AN INTERNATIONAL PERSPECTIVE ON RISK AND PERCEPTION

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ABSTRACT

Across nations and across cultures, public perceptions of risk are increasingly important in the management of technology. The past two decades have witnessed substantial growth in international understanding of the bases for such perceptions and a corresponding awareness of their impacts on public policy. This paper summarizes major findings emanating from social science research and relates them to an integrative framework, termed the "social amplification of risk." These analyses suggest the limitations of public-information or educational campaigns in changing perception. Rather, demonstrable safety records, the rediscovery of the benefits of a particular technology, and the degree of commitment to fairness and equity in making decisions and managing technology warrant attention and comparative analysis.

INTRODUCTION

As we enter the last decade of this century, advanced industrial societies have yet to come to terms with the risks associated with technological progress. Everywhere the fruits of this progress are apparent--in health and longevity, in increased leisure and well-being, in the exercise of choice over large segments of our lives. Yet the standard measures of increased affluence and well-being obviously do not capture the sources of increased public disenchantment with technology, the apparent increased skepticism and distrust accorded to those institutions charged with navigating the waters between hazard and gain, and doubts over the long-term effects of technological choice now seem quite deep-seated.

Some see in this situation a growing irrationality of the public. How, at a time when people are demonstrably safer, can they feel overwhelmed by risk? Are we becoming societies of hypochondriacs? Others see it as the outcome of social group conflict, in which sects critical of the mainstream have won over the media and public sentiment. Still others see it as a long-term societal correction for the uncritical views of technology that prevailed in earlier times. Finally, some see it as part of the broader evolution of postmodern attitudes affecting diverse parts of society and social institutions.

This paper does not seek to resolve these fundamental questions concerning human experience in technological society. Rather, it addresses the emergence of risk as a fundamental issue across advanced industrial societies and inquires into the factors that contribute to public concern and make such problems intrinsically difficult to resolve. In view of this conference, particular reference is made to the issues associated with nuclear power and radioactive wastes.

RISK AND THE PUBLIC

Whatever the actual public health and environmental risks posed by nuclear power and the disposal of radioactive wastes, they pale in comparison with what the public believes they are. There can be no doubt that members of the public perceive substantial dangers from such facilities and are intensely concerned about them. Intense concern is apparent in the controversy that has erupted in many societies where search activities are conducted for a radioactive or other hazardous waste disposal facility. It is also apparent in the findings from a significant accumulation of polls, surveys, attitude studies, and psychometric research as well as in direct experience in diverse countries in Europe, North America, and Asia. Indeed, a 1989 conference on hazardous waste facility siting in Taiwan revealed a widespread commonality in problems associated with public opposition to a wide variety of facilities and high levels of distrust with institutions depicting and man-aging their risks.

The underlying seeds of public concern have become reasonably well-defined over the past decade. A 1980 national poll conducted by Robert Mitchell at Resources for the Future found that only 10 to 12 percent of the American public would voluntarily live a mile or less from either a nuclear power plant or a hazardous waste disposal site, whereas 25 percent would accept a coal-fired power plant and nearly 60 percent a 10-story office building at this distance. (1) Further, majority acceptance for the hazardous waste disposal site occurred only at distances greater than 100 miles from the site despite assurances in the poll that the facility would be built and operated according to government environmental and safety regulations and that disposal could be done safely and that the site would be inspected regularly for possible problems. These results have been replicated by many studies over the past decade as well as by the difficulties encountered in siting facilities that evoke images of hazard for many publics. Such imagery is very evident even for low-level radioactive waste facilities, where the associated hazards in a highly engineered facility are very small. Nonetheless, public images of potential catastrophe and long-term contamination of the biosphere abound. And it is clear, as indicated strongly in the U.S. EPA's Unfinished Business report, that the expenditure of public funds is often more driven by these concerns than the

experts' conceptions of where expenditures will most protect the public. (2)

Having said this, it must also be recognized that this imagery of hazard and public concern is not random or irrational.

Substantial insight is available from the psychometric studies of risk perception conducted over the past 15 years. Psychologists at Decision Research, Inc., have conducted a series of experiments on attitudes toward risky technologies and activities and have published numerous findings of direct importance to understanding public response in this area:

- Perhaps surprisingly, members of the public can order quite well risks from highest to lowest in terms of expected fatalities. Despite some striking discrepancies (as for nuclear power, for example), these discrepancies appear to be related to qualitative attributes of risk, such as dread, likelihood that a mishap would be fatal, and catastrophic potential of the hazard.
- Perceived risk is influenced (and sometimes biased) by the imaginability and memorability of the hazard.
- Particular technologies are viewed as having enormous disaster potentials, which contribute to the perception that they are risky technologies and to strong public concern about them.

The various opinion surveys suggest that radioactive and other hazardous wastes share many of the attributes associated with particularly feared technologies--they are dread, relatively "new" hazards, seen as likely to be fatal, and viewed as having catastrophic potential. These views have been shaped by highly memorable events--such as the leaks at low-level radioactive waste sites in the U.S., the Chernobyl accident and its aftermath of response in Europe, and the extensive media coverage of the U.S. Superfund cleanup program. It is likely that many individuals fail to distinguish between the indiscriminate past dumping of wastes and the proposed new waste repositories. Further, since substantial evidence indicates that people's beliefs change slowly and are extraordinarily persistent in the face of contrary evidence, "unscaring" people, to use Weinberg's term, through the provision of information is likely to be fruitless. Meanwhile, each new additional waste site discovery and each of the mishaps certain to occur in the network of waste management facilities will be taken as evidence of the high risk and confirmatory to the validity of the individual's perception.

In their taxonomy of 162 technological controversies, von Winterfeldt and Edwards recognize three major classes: food/drug/consumer products, industrial development, and technological mysteries and value threats. (3) Contrary to the assumption held by some that siting a hazardous waste disposal facility is akin to locating other large-scale facilities (such as dams, airports, or the Alaskan pipeline), it is apparent that hazardous waste facilities fall into the class of "technological mysteries and value threats." This group contains the most dramatic controversies, involving the potential for disaster or possessing dreaded side effects that threaten social values. The debate in such controversies oscillates between factual disagreements and value disputes, receives widespread media coverage, and involves a broad spectrum of "stakeholders." In considering appropriate tools for resolution of this class of controversies, von Winterfeldt and Edwards conclude that compensation, bargaining, and negotiation will, because of the shifting debate and the presence of moral considerations, be less effective than for other controversies. They call for the creation of institutional mechanisms that involve stakeholders who are committed to resolution of the issues.

All this suggests that perceived risk is a central problem in many technological decisions, that public perceptions are rooted in "objective" characteristics of the risks, that the risk issues interact with related value conflicts, and that the underlying imagery and attitudes are likely to be persistent and difficult to change.

THE SOCIAL AMPLIFICATION OF RISK

Two years ago, we proposed a new framework to integrate the technical and social approaches to risk, which we term The Social Amplification of Risk (Fig. 1). (4) Its basic purpose is to explain why risk events that are seemingly very small can have unexpectedly large social impacts and can generate strong public concerns. People experience risks through personal experience or the depiction of the event in communication sources. Risk-related information is processed by social and individual amplification *stations*, including the scientist who communicates the risk assessment, the news media, activist social organizations, informal networks of friends and neighbors, and public agencies. These information systems *amplify* risk events in two primary ways--by intensifying or weakening signals about the risk and by filtering the signals with respect to the attributes of risk and their importance.

The informational amplification of risk both generates and reacts to behavioral responses in social groups and individuals. These, in turn, result in such secondary impacts as mental imagery and antitechnology attitudes, impacts on business sales and property values, and political and social pressures. Through such secondary effects, the impacts of the risk event may "ripple" to other parties, distant locations, or future generations. Such was the case with the Three Mile Island accident of 1979, which, although probably resulting in no fatalities, shut down nuclear plants worldwide, cost billions of dollars, and eroded public confidence in nuclear

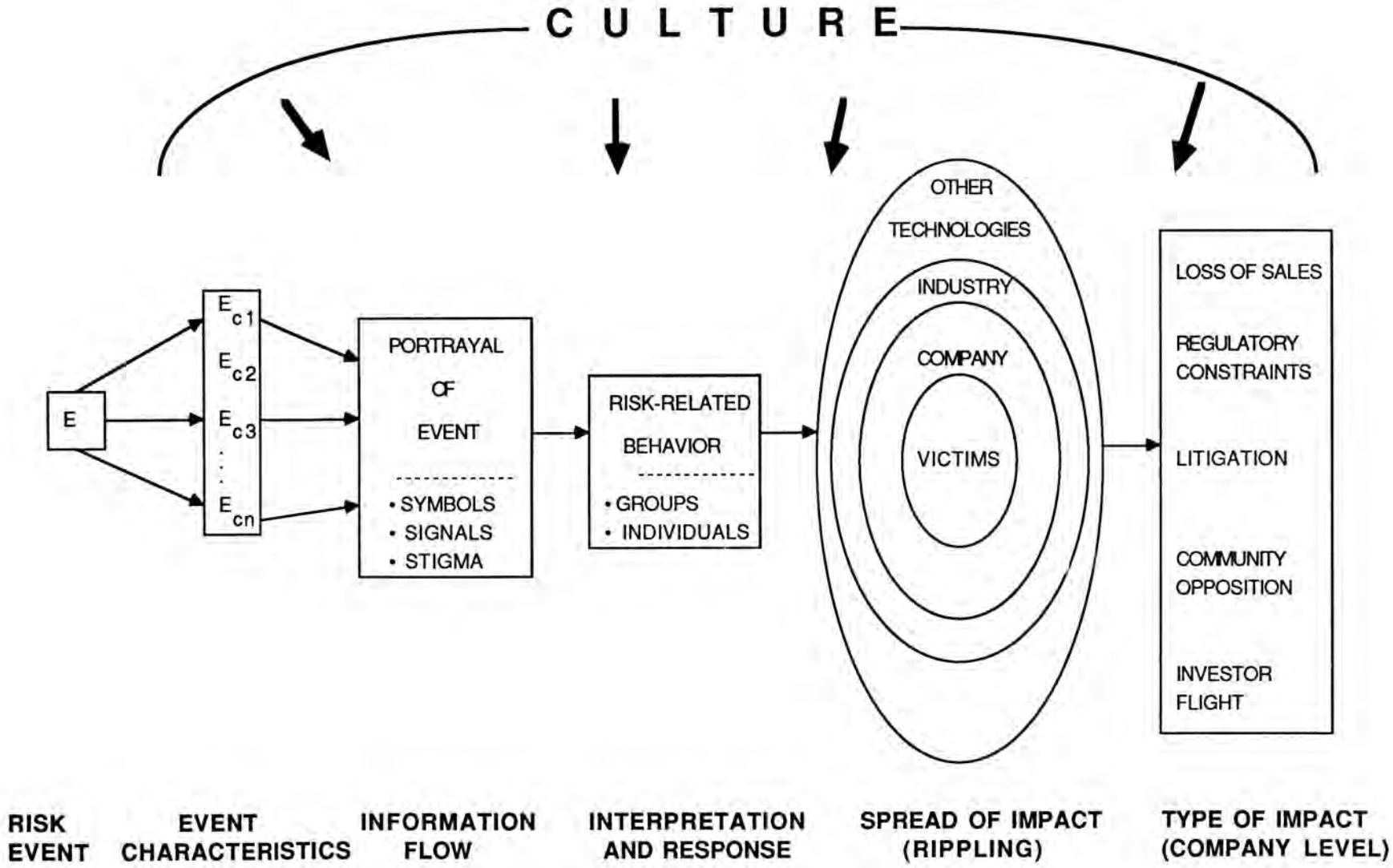

Fig. 1. Highly Simplified Representation of the Social Amplication of Risk and Potential Impacts on a Corporation.

power and (perhaps) other high technologies, industry, and regulatory institutions.

Many technologies or projects, of course, do not involve amplified hazards, and for these, conventional assessment techniques may suffice to characterize hazards and impacts. But the most controversial technologies and projects--such as radioactive waste disposal--are exactly those imbued with amplified hazards and for which existing assessment and management approaches miss the mark. Almost all industrial societies in Europe and the United States have experienced enormous difficulty in seeking sites for and in siting such waste facilities. Even in France and Sweden, where the greatest progress has been made, public opposition at sites has sometimes been intense. In other countries, such as the United Kingdom, public concerns have effectively prevented orderly progress in dealing with these issues and threatened nuclear energy as a national energy option.

Social scientists have abetted concern and misunderstanding among public officials over the "irrational" public and "hysterical" media by resorting to overly simplistic characterizations of public responses as so-called LULU (Locally Unwanted Land Uses) or NIMBY (Not-in-My-Backyard) syndromes. What is in fact occurring is a set of complex but rational public reactions to both the risk and social circumstances involving the social amplification of risk. Instead of addressing the sources of public concern, policy makers have fashioned siting processes addressed to misconceptions. Where the public has sought assurance of the safety of hazardous facilities, developers and siters have offered compensation (not infrequently construed by the public as bribery) for risk. Where fairness in site selection has been demanded, poor communities with high unemployment levels have been the siting targets. Where institutional trust has been lacking, developers have engaged in public relations to improve their image rather than in sharing power. Thus, efforts to site such facilities in various countries have been met with public concern, community conflict, and institutional distrust.

The effects have been quite dramatic. Consider the case of hazardous waste facility siting in the United States. By 1987, 22 states in the United States still, despite various federal and state efforts, had no commercial hazardous waste facilities and 35 states had no commercial land disposal facilities. Of 81 siting applications over the 50 states for hazardous waste disposal facilities between 1980 and 1987, 31 have been withdrawn or denied permits. Meanwhile, only 6 of the 81 have resulted in operational facilities; 2 have permits to operate, 2 are under judicial review, and 4 failed to become operational due to market factors. Yet the need for facilities persists.

To test a number of the components and relationships specified in our framework of the social amplification of risk, we have over the past two years assembled a large data base of some 126 hazard events, largely occurring over the past ten years and largely concentrated in North America. The events were accidents, releases, reports on exposures or the discovery of new consequences--manifestations, in short, of general hazards that could be located in time and place. The selection of hazard events drew upon the taxonomy of technological hazards developed at Clark University and was augmented by a selection of natural hazards and a subsample of radiological events. For each of these hazard events, data were collected about six major variables:

- the physical consequences of the event (e.g., mortality, illness, exposure, environmental damage)
- the amount and duration of media coverage
- individual lay perceptions of the hazard event
- likely public response to such events
- likely social group activity at the local and national levels
- the magnitude and types of social and economic impacts of the event.

Identification of the events themselves proceeded primarily through a search of the *New York Times Index*. For each event, information was gathered about the event from entries in the *Index* and about the hazard more generally from the scientific literature and from technical risk assessments. A panel of three risk analysis experts at Clark University's Center for Technology, Environment, and Development (CENTED) scored the physical consequences on a scale of 1-9 for each of four dimensions: magnitude of human expo-sure, severity of human consequences, magnitude of nonhuman consequences, and extent of nonhuman consequences. Media coverage was ascertained through a search of the group file "News" in the NEXIS data base and a rating of the coverage on a 1-10 point scale as well as a recording of the duration and half-life of coverage. Public perceptions of risk events were assessed on some 16 characteristics of the event by a sample of 120 subjects, who responded to a newspaper advertisement at the University of Oregon, on a 1-7 point scale devised by Decision Research investigators. Likely public responses to the event were judged in a similar way. Social group attention and socioeconomic impacts (the dependent variable) of the events were judged in a group Delphi process by a panel of experts composed of journalists, teachers, lawyers, business people, and others.

The results of this work point to the clear need for integrative approaches to our understanding of risk and clarify several key aspects of the public experience of risk. Among the notable findings are the following:

1. Public perception and media coverage are not dissociated from the picture of risk emerging in technical assessments (as has frequently been claimed). Rather,

media coverage in particular appears to be related systematically to the magnitude of human harm and adverse environmental effects of the events.

2. Public perceptions of risk reflect partially the physical consequences of risk and media coverage, and add only in a minor way to the variance in the judged overall socioeconomic impacts of hazard events. Specifically, the social amplification of risk is less determined by (biased) perceptions of risk probabilities than by a combination of media coverage that is roughly proportional to actual physical consequences and some rather sensible qualitative risk factors.
3. The overall impacts on society of risk events appear to be related more to characteristics of the social amplification processes and dynamics than to the actual direct physical impacts (e.g., health effects, property damage) normally included in risk assessments or impact studies.
4. Societal response to risk may, therefore, be both more influential in shaping identifiable social and economic impacts and more "rational" in its inner workings than has commonly been assumed. This points strongly to a need to reappraise our views on public perception of risk and to try new approaches and methodologies for environmental impact analysis.
5. Attempts to assess the social and economic impacts of a hazardous facility or a particular hazard event without explicit consideration of social amplification processes run a serious risk of underestimating, perhaps substantially, the magnitude of associated socioeconomic impacts or missing the specific impacts of primary public concern.

EDUCATING THE PUBLIC-IS IT THE ANSWER?

It has been frequently suggested that public concern over technology arises from unfounded fears, misinformation, and misperceptions of risk and that educational programs are the route to greater public acceptance. This belief has encouraged the nuclear and chemical industries in a variety of countries to wage extensive campaigns designed to counteract "misinformation" or "chemophobia," to provide a fuller understanding of risks and benefits, or to indicate why accidents that happen elsewhere could not happen in the particular country in question.

There is little doubt that the public has only limited knowledge of most complex technologies. Various surveys of public opinion have confirmed such a finding; a detailed U.S. study, for example, revealed that, out of five relatively simple multiple-choice questions on nuclear power, 51 percent of the respondents answered no more than one of the questions correctly.5 On the other hand, there is little evidence to support the view that more information or more knowledge will lead to more support. It is entirely possible, indeed likely, that increased information, rather than acting as an agent of change, serves primarily to confirm rather than to shape attitudes and that individuals selectively fit new information to existing belief structures.

These results are consistent, of course, with the social-amplification-of-risk approach. Psychologists have pointed out that more information to eradicate the "perception gap" may mobilize latent fears about technology and actually increase concern. The various public information campaigns and referenda conducted in Sweden and other European countries tend to confirm the limited ability of greater risk information to stimulate greater acceptance. The evidence, in short, continues to support the conclusion of Otway et al that "to expect people's attitudes toward a new technology to be primarily determined by statistical estimates of physical safety is a highly simplified, and incorrect, model of human thought processes--it implies such a degree of 'rationality' as to be itself irrational." (6)

PRECONDITIONS FOR GREATER PUBLIC ACCEPTANCE

If public education holds little promise for solving the public acceptance problem, what does? The first response--a necessary one--is that the problem will not always be solved, nor should it be. Not all technologies eventually survive the test of public acceptance (witness the case of asbestos!), and the judgment is still unclear on others (e.g., nuclear power). The eventual social determination is likely to be different among countries and different among cultural groups within a country.

A Demonstrated Record of Safety

Although the impacts of the accident at Chernobyl on public attitudes in Europe and North America will not become clear for several years, it is possible that they will prove to be of extraordinary long-term importance for nuclear power. The vivid portrayal in the media of the Chernobyl plumes moving across the expanses of Scandinavia, western and southern Europe, and the Soviet Union have doubtlessly added to the imagery of vast consequences of major nuclear accidents. Protective strategies, involving avoidance of milk consumption, washing of fresh vegetables, keeping children indoors, and distribution of potassium iodide, and the impacts on the Scandinavian reindeer and Lapps may well be etched upon the memories of publics throughout Europe and the Soviet Union. Then, too, the suspicion of some that nuclear power is surrounded by undue secrecy or has effects that cannot be con-trolled may be heightened by the confused national responses to the accident and by the problems in risk communication to the public. Most important, the evident public fright following

the accident will surely add to extant fears of this technology.

Accidents in one country reverberate strongly in others. Even near misses are important because of the potential for social amplification of risk and because the performance of technology managers during such crises indicates their competence, their candor with the public, and the degree of institutional compromise (if any) in their commitment to public protection. So an extended period of major accident-free operation of a technology and of successful handling of risk events is a clear need for any controversial technology, an opportunity already at least partially lost for both nuclear power and for radioactive waste management. Further serious accidents all add to the problem; another Chernobyl, meanwhile, could well be the death knell for the long-term acceptability of nuclear power.

Rediscovering the Benefits

Perhaps no factor has contributed more to the reduced public regard for nuclear energy than the changes in the public's assessment that it is a "beneficial" and "worthwhile" technology. Rediscovering the advantages of technology is crucial to a more favorable public response.

Such a changed assessment can occur in several ways. The gains during the 1980s in energy conservation in a number of countries have already run their course. In 1990, future energy crises are a distinct possibility, if not a likelihood, and could lead to greater appreciation of nuclear power's contribution to national energy security. This has certainly been a key to the relatively high public acceptance in France and (to a lesser extent) in Japan.

Several other pathways to greater benefit appreciation exist. Higher petroleum prices, more efficient and standardized reactor technology (as in France), and greater regulatory predictability could improve the comparative prices of nuclear versus other energy sources. Similarly, the discovery of the global environmental hazards and public health prices involved with competing technologies, such as coal, may lead to a greater appreciation of nuclear power.

A public assessment of increased benefits from a technology, particularly if combined with substantial progress on safety matters, can significantly affect over-all acceptability judgments. Again, it is important to stress that actual progress is crucial; information campaign claims unsupported by demonstrable progress are unlikely to have any significant impact on the public view.

In Search of Fairness and Trust

Institutional problems abound in the management of technology. Sometimes the nature of the technology presses toward secrecy and limitations upon public scrutiny and involvement. Sometimes the commitment to public safety is compromised by advocacy of technology development or by a reluctance to share bad news. Complex technology and massive quantitative risk assessments may frustrate, rather than enlighten, increased public understanding.

Risk acceptability is as much a matter of the process that renders such judgments as the particular levels of associated risks and benefits. The location of facilities, particularly if strong public concern exists, poses equity and public assurance questions. Institutional mechanisms that con-front these issues and that provide for procedural justice are absolutely essential for increased levels of public confidence and trust. In particular, opportunities for the public and critics to inform themselves of relevant issues and to find responsive treatment of their concerns are needed. The particular mechanisms that are needed are related to national political culture, so that public inquiries, litigation, consensus-building, and environmental mediation all have their place and potential. But the need is generic and is unlikely to disappear in the search for social acceptability.

FINAL NOTE

Much has been learned about the public experience of risk over the past two decades. These results suggest that, as we approach the year 2000, the public will be centrally involved in technological choice and management. Public perceptions and judgments on technology acceptability may well increasingly occupy the scarce time of corporate and governmental officials. But reasons for optimism exist: publics, contrary to much rhetoric, do not appear to demand "zero risk" and are generally rational in their overall coping with technological risk. But they also are demanding clearer evidence of the societal benefits of technology, uncompromised commitment to their protection, and greater fairness in how such decisions are made. Policies on technology that will survive these public demands will require increased sensitivity to the several societal conditions and tests that technology must now meet.

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