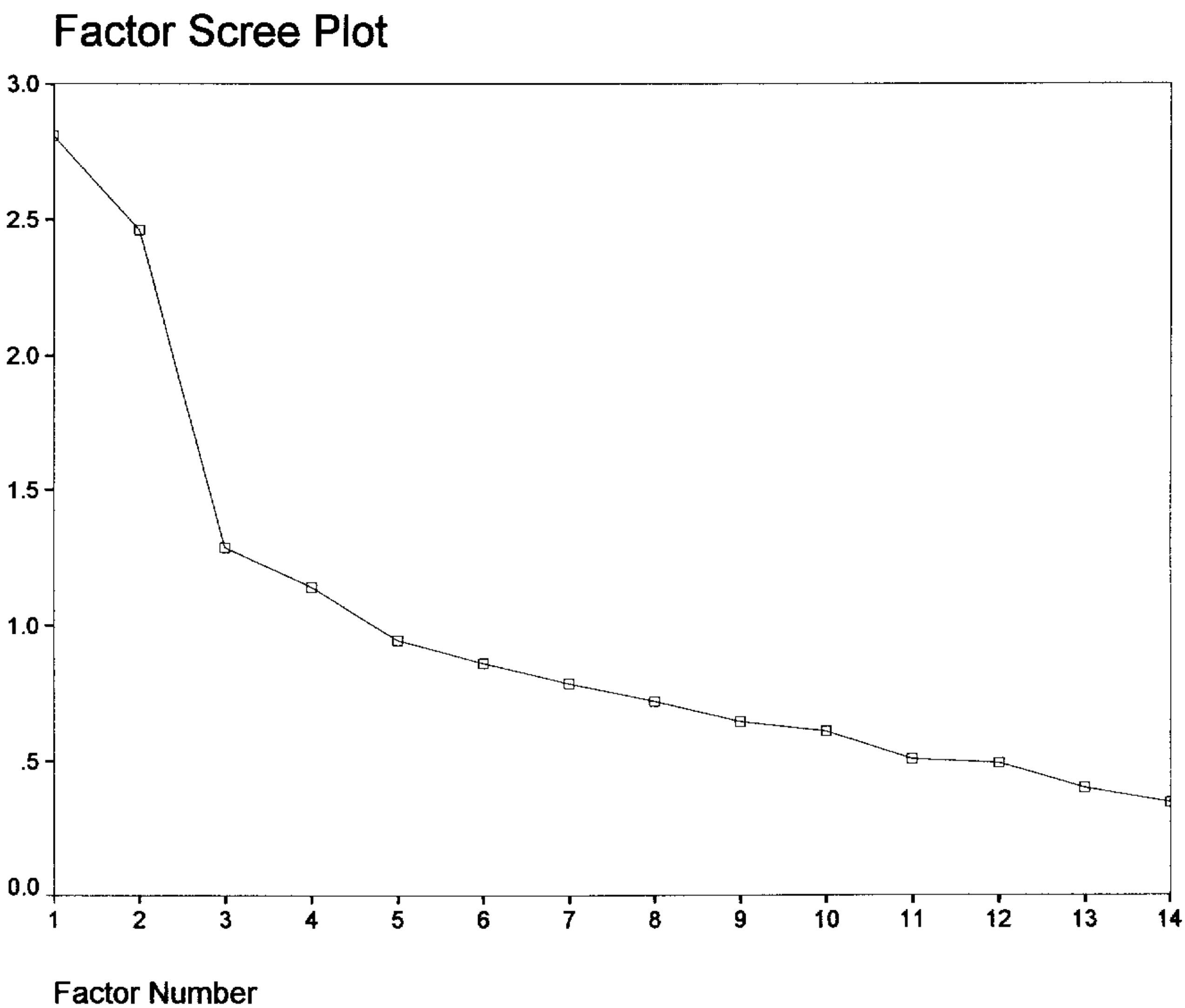
Factor Scree Plot



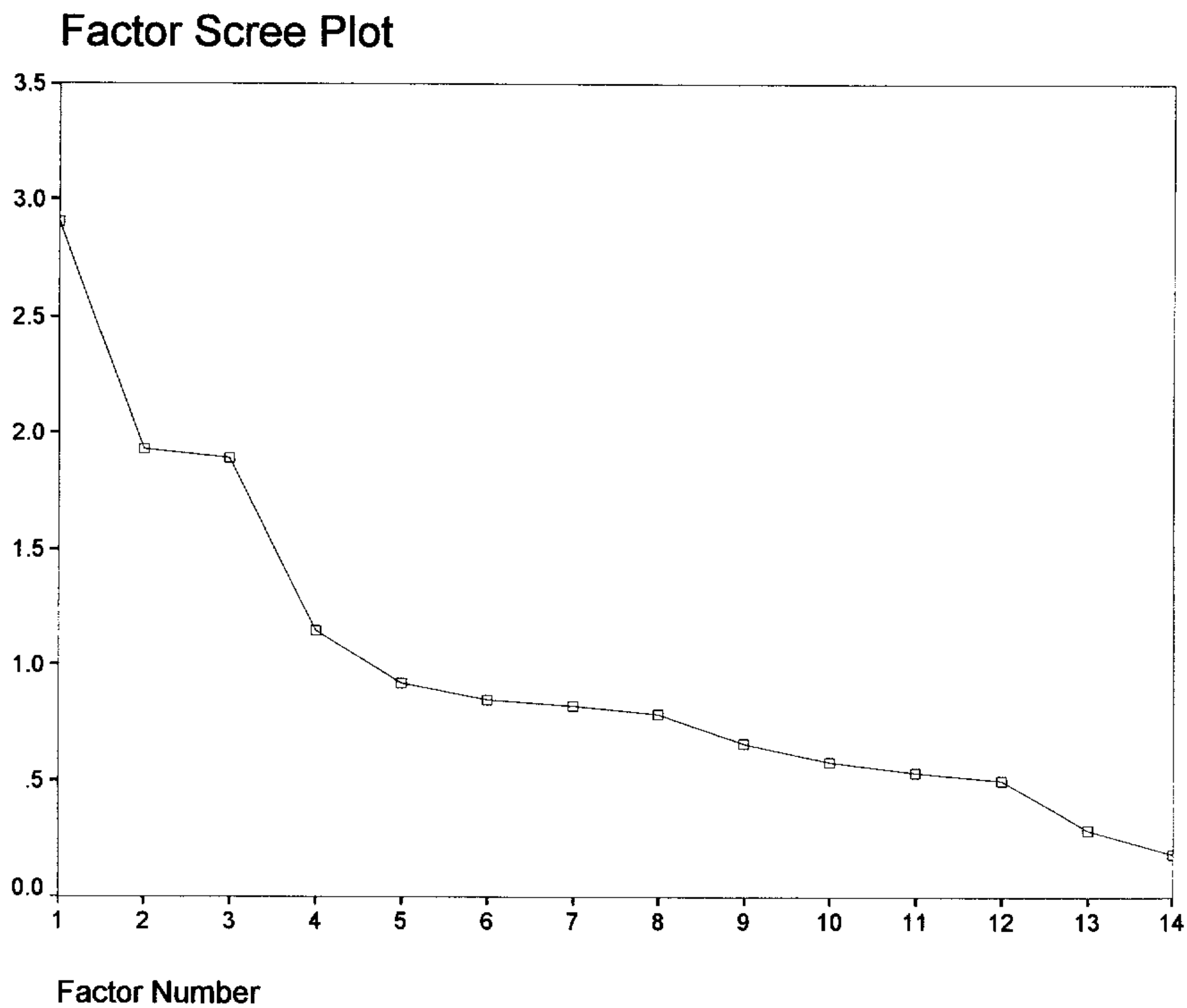
Generic Hazard Domain: Sunbathing



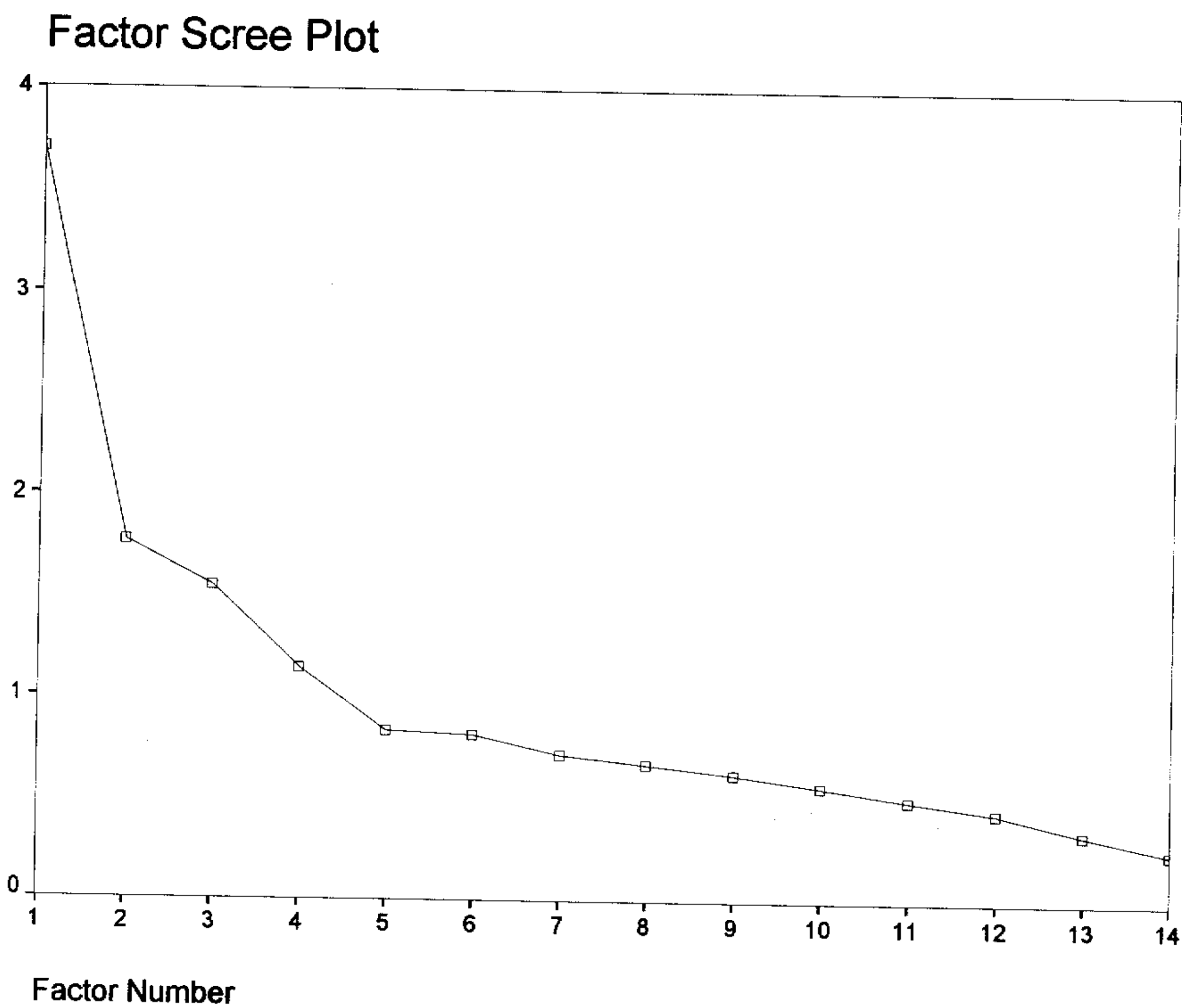
Asbestos Scenario A



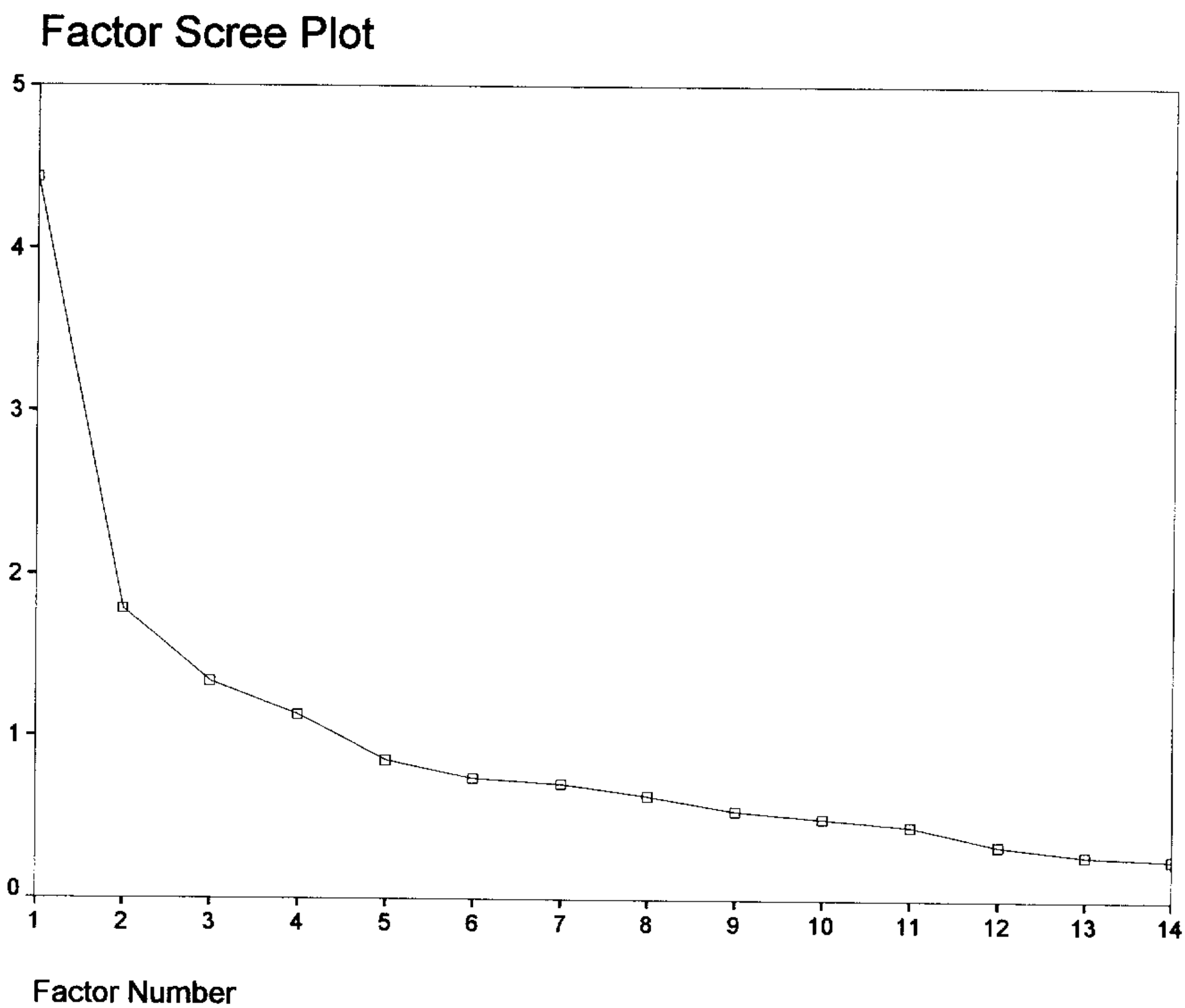
Asbestos Scenario B



Toxic Waste Incineration Scenario A



Toxic Waste Incineration Scenario B



APPENDIX F

RESULTS OF REGRESSION ANALYSES

Generic Hazard Domain: Asbestos

N of Cases = 109

Equation Number 1 Dependent Variable.. Q1N ASBESTOS OVERALL LEVEL OF RISK

Block Number 1. Method: Enter

Q1A	Q1B	Q1C	Q1D	Q1E	Q1F	Q1H	Q1I
Q1J	Q1K	Q1L	Q1M	Q1O	Q1P	Q1GSQ	

Variable(s) Entered on Step Number

1..	Q1GSQ	ASBESTOS SEVERITY OF CONSEQUENCES
2..	Q1D	ASBESTOS EXPERT KNOWLEDGE
3..	Q1M	ASBESTOS LIKELIHOOD OCCURRENCE
4..	Q1I	ASBESTOS INSTITUTIONAL CONTROL
5..	Q1B	ASBESTOS DREAD OF RISK
6..	Q1E	ASBESTOS EQUITY
7..	Q1H	ASBESTOS NUMBER OF PEOPLE EXPOSED
8..	Q1F	ASBESTOS SOCIETY'S KNOWLEDGE
9..	Q1L	ASBESTOS BENEFIT TO INDIVIDUAL
10..	Q1C	ASBESTOS TRUST IN INSTITUTION
11..	Q1A	ASBESTOS VOLITION
12..	Q1P	ASBESTOS SOCIETAL RISK ACCEPTANCE
13..	Q1J	ASBESTOS PERSONAL CONTROL
14..	Q1K	ASBESTOS BENEFIT TO SOCIETY
15..	Q1O	ASBESTOS ACCEPTABILITY OF RISK

Multiple R	.61951
R Square	.38379
Adjusted R Square	.28440
Standard Error	.99706

------------------------ Variables in the Equation ------------------------

Variable	B	SE B	Beta	T	Sig T
Q1A	-.034134	.063160	-.050268	-.540	.5902
Q1B	.055123	.071313	.067735	.773	.4415
Q1C	-.049486	.064800	-.068405	-.764	.4470
Q1D	.010265	.077249	.011483	.133	.8946
Q1E	.144048	.080282	.166708	1.794	.0760
Q1F	-.011052	.073006	-.013536	-.151	.8800
Q1H	.063475	.062635	.089427	1.013	.3135
Q1I	.019203	.074540	.024334	.258	.7973
Q1J	.059155	.068115	.081732	.868	.3874
Q1K	.075519	.078224	.097979	.965	.3368
Q1L	.135691	.087199	.160096	1.556	.1231
Q1M	.243138	.084368	.267868	2.882	.0049
Q1O	.050713	.103528	.055944	.490	.6254
Q1P	.146778	.088482	.175933	1.659	.1005
Q1GSQ	.001900	.008366	.019999	.227	.8209
(Constant)	.830616	.800955		1.037	.3024

Generic Hazard Domain: Asbestos

Equation Number 1 Dependent Variable.. Q10 ASBESTOS ACCEPTABILITY OF RISK

Block Number 1. Method: Enter

Q1A	Q1B	Q1C	Q1D	Q1E	Q1F	Q1H	Q1I
Q1J	Q1K	Q1L	Q1M	Q1N	Q1P	Q1GSQ	

Variable(s) Entered on Step Number

1..	Q1GSQ	
2..	Q1D	ASBESTOS EXPERT KNOWLEDGE
3..	Q1M	ASBESTOS LIKELIHOOD OCCURRENCE
4..	Q1I	ASBESTOS INSTITUTIONAL CONTROL
5..	Q1B	ASBESTOS DREAD OF RISK
6..	Q1E	ASBESTOS EQUITY
7..	Q1H	ASBESTOS NUMBER OF PEOPLE EXPOSED
8..	Q1F	ASBESTOS SOCIETY'S KNOWLEDGE
9..	Q1L	ASBESTOS BENEFIT TO INDIVIDUAL
10..	Q1C	ASBESTOS TRUST IN INSTITUTION
11..	Q1A	ASBESTOS VOLITION
12..	Q1P	ASBESTOS SOCIETAL RISK ACCEPTANCE
13..	Q1J	ASBESTOS PERSONAL CONTROL
14..	Q1K	ASBESTOS BENEFIT TO SOCIETY
15..	Q1N	ASBESTOS OVERALL LEVEL OF RISK

Multiple R	.70236
R Square	.49332
Adjusted R Square	.41159
Standard Error	.99738

------------------------ Variables in the Equation ---------------

Variable	B	SE B	Beta	T	Sig T
Q1A	.087583	.062624	.116920	1.399	.1653
Q1B	.158606	.069649	.176671	2.277	.0251
Q1C	.020440	.064989	.025612	.315	.7538
Q1D	.073817	.076902	.074852	.960	.3396
Q1E	.162094	.079938	.170051	2.028	.0454
Q1F	.088095	.072465	.097803	1.216	.2272
Q1H	-.070205	.062579	-.089659	-1.122	.2648
Q1I	-.008429	.074586	-.009682	-.113	.9103
Q1J	.040011	.068287	.050113	.586	.5593
Q1K	-.098930	.077968	-.116351	-1.269	.2077
Q1L	.230317	.085066	.246332	2.707	.0081
Q1M	.052386	.087916	.052317	.596	.5527
Q1N	.050746	.103595	.046001	.490	.6254
Q1P	.411220	.079042	.446810	5.203	.0000
Q1GSQ	-.003531	.008363	-.033690	-.422	.6739
(Constant)	-.261946	.805375		-.325	.7457

Generic Hazard Domain: Surfing

N of Cases = 108

Equation Number 1 Dependent Variable.. Q2N SURFING OVERALL LEVEL OF RISK

Block Number 1. Method: Enter

Q2B	Q2C	Q2D	Q2E	Q2F	Q2G	Q2H	Q2I
Q2J	Q2K	Q2L	Q2M	Q2P	Q2A1	Q2O	

Variable(s) Entered on Step Number

1..	Q2O	SURFING ACCEPTABILITY OF RISK
2..	Q2C	SURFING TRUST IN INSTITUTION
3..	Q2H	SURFING NUMBER OF PEOPLE EXPOSED
4..	Q2F	SURFING SOCIETY'S KNOWLEDGE
5..	Q2J	SURFING PERSONAL CONTROL
6..	Q2D	SURFING EXPERT KNOWLEDGE
7..	Q2K	SURFING BENEFIT TO SOCIETY
8..	Q2E	SURFING EQUITY
9..	Q2I	SURFING INSTITUTIONAL CONTROL
10..	Q2G	SURFING SEVERITY OF CONSEQUENCES
11..	Q2A1	SURFING VOLITION
12..	Q2L	SURFING BENEFIT TO INDIVIDUAL
13..	Q2B	SURFING DREAD OF RISK
14..	Q2M	SURFING LIKELIHOOD OCCURRENCE
15..	Q2P	SURFING SOCIETAL RISK ACCEPTANCE

Multiple R	.65474
R Square	.42868
Adjusted R Square	.33553
Standard Error	1.10783

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q2B	-.013278	.118530	-.010614	-.112	.9111
Q2C	.138637	.071740	.172204	1.933	.0564
Q2D	.081382	.083454	.084421	.975	.3320
Q2E	.002737	.062290	.003740	.044	.9650
Q2F	-.082981	.088146	-.081141	-.941	.3490
Q2G	.289644	.088756	.292903	3.263	.0015
Q2H	-.017399	.062372	-.023955	-.279	.7809
Q2I	.016795	.082321	.017796	.204	.8388
Q2J	-.075742	.076337	-.092777	-.992	.3237
Q2K	-.053260	.066591	-.070141	-.800	.4259
Q2L	-.160993	.096395	-.155729	-1.670	.0983
Q2M	.445164	.099035	.432930	4.495	.0000
Q2P	-.023765	.107159	-.023185	-.222	.8250
Q2A1	.606335	.327287	.170666	1.853	.0671
Q2O	.134103	.108102	.135242	1.241	.2179
(Constant)	.500879	.822258		.609	.5439

Generic Hazard Domain: Surfing

Equation Number 1 Dependent Variable.. Q2O SURFING ACCEPTABILITY OF RISK

Block Number 1. Method: Enter

Q2B	Q2C	Q2D	Q2E	Q2F	Q2G	Q2H	Q2I
Q2J	Q2K	Q2L	Q2M	Q2P	Q2A1	Q2N	

Variable(s) Entered on Step Number

1..	Q2N	SURFING OVERALL LEVEL OF RISK
2..	Q2F	SURFING SOCIETY'S KNOWLEDGE
3..	Q2K	SURFING BENEFIT TO SOCIETY
4..	Q2E	SURFING EQUITY
5..	Q2D	SURFING EXPERT KNOWLEDGE
6..	Q2J	SURFING PERSONAL CONTROL
7..	Q2P	SURFING SOCIETAL RISK ACCEPTANCE
8..	Q2H	SURFING NUMBER OF PEOPLE EXPOSED
9..	Q2I	SURFING INSTITUTIONAL CONTROL
10..	Q2C	SURFING TRUST IN INSTITUTION
11..	Q2L	SURFING BENEFIT TO INDIVIDUAL
12..	Q2A1	SURFING VOLITION
13..	Q2B	SURFING DREAD OF RISK
14..	Q2G	SURFING SEVERITY OF CONSEQUENCES
15..	Q2M	SURFING LIKELIHOOD OCCURRENCE

Multiple R	.69721
R Square	.48611
Adjusted R Square	.40232
Standard Error	1.05960

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q2B	.039847	.113301	.031586	.352	.7259
Q2C	-.018416	.069969	-.022682	-.263	.7930
Q2D	.123679	.079189	.127218	1.562	.1218
Q2E	.094151	.058764	.127553	1.602	.1125
Q2F	-.025308	.084673	-.024539	-.299	.7657
Q2G	.046985	.089537	.047114	.525	.6010
Q2H	-.035013	.059570	-.047800	-.588	.5581
Q2I	.048894	.078590	.051371	.622	.5354
Q2J	-.001136	.073403	-.001380	-.015	.9877
Q2K	.005565	.063910	.007267	.087	.9308
Q2L	.076130	.093249	.073021	.816	.4164
Q2M	.128707	.103745	.124116	1.241	.2179
Q2P	.555040	.084628	.536937	6.559	.0000
Q2A1	-.111554	.318612	-.031135	-.350	.7270
Q2N	.122681	.098895	.121648	1.241	.2179
(Constant)	-.607083	.785499		-.773	.4416

Generic Hazard Domain: Bush Fires

N of cases = 106

Dependent variable: Q3N Overall level of risk

Method: Enter

Q3P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q3O (Individual acceptance) r = .78.

Variable(s) Entered on Step Number

1..	Q3O	BUSH FIRES ACCEPTABILITY OF RISK
2..	Q3H	BUSH FIRES NUMBER OF PEOPLE EXPOSED
3..	Q3J	BUSH FIRES PERSONAL CONTROL
4..	Q3F	BUSH FIRES SOCIETY'S KNOWLEDGE
5..	Q3A	BUSH FIRES VOLITION
6..	Q3C	BUSH FIRES TRUST IN INSTITUTION
7..	Q3M	BUSH FIRES LIKELIHOOD OCCURRENCE
8..	Q3B	BUSH FIRES DREAD OF RISK
9..	Q3I	BUSH FIRES INSTITUTIONAL CONTROL
10..	Q3E	BUSH FIRES EQUITY
11..	Q3LSQ	BUSH FIRES INDIVIDUAL BENEFIT
12..	Q3GSQ	BUSH FIRES SEVERITY
13..	Q3DLG10	BUSH FIRES EXPERT KNOWLEDGE
14..	Q3KSQ	BUSH FIRES SOCIETAL BENEFIT

Multiple R	.64835
R Square	.42036
Adjusted R Square	.33118
Standard Error	.95951

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q3DLG10	-.686540	.569999	-.127712	-1.204	.2315
Q3GSQ	-.005558	.010812	-.052684	-.514	.6085
Q3KSQ	-.003889	.016613	-.040963	-.234	.8154
Q3LSQ	.001472	.015624	.015782	.094	.9251
Q3A	.068097	.066112	.095873	1.030	.3057
Q3B	.124690	.099199	.122241	1.257	.2120
Q3C	.050187	.069899	.066550	.718	.4746
Q3E	.063814	.066497	.096390	.960	.3398
Q3F	-.071890	.068710	-.098670	-1.046	.2982
Q3H	.034526	.064381	.046514	.536	.5931
Q3I	.062077	.061618	.097285	1.007	.3164
Q3J	-.112156	.062096	-.164445	-1.806	.0742
Q3M	.202759	.073697	.236203	2.751	.0072
Q3O	.302424	.084736	.397654	3.569	.0006
(Constant)	2.476351	.860953		2.876	.0050

Generic Hazard Domain: Bush Fires

N of cases = 106

Dependent variable: Q3O Individual acceptance of risk

Method: Enter

Q3P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q3O (Individual acceptance) r = .78.

Variable(s) Entered on Step Number

1..	Q3N	BUSH FIRES OVERALL LEVEL OF RISK
2..	Q3I	BUSH FIRES INSTITUTIONAL CONTROL
3..	Q3C	BUSH FIRES TRUST IN INSTITUTION
4..	Q3H	BUSH FIRES NUMBER OF PEOPLE EXPOSED
5..	Q3F	BUSH FIRES SOCIETY'S KNOWLEDGE
6..	Q3E	BUSH FIRES EQUITY
7..	Q3B	BUSH FIRES DREAD OF RISK
8..	Q3LSQ	BUSH FIRES INDIVIDUAL BENEFIT
9..	Q3M	BUSH FIRES LIKELIHOOD OCCURRENCE
10..	Q3J	BUSH FIRES PERSONAL CONTROL
11..	Q3A	BUSH FIRES VOLITION
12..	Q3GSQ	BUSH FIRES SEVERITY
13..	Q3DLG10	BUSH FIRES EXPERT KNOWLEDGE
14..	Q3KSQ	BUSH FIRES SOCIETAL BENEFIT

Multiple R	.74155
R Square	.54990
Adjusted R Square	.48065
Standard Error	1.11177

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q3DLG10	-.443824	.664063	-.062790	-.668	.5056
Q3GSQ	.033955	.012030	.244784	2.822	.0059
Q3KSQ	-.022431	.019110	-.179694	-1.174	.2436
Q3LSQ	.056502	.017108	.460568	3.303	.0014
Q3A	.037128	.076950	.039754	.482	.6306
Q3B	.146292	.114915	.109072	1.273	.2062
Q3C	.082988	.080753	.083692	1.028	.3068
Q3E	.147882	.075870	.169880	1.949	.0544
Q3F	.138829	.078758	.144911	1.763	.0813
Q3H	-.081506	.074225	-.083511	-1.098	.2751
Q3I	.046950	.071624	.055958	.656	.5138
Q3J	-.049267	.073046	-.054937	-.674	.5017
Q3M	.006046	.088870	.005357	.068	.9459
Q3N	.406018	.113762	.308785	3.569	.0006
(Constant)	-1.726578	1.026091		-1.683	.0959

Generic Hazard Domain: Toxic Waste Incineration

N of cases = 109

Dependent variable: Q4N Overall level of risk

Method: Enter

Q4L (Individual benefit) was not included in the regression analysis due to strong correlation with Q4K (Societal benefit) r = .71.

```
Variable(s) Entered on Step Number
   1..    Q4GSQ     Tox Waste Incin Severity
   2..    Q4P       TOX WASTE INCIN SOCIETAL RISK ACCEPTANCE
   3..    Q4M       TOX WASTE INCIN LIKELIHOOD OCCURRENCE
   4..    Q4J       TOX WASTE INCIN PERSONAL CONTROL
   5..    Q4D       TOX WASTE INCIN EXPERT KNOWLEDGE
   6..    Q4A       TOX WASTE INCIN VOLITION
   7..    Q4I       TOX WASTE INCIN INSTITUTIONAL CONTROL
   8..    Q4E       TOX WASTE INCIN EQUITY
   9..    Q4H       TOX WASTE INCIN NUMBER PEOPLE EXPOSED
  10..    Q4F       TOX WASTE INCIN SOCIETY'S KNOWLEDGE
  11..    Q4K       TOX WASTE INCIN BENEFIT TO SOCIETY
  12..    Q4B       TOX WASTE INCIN DREAD OF RISK
  13..    Q4C       TOX WASTE INCIN TRUST IN INSTITUTION
  14..    Q4O       TOX WASTE INCIN ACCEPTABILITY OF RISK

Multiple R            .73852
R Square              .54541
Adjusted R Square     .47770
Standard Error        .87843
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q4A	-.037698	.057713	-.050388	-.653	.5152
Q4B	-.061122	.064390	-.082278	-.949	.3449
Q4C	-.102725	.051817	-.177132	-1.982	.0503
Q4D	.002868	.057948	.004303	.049	.9606
Q4E	.024390	.065766	.028269	.371	.7116
Q4F	-.026662	.061654	-.036031	-.432	.6664
Q4H	-.028601	.052880	-.041918	-.541	.5899
Q4I	-.089579	.052998	-.128797	-1.690	.0943
Q4J	.055669	.051461	.085419	1.082	.2821
Q4K	.033573	.060030	.048895	.559	.5773
Q4M	.246957	.069123	.295362	3.573	.0006
Q4O	.208121	.073750	.272088	2.822	.0058
Q4P	.223445	.079748	.282652	2.802	.0062
Q4GSQ	.046092	.008479	.450559	5.436	.0000
(Constant)	1.368067	.632175		2.164	.0330

Generic Hazard Domain: Toxic Waste Incineration

N of cases = 109

Dependent variable: Q4O Individual acceptance of risk

Method: Enter

Q4L (Individual benefit) was not included in the regression analysis due to strong correlation with Q4K (Societal benefit) r = .71.

```
Variable(s) Entered on Step Number
   1..     Q4N       TOX WASTE INCIN OVERALL LEVEL OF RISK
   2..     Q4D       TOX WASTE INCIN EXPERT KNOWLEDGE
   3..     Q4A       TOX WASTE INCIN VOLITION
   4..     Q4H       TOX WASTE INCIN NUMBER PEOPLE EXPOSED
   5..     Q4E       TOX WASTE INCIN EQUITY
   6..     Q4I       TOX WASTE INCIN INSTITUTIONAL CONTROL
   7..     Q4J       TOX WASTE INCIN PERSONAL CONTROL
   8..     Q4B       TOX WASTE INCIN DREAD OF RISK
   9..     Q4K       TOX WASTE INCIN BENEFIT TO SOCIETY
  10..     Q4F       TOX WASTE INCIN SOCIETY'S KNOWLEDGE
  11..     Q4M       TOX WASTE INCIN LIKELIHOOD OCCURRENCE
  12..     Q4C       TOX WASTE INCIN TRUST IN INSTITUTION
  13..     Q4GSQ     Tox Waste Incin Severity
  14..     Q4P       TOX WASTE INCIN SOCIETAL RISK ACCEPTANCE
```

Multiple R	.72139
R Square	.52041
Adjusted R Square	.44898
Standard Error	1.17958

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q4A	.099649	.076990	.101880	1.294	.1987
Q4B	.065738	.086612	.067688	.759	.4498
Q4C	.029011	.070957	.038264	.409	.6836
Q4D	-5.57188E-04	.077815	-6.395E-04	-.007	.9943
Q4E	-.006027	.088374	-.005343	-.068	.9458
Q4F	.054486	.082682	.056321	.659	.5115
Q4H	.066665	.070785	.074735	.942	.3487
Q4I	.078171	.071789	.085971	1.089	.2790
Q4J	-.072126	.069132	-.084653	-1.043	.2995
Q4K	.114381	.079876	.127420	1.432	.1555
Q4M	-.030081	.098872	-.027519	-.304	.7616
Q4P	.419195	.102742	.405606	4.080	.0001
Q4GSQ	-.006681	.013036	-.049956	-.513	.6095
Q4N	.375275	.132982	.287049	2.822	.0058
(Constant)	-.418285	.868714		-.481	.6313

Generic Hazard Domain: Dams

N of cases = 108

Dependent variable: Q5N Overall level of risk

Method: Enter

Q5L (Individual benefit) was not included in the regression analysis due to strong correlation with Q5K (Societal benefit) r = .79.

Q5P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q5O (Individual acceptance) r = .87.

```
Variable(s) Entered on Step Number
   1..     Q5O        DAMS ACCEPTABILITY OF RISK
   2..     Q5G        DAMS SEVERITY OF CONSEQUENCES
   3..     Q5E        DAMS EQUITY
   4..     Q5I        DAMS INSTITUTIONAL CONTROL
   5..     Q5H        DAMS NUMBER OF PEOPLE EXPOSED
   6..     Q5A        DAMS VOLITION
   7..     Q5M        DAMS LIKELIHOOD OCCURRENCE
   8..     Q5D        DAMS EXPERT KNOWLEDGE
   9..     Q5B        DAMS DREAD OF RISK
  10..     Q5K        DAMS BENEFIT TO SOCIETY
  11..     Q5F        DAMS SOCIETY'S KNOWLEDGE
  12..     Q5J        DAMS PERSONAL CONTROL
  13..     Q5C        DAMS TRUST IN INSTITUTION

Multiple R            .69798
R Square              .48718
Adjusted R Square     .41626
Standard Error       1.13332
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q5A	-.015726	.067140	-.021569	-.234	.8153
Q5B	.216221	.080632	.241664	2.682	.0087
Q5C	-.047392	.114401	-.049120	-.414	.6796
Q5D	-.096722	.108293	-.083369	-.893	.3741
Q5E	-.002931	.059374	-.003953	-.049	.9607
Q5F	.140583	.082139	.154792	1.712	.0903
Q5G	.110039	.072493	.120499	1.518	.1324
Q5H	.036457	.065323	.049778	.558	.5781
Q5I	.092556	.083234	.109595	1.112	.2690
Q5J	-.025011	.066480	-.035894	-.376	.7076
Q5K	.290763	.099179	.264562	2.932	.0042
Q5M	.297389	.080703	.317439	3.685	.0004
Q5O	.090997	.085920	.101815	1.059	.2923
(Constant)	-.333744	.526757		-.634	.5279

Generic Hazard Domain: Dams

N of cases = 108

Dependent variable: Q5O Individual acceptance of risk

Method: Enter

Q5L (Individual benefit) was not included in the regression analysis due to strong correlation with Q5K (Societal benefit) r = .79.

Q5P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q5O (Individual acceptance) r = .87.

```
Variable(s) Entered on Step Number
   1..      Q5N        DAMS OVERALL LEVEL OF RISK
   2..      Q5E        DAMS EQUITY
   3..      Q5G        DAMS SEVERITY OF CONSEQUENCES
   4..      Q5A        DAMS VOLITION
   5..      Q5D        DAMS EXPERT KNOWLEDGE
   6..      Q5H        DAMS NUMBER OF PEOPLE EXPOSED
   7..      Q5I        DAMS INSTITUTIONAL CONTROL
   8..      Q5B        DAMS DREAD OF RISK
   9..      Q5M        DAMS LIKELIHOOD OCCURRENCE
  10..      Q5F        DAMS SOCIETY'S KNOWLEDGE
  11..      Q5K        DAMS BENEFIT TO SOCIETY
  12..      Q5J        DAMS PERSONAL CONTROL
  13..      Q5C        DAMS TRUST IN INSTITUTION
```

Multiple R	.64549
R Square	.41666
Adjusted R Square	.33599
Standard Error	1.35244

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q5A	.056004	.079936	.068654	.701	.4853
Q5B	.308075	.094642	.307741	3.255	.0016
Q5C	.180096	.135376	.166829	1.330	.1866
Q5D	.164668	.128661	.126854	1.280	.2037
Q5E	.112108	.069905	.135111	1.604	.1121
Q5F	.016628	.099521	.016364	.167	.8677
Q5G	-.022719	.087531	-.022235	-.260	.7958
Q5H	.054693	.077878	.066742	.702	.4842
Q5I	-.117781	.099237	-.124646	-1.187	.2383
Q5J	.056679	.079177	.072700	.716	.4759
Q5K	.213849	.121663	.173905	1.758	.0821
Q5M	-.042319	.102935	-.040372	-.411	.6819
Q5N	.129584	.122356	.115816	1.059	.2923
(Constant)	-.366205	.628806		-.582	.5617

Generic Hazard Domain: Bicycles

N of cases = 109

Dependent variable: Q6N Overall level of risk

Method: Enter

Q6P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q6O (Individual acceptance) r = .94

```
Variable(s) Entered on Step Number
   1..     Q6LLG10     BICYCLES IND BENEFIT
   2..     Q6H         BICYCLES NUMBER OF PEOPLE EXPOSED
   3..     Q6C         BICYCLES TRUST IN INSTITUTION
   4..     Q6E         BICYCLES EQUITY
   5..     Q6M         BICYCLES LIKELIHOOD OCCURRENCE
   6..     Q6G         BICYCLES SEVERITY OF CONSEQUENCES
   7..     Q6O         BICYCLES ACCEPTABILITY OF RISK
   8..     Q6F         BICYCLES SOCIETY'S KNOWLEDGE
   9..     Q6I         BICYCLES INSTITUTIONAL CONTROL
  10..     Q6AMED      BICYCLES VOLITION
  11..     Q6JLG10     BICYCLES PERSONAL CONTROL
  12..     Q6K         BICYCLES BENEFIT TO SOCIETY
  13..     Q6DLG10     BICYCLES EXPERT KNOWLEDGE
  14..     Q6B         BICYCLES DREAD OF RISK

Multiple R              .68658
R Square                .47139
Adjusted R Square       .39266
Standard Error         1.06368
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q6B	.231206	.093820	.256164	2.464	.0155
Q6C	.076753	.077849	.087516	.986	.3267
Q6E	-.116399	.054070	-.172074	-2.153	.0339
Q6F	.118112	.096452	.109015	1.225	.2238
Q6G	.085680	.072828	.096232	1.176	.2424
Q6H	.008519	.068917	.010354	.124	.9019
Q6I	.007669	.072722	.009515	.105	.9162
Q6K	-.125120	.080488	-.142992	-1.555	.1234
Q6M	.434870	.085691	.418623	5.075	.0000
Q6O	.068476	.085741	.069787	.799	.4265
Q6AMED	-.269600	.272676	-.093328	-.989	.3253
Q6DLG10	.543847	.579545	.088497	.938	.3504
Q6JLG10	.941577	.540892	.160579	1.741	.0850
Q6LLG10	.138955	.542384	.025003	.256	.7984
(Constant)	.856504	.815044		1.051	.2960

Generic Hazard Domain: Bicycles

N of cases = 109

Dependent variable: Q6O Individual acceptance of risk

Method: Enter

Q6P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q6O (Individual acceptance) r = .94

```
Variable(s) Entered on Step Number
   1..     Q6N        BICYCLES OVERALL LEVEL OF RISK
   2..     Q6I        BICYCLES INSTITUTIONAL CONTROL
   3..     Q6K        BICYCLES BENEFIT TO SOCIETY
   4..     Q6E        BICYCLES EQUITY
   5..     Q6H        BICYCLES NUMBER OF PEOPLE EXPOSED
   6..     Q6F        BICYCLES SOCIETY'S KNOWLEDGE
   7..     Q6C        BICYCLES TRUST IN INSTITUTION
   8..     Q6G        BICYCLES SEVERITY OF CONSEQUENCES
   9..     Q6AMED     BICYCLES VOLITION
  10..     Q6JLG10    BICYCLES PERSONAL CONTROL
  11..     Q6DLG10    BICYCLES EXPERT KNOWLEDGE
  12..     Q6M        BICYCLES LIKELIHOOD OCCURRENCE
  13..     Q6LLG10    BICYCLES IND BENEFIT
  14..     Q6B        BICYCLES DREAD OF RISK

Multiple R            .51816
R Square              .26849
Adjusted R Square     .15954
Standard Error       1.27524
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q6B	.286402	.112234	.311355	2.552	.0123
Q6C	-.212494	.091218	-.237740	-2.330	.0220
Q6E	.027427	.066343	.039784	.413	.6802
Q6F	.224123	.114239	.202974	1.962	.0527
Q6G	.017683	.087935	.019487	.201	.8411
Q6H	.115246	.081771	.137436	1.409	.1620

Generic Hazard Domain: **Vaccinations**

N of cases = 109

Dependent variable: Q7N Overall level of risk

Method: Enter

Q7P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q7O (Individual acceptance) r = .93

Q7LLG10 (Individual benefit) was not included in the regression analysis due to strong correlation with Q7KLG10 (Societal benefit) r = .75

```
Variable(s) Entered on Step Number
   1..     Q7KLG10    VACCINATIONS SOCIETAL BENEFIT
   2..     Q7E        VACCINATIONS EQUITY
   3..     Q7F        VACCINATIONS SOCIETY'S KNOWLEDGE
   4..     Q7B        VACCINATIONS DREAD OF RISK
   5..     Q7H        VACCINATIONS NUMBER OF PEOPLE EXPOSED
   6..     Q7I        VACCINATIONS INSTITUTIONAL CONTROL
   7..     Q7DLG10    VACCINATIONS EXPERT KNOWLEDGE
   8..     Q7J        VACCINATIONS PERSONAL CONTROL
   9..     Q7G        VACCINATIONS SEVERITY OF CONSEQUENCES
  10..     Q7O        VACCINATIONS ACCEPTABILITY OF RISK
  11..     Q7M        VACCINATIONS LIKELIHOOD OCCURRENCE
  12..     Q7A        VACCINATIONS VOLITION
  13..     Q7C        VACCINATIONS TRUST IN INSTITUTION

Multiple R           .77643
R Square             .60284
Adjusted R Square    .54850
Standard Error       .90232
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q7A	.100212	.055590	.146006	1.803	.0746
Q7B	.071555	.061772	.097182	1.158	.2496
Q7C	.137316	.079713	.141106	1.723	.0882
Q7E	.009204	.043291	.015287	.213	.8321
Q7F	-.019163	.052914	-.026478	-.362	.7180
Q7G	.099140	.063865	.114912	1.552	.1239
Q7H	.002562	.048574	.003546	.053	.9581
Q7I	-.023365	.070588	-.025188	-.331	.7414
Q7J	.009726	.047271	.015926	.206	.8374
Q7M	.375909	.069489	.428692	5.410	.0000
Q7O	.265541	.055891	.355568	4.751	.0000
Q7DLG10	.745722	.444867	.123877	1.676	.0970
Q7KLG10	-.682782	.471422	-.117252	-1.448	.1508
(Constant)	-.357980	.475029		-.754	.4530

Generic Hazard Domain: Vaccinations

N of cases = 109

Dependent variable: Q7O Individual acceptance of risk

Method: Enter

Q7P (Societal acceptance) was not included in the regression analysis due to strong correlation with Q7O (Individual acceptance) r = .93

Q7LLG10 (Individual benefit) was not included in the regression analysis due to strong correlation with Q7KLG10 (Societal benefit) r = .75

```
Variable(s) Entered on Step Number
   1..      Q7N         VACCINATIONS OVERALL LEVEL OF RISK
   2..      Q7H         VACCINATIONS NUMBER OF PEOPLE EXPOSED
   3..      Q7J         VACCINATIONS PERSONAL CONTROL
   4..      Q7F         VACCINATIONS SOCIETY'S KNOWLEDGE
   5..      Q7I         VACCINATIONS INSTITUTIONAL CONTROL
   6..      Q7KLG10     VACCINATIONS SOCIETAL BENEFIT
   7..      Q7E         VACCINATIONS EQUITY
   8..      Q7DLG10     VACCINATIONS EXPERT KNOWLEDGE
   9..      Q7G         VACCINATIONS SEVERITY OF CONSEQUENCES
  10..      Q7B         VACCINATIONS DREAD OF RISK
  11..      Q7A         VACCINATIONS VOLITION
  12..      Q7C         VACCINATIONS TRUST IN INSTITUTION
  13..      Q7M         VACCINATIONS LIKELIHOOD OCCURRENCE
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q7A	-.068863	.093015	-.074928	-.740	.4609
Q7B	.142208	.101604	.144238	1.400	.1649
Q7C	-.160756	.132549	-.123368	-1.213	.2282
Q7E	.059768	.071187	.074140	.840	.4032
Q7F	.033625	.087304	.034696	.385	.7010
Q7G	.055121	.106561	.047714	.517	.6062
Q7H	-.100592	.079484	-.103999	-1.266	.2088
Q7I	.035181	.116486	.028323	.302	.7633
Q7J	-.114397	.077131	-.139887	-1.483	.1413
Q7M	-.208013	.129390	-.177159	-1.608	.1112
Q7DLG10	-.294290	.744229	-.036509	-.395	.6934
Q7KLG10	2.275732	.750963	.291856	3.030	.0031
Q7N	.723002	.152178	.539944	4.751	.0000
(Constant)	1.248640	.775665		1.610	.1108

Generic Hazard Domain: Sunbathing

N of cases = 110

Dependent variable: Q8N Overall level of risk

Method: Enter

Variable(s) Entered on Step Number

1..	Q8KSQ	SUNBATHING SOCIETAL BENEFIT
2..	Q8DLG10	SUNBATHING EXPERT KNOWLEDGE
3..	Q8B	SUNBATHING DREAD OF RISK
4..	Q8M	SUNBATHING LIKELIHOOD OCCURRENCE
5..	Q8HMED	SUNBATHING NUMBER OF PEOPLE EXPOSED
6..	Q8P	SUNBATHING SOCIETAL RISK ACCEPTANCE
7..	Q8F	SUNBATHING SOCIETY'S KNOWLEDGE
8..	Q8I	SUNBATHING INSTITUTIONAL CONTROL
9..	Q8ALG10	SUNBATHING VOLITION
10..	Q8E	SUNBATHING EQUITY
11..	Q8G	SUNBATHING SEVERITY OF CONSEQUENCES
12..	Q8JMED	SUNBATHING PERSONAL CONTROL
13..	Q8C	SUNBATHING TRUST IN INSTITUTION
14..	Q8L	SUNBATHING BENEFIT TO INDIVIDUAL
15..	Q8O	SUNBATHING ACCEPTABILITY OF RISK

Multiple R	.69273
R Square	.47987
Adjusted R Square	.39687
Standard Error	.97236

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q8B	.165655	.060255	.225416	2.749	.0072
Q8C	.005918	.077680	.006791	.076	.9394
Q8E	-.052247	.052752	-.084567	-.990	.3245
Q8F	.050724	.071030	.058330	.714	.4769
Q8G	.066249	.084792	.065982	.781	.4366
Q8I	.023563	.060506	.032099	.389	.6978
Q8L	-.045656	.061183	-.070348	-.746	.4574
Q8M	.396764	.082430	.400002	4.813	.0000
Q8O	.222850	.073641	.311247	3.026	.0032
Q8P	.038975	.072570	.052374	.537	.5925
Q8ALG10	-.109718	.494522	-.018304	-.222	.8249
Q8DLG10	.174179	.541418	.029090	.322	.7484
Q8HMED	.113400	.205456	.045463	.552	.5823
Q8JMED	-.227804	.233416	-.085132	-.976	.3316
Q8KSQ	.011979	.008872	.130662	1.350	.1802
(Constant)	.988085	.823948		1.199	.2335

Generic Hazard Domain: Sunbathing

N of cases = 110

Dependent variable: Q8O Individual acceptance of risk

Method: Enter

Variable(s) Entered on Step Number

1..	Q8N	SUNBATHING OVERALL LEVEL OF RISK
2..	Q8C	SUNBATHING TRUST IN INSTITUTION
3..	Q8HMED	SUNBATHING NUMBER OF PEOPLE EXPOSED
4..	Q8F	SUNBATHING SOCIETY'S KNOWLEDGE
5..	Q8L	SUNBATHING BENEFIT TO INDIVIDUAL
6..	Q8ALG10	SUNBATHING VOLITION
7..	Q8I	SUNBATHING INSTITUTIONAL CONTROL
8..	Q8G	SUNBATHING SEVERITY OF CONSEQUENCES
9..	Q8JMED	SUNBATHING PERSONAL CONTROL
10..	Q8E	SUNBATHING EQUITY
11..	Q8B	SUNBATHING DREAD OF RISK
12..	Q8P	SUNBATHING SOCIETAL RISK ACCEPTANCE
13..	Q8DLG10	SUNBATHING EXPERT KNOWLEDGE
14..	Q8M	SUNBATHING LIKELIHOOD OCCURRENCE
15..	Q8KSQ	SUNBATHING SOCIETAL BENEFIT

Multiple R	.72345
R Square	.52337
Adjusted R Square	.44732
Standard Error	1.30003

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q8B	.045622	.083604	.044449	.546	.5866
Q8C	-.022918	.103833	-.018829	-.221	.8258
Q8E	.046055	.070736	.053374	.651	.5166
Q8F	-.013183	.095213	-.010854	-.138	.8902
Q8G	.024451	.113705	.017437	.215	.8302
Q8I	-.069170	.080646	-.067465	-.858	.3932
Q8L	.189296	.079685	.208833	2.376	.0196
Q8M	-.001282	.123041	-9.257E-04	-.010	.9917
Q8P	.463762	.084586	.446202	5.483	.0000
Q8ALG10	.039974	.661329	.004775	.060	.9519
Q8DLG10	.100890	.724192	.012064	.139	.8895
Q8HMED	-.360465	.272614	-.103470	-1.322	.1893
Q8JMED	-.008089	.313650	-.002164	-.026	.9795
Q8KSQ	.002800	.011973	.021869	.234	.8156
Q8N	.398351	.131636	.285216	3.026	.0032
(Constant)	.084479	1.109968		.076	.9395

Asbestos Scenario A

```
N of Cases =    226

Equation Number 1
Dependent Variable..   Q9N    ASB SCEN A OVERALL LEVEL OF RISK


Block Number  1.  Method:  Enter
   Q9A       Q9B       Q9C       Q9D       Q9E       Q9F       Q9G       Q9H
   Q9I       Q9J       Q9K       Q9L       Q9M


Variable(s) Entered on Step Number
   1..     Q9M       ASB SCEN A LIKELIHOOD OCCURRENCE
   2..     Q9J       ASB SCEN A PERSONAL CONTROL
   3..     Q9B       ASB SCEN A DREAD OF RISK
   4..     Q9E       ASB SCEN A EQUITY
   5..     Q9C       ASB SCEN A TRUST IN INSTITUTION
   6..     Q9G       ASB SCEN A SEVERITY OF CONSEQUENCES
   7..     Q9K       ASB SCEN A BENEFIT TO SOCIETY
   8..     Q9I       ASB SCEN A INSTITUTIONAL CONTROL
   9..     Q9H       ASB SCEN A NUMBER OF PEOPLE EXPOSED
  10..     Q9F       ASB SCEN A SOCIETY'S KNOWLEDGE
  11..     Q9D       ASB SCEN A EXPERT KNOWLEDGE
  12..     Q9L       ASB SCEN A BENEFIT TO INDIVIDUAL
  13..     Q9A       ASB SCEN A VOLITION


Multiple R           .69015
R Square             .47631
Adjusted R Square    .44420
Standard Error       .84902
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q9A	.007225	.042134	.011398	.171	.8640
Q9B	.041478	.035522	.068074	1.168	.2442
Q9C	-.027692	.033939	-.044645	-.816	.4155
Q9D	-.068796	.040396	-.101596	-1.703	.0900
Q9E	.010715	.033093	.016794	.324	.7464
Q9F	.041168	.036165	.069810	1.138	.2563
Q9G	.395372	.058734	.360080	6.732	.0000
Q9H	.082785	.032479	.143001	2.549	.0115
Q9I	.015061	.030653	.026953	.491	.6237
Q9J	-.001540	.031418	-.002806	-.049	.9609
Q9K	.123188	.038879	.181313	3.169	.0018
Q9L	-.016258	.037932	-.025492	-.429	.6686
Q9M	.326154	.052683	.343960	6.191	.0000
(Constant)	.498868	.454388		1.098	.2735

Asbestos Scenario B

N OF CASES = 209

Equation Number 1

Dependent Variable.. Q15N ASBESTOS SCEN B OVERALL LEVEL OF RISK

NOTE: Q15L (INDIVIDUAL BENEFIT) NOT INCLUDED DUE TO STRONG CORRELATION WITH Q15K

Block Number 1. Method: Enter

Q15A	Q15B	Q15C	Q15D	Q15E	Q15F	Q15G	Q15H
Q15I	Q15J	Q15K	Q15M				

Variable(s) Entered on Step Number

1..	Q15M	ASB SCEN B LIKELIHOOD OCCURRENCE
2..	Q15A	ASB SCEN B VOLITION
3..	Q15I	ASB SCEN B INSTITUTIONAL CONTROL
4..	Q15D	ASB SCEN B EXPERT KNOWLEDGE
5..	Q15E	ASB SCEN B EQUITY
6..	Q15B	ASB SCEN B DREAD OF RISK
7..	Q15G	ASB SCEN B SEVERITY OF CONSEQUENCES
8..	Q15K	ASB SCEN B BENEFIT TO SOCIETY
9..	Q15F	ASB SCEN B SOCIETY'S KNOWLEDGE
10..	Q15C	ASB SCEN B TRUST IN INSTITUTION
11..	Q15J	ASB SCEN B PERSONAL CONTROL
12..	Q15H	ASB SCEN B NUMBER OF PEOPLE EXPOSED

Multiple R	.73377
R Square	.53841
Adjusted R Square	.51015
Standard Error	1.02305

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q15A	-.030282	.049415	-.034731	-.613	.5407
Q15B	.056976	.058521	.052055	.974	.3315
Q15C	.025341	.048318	.028567	.524	.6005
Q15D	-.025522	.051319	-.026874	-.497	.6195
Q15E	-.037120	.053051	-.036852	-.700	.4849
Q15F	-.055510	.045555	-.067334	-1.219	.2245
Q15G	.049148	.059483	.044263	.826	.4097
Q15H	.084317	.054664	.088467	1.542	.1246
Q15I	.086502	.044803	.102191	1.931	.0550
Q15J	-.050994	.043882	-.064433	-1.162	.2466
Q15K	.080736	.044167	.096985	1.828	.0691
Q15M	.615883	.054656	.641801	11.268	.0000
(Constant)	1.316850	.517195		2.546	.0117

Toxic Waste Incineration Scenario A

N of Cases = 220

Equation Number 1
Dependent Variable Q20N TOXIC WASTE INCIN SCEN A OVERALL LEVEL RISK

Block Number 1. Method: Enter

Q20A	Q20B	Q20C	Q20D	Q20E	Q20F	Q20G	Q20H
Q20I	Q20J	Q20K	Q20L	Q20M			

Variable(s) Entered on Step Number

1..	Q20M	TX INCIN SCEN A LIKELIHOOD OCCURRENCE
2..	Q20F	TX INCIN SCEN A SOCIETY'S KNOWLEDGE
3..	Q20A	TX INCIN SCEN A VOLITION
4..	Q20C	TX INCIN SCEN A TRUST IN INSTITUTION
5..	Q20L	TX INCIN SCEN A BENEFIT TO INDIVIDUAL
6..	Q20D	TX INCIN SCEN A EXPERT KNOWLEDGE
7..	Q20G	TX INCIN SCEN A SEVERITY OF CONSEQUENCES
8..	Q20H	TX INCIN SCEN A NUMBER OF PEOPLE EXPOSED
9..	Q20B	TX INCIN SCEN A DREAD OF RISK
10..	Q20J	TX INCIN SCEN A PERSONAL CONTROL
11..	Q20E	TX INCIN SCEN A EQUITY
12..	Q20I	TX INCIN SCEN A INSTITUTIONAL CONTROL
13..	Q20K	TX INCIN SCEN A BENEFIT TO SOCIETY

Multiple R	.78701
R Square	.61938
Adjusted R Square	.59536
Standard Error	.90542

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q20A	.042881	.048531	.045059	.884	.3780
Q20B	-.010303	.047689	-.010550	-.216	.8292
Q20C	.023847	.039456	.028983	.604	.5462
Q20D	.045637	.043240	.051367	1.055	.2925
Q20E	.074715	.046722	.080241	1.599	.1113
Q20F	.017536	.037660	.022016	.466	.6420
Q20G	.218937	.049161	.214006	4.453	.0000
Q20H	.112140	.042315	.131617	2.650	.0087
Q20I	.018367	.039496	.024788	.465	.6424
Q20J	-.094049	.049631	-.096672	-1.895	.0595
Q20K	.113754	.041098	.155532	2.768	.0062
Q20L	.019571	.050540	.021727	.387	.6990
Q20M	.454113	.052620	.474284	8.630	.0000
(Constant)	.112247	.425950		.264	.7924

Toxic Waste Incineration Scenario B

```
N of Cases =    219

Equation Number 1
Dependent Variable..   Q25N TOXIC WASTE INCIN SCEN B OVERALL LEVEL RISK

Block Number  1.  Method:  Enter
   Q25A      Q25B      Q25C      Q25D      Q25E      Q25F      Q25G      Q25H
   Q25I      Q25J      Q25K      Q25L      Q25M

Variable(s) Entered on Step Number
   1..     Q25M       TX INCIN SCEN B LIKELIHOOD OCCURRENCE
   2..     Q25F       TX INCIN SCEN B SOCIETY'S KNOWLEDGE
   3..     Q25B       TX INCIN SCEN B DREAD OF RISK
   4..     Q25J       TX INCIN SCEN B PERSONAL CONTROL
   5..     Q25I       TX INCIN SCEN B INSTITUTIONAL CONTROL
   6..     Q25C       TX INCIN SCEN B TRUST IN INSTITUTION
   7..     Q25L       TX INCIN SCEN B BENEFIT TO INDIVIDUAL
   8..     Q25H       TX INCIN SCEN B NUMBER OF PEOPLE EXPOSED
   9..     Q25E       TX INCIN SCEN B EQUITY
  10..     Q25D       TX INCIN SCEN B EXPERT KNOWLEDGE
  11..     Q25G       TX INCIN SCEN B SEVERITY OF CONSEQUENCES
  12..     Q25A       TX INCIN SCEN B VOLITION
  13..     Q25K       TX INCIN SCEN B BENEFIT TO SOCIETY

Multiple R           .77175
R Square             .59560
Adjusted R Square    .56995
Standard Error       .98813
```

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
Q25A	.167768	.055529	.178613	3.021	.0028
Q25B	.037902	.062622	.033880	.605	.5457
Q25C	-.028368	.049472	-.030273	-.573	.5670
Q25D	-.004643	.050346	-.005020	-.092	.9266
Q25E	-.011644	.057674	-.010893	-.202	.8402
Q25F	.038530	.047145	.041271	.817	.4147
Q25G	.193753	.065954	.165409	2.938	.0037
Q25H	.028001	.059778	.025311	.468	.6400
Q25I	.114637	.040436	.154814	2.835	.0050
Q25J	-.076646	.050263	-.082699	-1.525	.1288
Q25K	.152554	.052983	.184066	2.879	.0044
Q25L	.020266	.060312	.021026	.336	.7372
Q25M	.428148	.061478	.435246	6.964	.0000
(Constant)	-.081969	.472069		-.174	.8623