RISK PERCEPTION, A SCIENTIFIC PERSPECTIVE

John F. Ahearne
Vice President and Senior Fellow
Resources for the Future

ABSTRACT

Conflicts on technical issues frequently involve disagreements between the public and the technologists. This paper summarizes the major characteristics of three groups of technologists and four groups of the public which lead to many of the disagreements. To advance the mores of making decisions involving complex science or technology, technologists should develop an understanding of what information is needed for decisions, of the need for two-way communication with the public, and to become responsible for the accuracy and honesty of risk communication messages.

Several months ago, when I accepted the invitation to speak here today, I had intended to describe results from the report of the National Research Council Risk Communication and Perception Committee. At that time, there was hope that the report would have completed the review process and been accepted by the Academies and, consequently, although not published, I could at least reflect the results. Unfortunately, as is true of many reports, the review process has taken longer than we had expected. Consequently, although we still hope to have our report published by summer, it is no longer possible to indicate that the positions I am going to describe are those reflected in our report. In other words, what you will be hearing today are my views and not those necessarily of the Committee.

When I realized the underlying theme of the report was not going to be available, I decided to give one technologist's view on risk perception. Although most of you are technologists, I may have a slightly different view. Technologists have played a significant role in the development of risk analysis in this country and elsewhere. One of the first analyses was done by Fisher of the chemical industry in England, and Chauncey Starr, in this country, is usually recognized as having done the first comprehensive risk examination, along with his colleagues, including Chris Whipple. Professor Richard Wilson, a physicist from Harvard, has advanced this field. Organizations, such as SE_2, Scientists and Engineers for Secure Energy, have become active in public discussions of risk. This group includes at least six Nobel laureates, and identifies itself as providing the views of the scientific community regarding risks of energy alternatives, particularly nuclear power. The United States Committee on Energy Awareness, a pro-nuclear industry group, publishes report showing that whereas the American public may be ambivalent, technologists are strongly in favor of nuclear power.

The people who have worked in nuclear waste management have had many struggles with the public over differences of opinion, on risk, process, geology and attitude. Many of you have been involved in such disputes. My nuclear conflict experience is primarily with disputes concerning nuclear power plants, and with controversies about low-level nuclear waste. Also, as its publisher, I read multiple drafts of Luther Carter's recent book on the high-level waste dilemma.(1) After realizing I could not review the findings of the National Academy report, I concluded that perhaps what this audience might need most is a perspective from a scientist, and I used to be one, regarding the problems that technologists have in talking to the public (2).

Many scientists and engineers believe the public just does not care about technical things. However, that is not what polls indicate, as shown in Fig. 1. These polls, done by Jon Miller for the national Science Board, show that about 70% of the public are somewhat or very interested in science and technology. However, many technologists believe the general public does not know much about science, engineering, or technology in general. The public does not share that opinion: About 70% of the public believe they have at least an adequate understanding. However, the Science Board is concerned about the nation's technical knowledge. Recent studies of the math and science skills of U.S. students does not indicate a solid base is being formed in our students to develop an understanding of technology. Reflecting skepticism, the Science Board commissioned polls addressing whether the interested and understanding public shares beliefs similar to those of scientists. Figure 2 shows some of those results, which highlight differences between the public and the scientists.

- Scientists, engineers, and other technologists can be separated into three subgroups:
- Those who know in depth the science and engineering associated with given issues;
- Those who know a lot of science or engineering, but are not experts on the specific issues in dispute; and
- Those who operate or manage high-technology systems, but do not truly understand the technology they are using.

Of the true experts, unfortunately, many cannot communicate their knowledge. They are not able to simplify their discussions so that they can be translated by the media or understood by lay people. In some cases, this lack of communication is due not to an inability but rather to a belief that the effort is not worthwhile. Some scientists believe that writing for the general public is a waste of their time, because it is of little professional benefit and does little good.

Some good scientists do work at communication, but do not deal effectively with the media. Many scientists are quite properly reluctant to say more than they know. Journalists have a tendency to treat this reluctance as equivocation and to describe it as such to the public. Many lay people believe that if you know something, you should be positive and unconditional about it. Therefore, they conclude that when a scientist refuses to be definitive, it is equivocation or

	Very Interested	Somewhat Interested	Rather Uninterested	Not At All Interested	Not Sure
How Much Interest Do You Have In Scientific and Technological Matters?	23%	48%	11%	18%	1%
	Very Good	Adequate	Poor	Not Sure	
How Would You Rate Your Basic Understanding of Science and Technology?	16%	54%	28%	1%	

Fig. 1. Harris Poll.

at least indicates that the scientist does not know much about the area.

	Agree	Disagree	Don't Know
Human Beings as We Know Them Developed From Earlier Species of Animals	45%	47%	7%
Some Numbers Are Especially Lucky For Some People	43%	53%	4%
Rocket Launches And Other Space Activities Have Caused Changes In Our Weather	44%	44%	12%

Fig. 2. National Science Board Poll.

1. What Are The Hazards, Benefits?
2. What Is The Exposure?
3. What Are The Probabilities?
4. What Are The Distributions?
5. What Are The Synergisms?
6. What Are The Total Risks/Benefits?

Fig. 3. Risk/Benefit Information.

Regrettably, what a scientist can be positive about is often not what the lay person is interested in. This difficulty faces all scientists and engineers who try to deal with the media. Nevertheless, my belief is that most representatives of the media will take time to try to understand, if it is obvious that the technologist is making an effort to help them understand.

Failure to communicate well also can be connected, with an overestimation of one's own expertise. In contrast to those who are aware of all of the complexities bearing on the issues at hand, the less informed often take a paternalistic or maternalistic attitude toward the general public. Sometimes they express the belief that controversy would disappear if only the public were better educated--if only, that is, the public became as well-informed as they believe themselves to be. Sometimes they act as though the solution to conflict is simply for the public to trust them and to accept what they claim.

The attitude that education is the answer to everything was apparent in articles in the 1970's that importuned the public to understand "true risks" and to rank those risks relative to one another. The attempt to address technological risk management by taking risks for different hazards has led to an attempt to define acceptable risk. However, many of these efforts have failed to be effective with the general public because "the acceptable risk formulation has provided increasingly elaborate and precise answers to the wrong questions."(3) The questions are wrong because they do not arise from sustained dialogue with the concerned public.

"Trust me" is still used by U.S. government officials responsible for technology as the principal answer to the question, "Why are you doing that?" This attitude characterizes the approach the government has taken to locating nuclear waste sites, starting with the Atomic Energy Commission's efforts in Kansas, continuing with the Energy Research and Development Administration's search in the Middle West, and now seen for many years in the Department of Energy's efforts to site a high-level waste repository.

The third group, those who are engaged in managing or operating high-technology systems, often have had substantial technical training. Their chronic weakness is complacency, and their failings lead the public to question the competence and judgment of the scientists and engineers

who design such systems. Complacency can be reflected in many ways:

- A lack of recognition by management that constant attention is required for technologies whose use has potentially serious consequences;
- Inadequate attention by operators, based upon a belief that the technology is so well developed that monitoring is not really needed;
- A belief that it is not important to understand the technology and not necessary to investigate anomalous behavior; and
- A lack of attention to mundane matters such as regular maintenance.

Underlying the problems that led to the space shuttle Challenger disaster was a disbelief that the technology was hazardous--complacency on the part of the people who did not fully understand the shuttle system. Many reports on the Three Mile Island accident showed that operator misunderstanding initiated the accident. Similarly, reviews of the Chernobyl accident have highlighted the complacency that had afflicted the crew of the plant.

After reading about or participating in disputes on acceptability of a technology, or of a particular facility, those who do understand technology often describe conflicts on environmental issues as being between technologists, like themselves, and the others, who do not understand technology. The technologist tends to conclude this difference of understanding is the fundamental reason for the conflict. But those others, who do not understand technology, do not believe technological understanding is central to conflicts about the environment, but argue that the conflict is about acceptable risk. Unfortunately, many people who are untrained in science and technology believe that understanding technology is not important to understanding the risks of technology.

Just as I attempted to separate technologists into groups, the public also can be separated into groups:

- Some people are against all technology;
- Some are afraid of technologies they do not understand;
- Some are opposed only to the technologies that affect the local government; but
- Many concerned citizens, however, try sincerely to understand confusing and complex issues.

People who are against technology or against anything new tend to be the most dedicated opponents of projects. They sincerely believe that technology is wrecking our culture. The attitude is not new. Consider how contemporaries of Galileo commented on his discovery of the moons of Jupiter. "Jupiter's moons are invisible to the naked eye, and therefore can have no influence on the Earth, and therefore would be useless, and therefore do not exist."(4)

Although the people who oppose technology may not be many, they are sincere and strong in their beliefs. They participate, often effectively, in debates, public meetings, letter-writing, and other activities that number among the advantages of living in a democracy.

People who are afraid of technology, essentially because they do not understand it, tend not to trust anyone who argues the citizen should not be worried, whether or not the citizen understands the argument. The corollary is that these people tend to believe anyone who says things are worse than they seem. Organizations which lobby against local waste dumps or nuclear power plants include many individuals who belong to this group. They believe they are being asked to accept on faith the safety of a technology.

Some concerned citizens have a special agenda that they prefer not to state explicitly. This agenda is based sometimes on opposition to big government, other times on protecting the local government. Often, these citizens are affluent and prefer to have costs imposed on others while they reap the benefits. "Not in my backyard" is the way political scientists and sociologists characterize this attitude. Of course, affluence does not necessarily coincide with selfishness. Sometimes affluence enables one to take a more objective view of costs and benefits. The situation is similar to the debates between less developed countries and the highly industrialized countries concerning the costs and benefits of environmental regulation versus economic growth.

The fourth and perhaps the largest group of concerned citizens consists of people who do not fully understand the technologies at issue and are skeptical about strong claims by participants on either side of the debate. They do not believe that technology is automatically bad, nor to they believe government is automatically wise. These people will enter a proceeding or hearing with reasonably open minds. They will listen to arguments. They will value substance more than the appearance of sincerity. They will focus more on rationality than on rhetoric. In the end, they will be forced to reach a conclusion based on incomplete information. And they will reach a conclusion. This subgroup of concerned citizens has not been well served by many technologists.

Technologists have not participated effectively in the process by which the public reaches conclusions, although there are exceptions. Technologists also have not been very effective in the process by which decisions are made. However, unlike the public process, where the public seems willing to let technologists speak, frequently decision-makers do not allow technologists a voice.

Making decisions is difficult; making complex decisions is very difficult. It is important to note some of the key pieces of information that a decision-maker should have, when he or she is addressing a decision in which risk and benefits are significant factors. Figure 3 gives a list of that information.

First, what environments, people, or species might be harmed and who benefits from the activity?

Second, how do exposures accumulate over time? What is the total number of people or the total amount of valuable things, such as aquifers, that are potentially

exposed? Conversely, how many people benefit, and for how long, by the activity?

Third, how probable are the hazards and how probable are the benefits?

Fourth, is there a disproportionate allocation of risks and benefits?

Fifth, are there interactions, particularly between one hazard and another, so that one cannot solely look at the effects of the single hazard?

Finally, what are the total risks and benefits of the activity?

Obviously, a lot of information will have to be collected in order to provide answers to these questions. Sometimes the information has considerable uncertainty and sometimes the information will not be available before a decision has to be made. But a decision-maker should be sensitive of the need for this information and skeptical of advocates who press the decision without addressing these questions.

In this process of making a decision, decision-makers must realize that the public is a significant factor and an interaction with he public is critical to good decision-making. Let me give short descriptions of a good and a bad example of government officials trying to understand public attitudes.

During the 1970's, I worked with four Secretaries of Defense. Each relied upon the two communications Assistant Secretaries--the Assistant Secretary for Legislative Affairs and the Assistant Secretary for Public Affairs. Although styles differed somewhat, in general, the Secretary would meet each morning with his key staff to review the most important issues. The communications people were always included. The Defense Secretaries appreciated that the communications people provided excellent in-house critics of proposed policies or actions by reflecting the views of those with whom they regularly dealt, that is, the Congress and the media. This public affairs and legislative affairs information was always an integral part of the decision process in the Defense Department.

A bad example is seen in the Love Canal events. Within the scientific community, Love Canal is a symbol of government incompetence. A former EPA official commented that during the Love Canal controversy, EPA had a continuous concern that they could not get this thing organized. As some of you may know, EPA decided to conduct a study of chromosome damage among residents of the Love Canal area. However, there was no control group for this study, apparently because the study was ordered by the legal office, which did not understand how to do a valid evaluation. Thus, and funding was a factor, only 36 people were examined and these were selected to maximize the likelihood of damage. After the study was reported, five reviews were done to determine whether any valid conclusions could be drawn.

At Love Canal, risk communication made the problems worse. I see risk communication as a circuit with feedback loops. In communication terminology, I should label the path as a channel. Figure 4 describes this process. Figure 4 has the decision-maker on one side, separated from the communication channel by a barrier that I will call a buffer. At the other end of the channel, there is another barrier or buffer. An on the far side of that buffer are recipients--the media, the public, and the government, which can include Congress, state legislatures, governors, mayors, etc.

Some decision-makers, some technologists, and some communications people see the channel and the buffers as one-way transmission devices for decision-maker to communications channel and from communications channel to recipients. I see the buffers as two-way and the smart channel as providing information back to the decision-maker. This information feedback can improve decisions by letting the decision-makers know what the recipients think about proposed actions, about what are they angry, what are their concerns, what information do they want, etcetera. This was the Defense Department model.

A major difficulty in risk communication today is that the risks involve very complex science or engineering issues. For the communications channel to be a smart channel, a communicator must understand the technology. If the communicator or the channel is a dumb channel, for one-way transfer of anything put into it, several problems arise. The smart buffer, a knowledgeable media person or a skilled public interest group, will reject the transmission. The Natural Resources Defense Council and the Environmental Defense Fund are very good at this. They have people who are very knowledgeable, who understand the issues and the science. When they are being faced by a communicator who does not understand what the communicator is talking about, NRDC, EDF, and the similar organizations, are able to demonstrate easily that this communication is not worth paying much attention to, or at least they can make that appear so.

A concerned public will attempt to communicate via the channel, but a dumb channel cannot become a two-way smart channel. For example, in public meetings, frustration arises when some of the public start asking questions of the communicator in which they are trying to say, well, this is what our concern is. Will you let decision-maker X know that? The communicator tries to reflect the question that was asked. Many times the communicators bungle this attempt because they don't really understand what was asked.

Now, of course, my model assumes the decision-maker understands the science or engineering involved. I recognize this is not always true. The problem of incompetent decision-makers has not received the attention it deserves. Scientists and engineers often have not demanded competence from government officials. Worse, they themselves have sometimes been willing to depart from their normal standards of professional behavior when policy is at stake.

An increasingly popular quote is one by Thomas Jefferson: "I know of no safe depository of the ultimate powers in society but the people themselves. And if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion." Jefferson did not endorse manipulating or even persuading. He endorsed

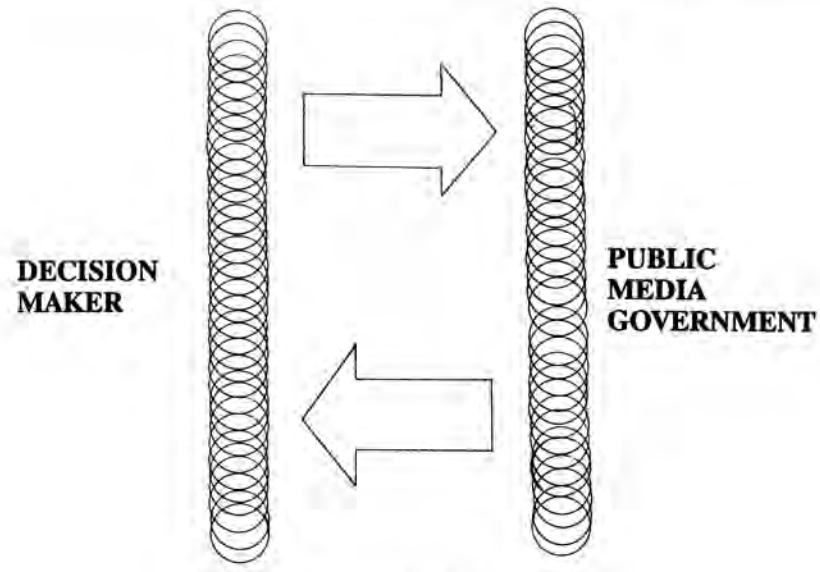

Fig. 4. Communication Channel.

informing. It is in this Jeffersonian sense, coupled with a smart channel, that I define success in risk communications as raising the level of understanding of relevant issues among the participants including the decision-makers. Informing is necessary to maintain credibility, and although credibility is not necessary and sufficient, it is necessary for successful communication. A large problem for people in government is that they lack credibility. Credibility is easily lost and very slowly restored and once lost, is never restored completely. But maintaining credibility requires continuing efforts to be accurate and complete. Each of those requires understanding the technology involved.

I close with a dilemma that arises in any discussion among public interest organizations and government technologists. On the one hand, representatives of public groups note there is a serious deficiency in the United States in that the public does not know where it can get reliable information. They want good numbers. On the other hand, as Chauncey Starr noted last summer, "It is hard to use numbers. The public uses the as a test to see if this person is an expert even though the public doesn't understand the numbers."

Having spent many years trying to make controversial, technical decisions and interacting with the public, and now being heavily involved in disputes regarding the Federal government's nuclear weapons facilities, I can only advise three simple rules of thumb.

First, learn as much as you can about the issue in controversy. You may be an expert on some part of the issue, but probably do not understand at least one area that will be important to the local community. When you go into a dispute, either know the material yourself or have someone with you who does.

Second, insist on objectivity, of yourself, your colleagues, and anyone who speaks for you. Be very skeptical of advocates.

Third, maintain honesty at all times. Honesty really is the best policy.

REFERENCES

1. Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste, Luther J. Carter, Resources for the Future, 1987.
2. Several of the following points are taken from Ahearne, J. F., "Addressing Public Concerns in Science," Physics Today, pp. 36-42, Sept. 1988"
3. Otway, H. J., D. von Winterfeldt, Policy Science, Vol. 14 (1982), p. 255.
4. Williams-Ellis, A., Men Who Found Out, Coward-McCann, New York (1930), p. 43 (quoted in Congressional Research Service Report CB-150 (29 May 1969), p. 32).