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Assessing technological risks and benefits

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Chapter 4

Assessing Technological Risks and Benefits

*Meinolf Dierkes**

RISKS AND BENEFITS OF TECHNOLOGICAL PROGRESS: CHANGING VIEWS AND PERCEPTIONS

The last decade has revealed significant changes in public attitudes towards the benefits and risks of technological progress as a whole and individual technologies in particular as compared with the 1950s. Technologies have been developed and applied to meet needs in all aspects of human activity: to strengthen political and military power, to raise productivity in the workplace, to lighten the workload in the home, to increase opportunities for leisure and mobility, to improve health care, and to control the impact of environmental hazards, among others. While the benefits these technologies have produced are obviously significant, a large proportion have been accompanied by unforeseen negative side effects. Growing understanding and public recognition of these effects has shifted the very nature of the discussion about technological progress from exclusive emphasis of the advantages to heightened awareness of the risks that technology entails.

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Discussions about these matters with policymakers and observers of social and political change commonly include the analysis that technology was discussed during the 1950s predominantly in terms of employment and strategic interests. Negative consequences hardly received attention. During the 1960s, attitudes became more critical as environmental concerns emerged. Examples of environmental damage attributable to technology multiplied in industrialized countries, which led portions of the population to start questioning the acceptability of the costs and risks of technological progress. The late 1970s have seen this concern extended to a wider range of areas. The impact of technology on the quality of life of the population as a whole—in the workplace, in the home, and in leisure activities—is being examined by scientists, unions, government, and a growing number of citizen action groups.

Initial awareness of technological risks was primarily a phenomenon among small segments of the scientific community, politicians, and the media, together with advocates of alternative life styles, decentralization, and alternative technologies. It seems gradually to have spread to other parts of the population, however, specifically with the emergence of the nuclear controversy, the growth of citizen action groups and the development of the ecological movement. Though still far from being a mass movement, the concern for risks associated with technological progress is seen today to be more than a marginal or negligible social development. Attempts have, of course, been made to reduce the negative side effects of technologies through legislation of standards, quality controls, and other measures. But rather than allaying public fears and criticism, these efforts have in many cases triggered yet more concern.

One need only read the back issues of major newspapers to confirm the correctness of these impressions. To document this, we selected issues of the *New York Times* between 1950 and 1978 and reviewed articles referring to technological risk. The broad conclusions that can be drawn from this survey are supported by similar content analyses. (See, for example, Halverson and Pijakawa, 1974; Lawless, 1974.) Briefly, the concern with technological risk in the mid-1950s was limited mostly to nuclear fallout from military testing and to the construction of superhighways. A significant change is noted in the mid-1960s. The majority of the articles remain positive, but the number of articles skeptical of technological developments increases. Articles referring to ecological damage begin to appear, and whereas the sources of information for articles during the previous period were largely confined to the defense industry and government, citizen action groups are now mentioned for the first time as sources of information. Military and economic arguments supporting the introduction of new technologies

practically disappear. Although a concern for health and safety is evidenced throughout the whole period of analysis, it is given more prominence only since the mid-1960s when people begin to notice the impact of technology on the quality of life as a whole.

The implications of these changes for science policy have been the subject of discussions among decisionmakers in science and technology for almost a decade. As early as 1971, the Brooks Report referred to the difficulties facing science policy due to changes in basic attitudes towards technology and the growing recognition of second-order consequences. A central task of policymakers and the scientific community therefore seems to be to develop an understanding of the often paradoxical reasons for the different views on the risks and benefits of major technologies in the light of divergent and changing value systems.

EXPLAINING INCREASED CONCERN ABOUT THE RISKS OF TECHNOLOGICAL PROGRESS: SPECULATIONS AND HYPOTHESES

There has not yet been enough in-depth study for anyone to offer more than vague insights, speculations, and hypotheses to explain the change from an almost unanimous welcome of new technologies in the '50s and early '60s to an ever-deeper concern for their inherent risks. An examination of existing literature, however, seems to indicate that the interplay among the following major factors has been instrumental in determining the nature and direction of the shift in attitudes:

- The large number of unfamiliar technologies
- The magnified scale of application
- The increase in available knowledge and the related heightened awareness of possible effects
- The underlying value changes in society, especially the declining confidence in institutions.

Let us examine each of these in more detail.

Research on human behavior and patterns of acceptance indicates that people seem to react more cautiously and critically to unfamiliar than to familiar elements in their environment. Totally new things tend to cause anxiety, whereas familiar things, even when very dangerous, are less fearful because their dangers are known. A review of the major technologies that have been developed and applied since World War II or that are presently in advanced stages of development reveals a significant number of technologies that deviate enough from the familiar to be classified as anxiety-producing in this sense.

It is perhaps interesting to note in passing that this response to unfamiliar technologies does not necessarily reflect whether or not they are actually more or less dangerous than familiar technologies. The degree to which "actual" increases in risks enter overall societal concern involves a separate factor that will be discussed immediately.

The anxiety engendered by this constellation of new technologies is compounded by the scale on which technologies—both old and new—are now being applied. They appear to permeate every aspect of daily life, and people therefore fear that each additional activity does not merely add to the risks they face, but multiplies them. The probability of accidents with millions of cars on the road is far greater than when only a couple of thousand are being driven. The spread of the use of computerized information storage and retrieval systems did not cause people to worry about the protection of their privacy and the misuse of information until they replaced other filing systems to such a large degree that not only banks but even grocery stores monitor their inventories with them.

Even attitudes toward familiar technology have shifted. The burden on the environment and the consequences for human health of one conventional power plant is a much different matter than even two such plants in conjunction with a variety of other sources of pollution. The now extensive rather than occasional use of pesticides is a severe threat to human health and to the environment, which is not capable of absorbing such large quantities of chemicals. Thus, for many people, poorly understood dangers of unfamiliar technologies are multiplied—sometimes exponentially—by the scale on which all old and new technologies are used.

The awareness of the possible risks these two aspects of the present technological environment might entail is sharpened by an increase in available knowledge and the expansion of the modes of its diffusion. Technology assessments and environmental impact studies take into consideration a wide range of possible secondary and higher-order effects that previously received little or no attention. Highly refined measurements of the effects of technologies on humans and the environment are being employed today. Methods of detection are being improved. For example, shortly after World War II, the only way to determine if DDT ingested by cows entered the bloodstream was to observe if flies died after drinking the blood of the animals. But already by 1962, when Rachel Carson wrote *The Silent Spring*, DDT could be detected scientifically at seven parts per million.

The information researchers are gathering about possible risks related to new technologies is being widely diffused by the media. News of scientific breakthroughs as well as of unforeseen negative side effects of technologies in use are receiving wider coverage than ever before in

the press, on the radio, and on television. Researchers who have conducted studies on the impact of such wide media coverage (for example, E. Lawless, 1974) have noted that a certain distortion and sensationalization of events occurs, which in some cases raises greater alarm than is actually justified. But these studies maintain that the spread of information through the media has, overall, served to generate public pressure for more careful research and government control to minimize risks, especially those of new technologies. An additional factor contributing to increased public concern and changing attitudes towards technology are the widely publicized judicial proceedings on social and environmental impacts in the application of certain new technologies, such as with nuclear power plants and thalidomide. The courts are perceived to be a credible source of information and judgment, and the decisions on negative affects of such technologies have themselves had a significant impact on public opinion, which reinforces the belief that at least some fears about technology are well-founded.

In order to appreciate the impact of the three factors outlined above, they must be seen in the context of changing social values. As Inglehart (1977) stated in his large-scale analysis of survey data, "the values of Western publics have been shifting from an overwhelming emphasis on material well-being and physical security toward greater emphasis on the quality of life" (p. 3). Besides that, his data clearly indicate

that a significant shift is also taking place in the distribution of political skills. An increasingly large proportion of the public is coming to have sufficient interest and understanding of national and international politics to participate in decisionmaking at this level . . . Current changes enable them to play an increasingly active role in formulating policy and to engage in what might be called 'elite-challenging' as opposed to 'elite-directed' activities . . . The two processes of change reinforce each other. One aspect of the change in values, we believe, is a decline in the legitimacy of hierarchical authority, patriotism, religion, and so on, which leads to declining confidence in institutions (pp. 3-4).

At a time—as characterized by these data—when the qualitative aspects of economic growth are being stressed, it is perceived that technology has in many cases detracted from rather than contributed to improvement that would allow the avoidance of things like environmental pollution, monotony in the workplace because of mechanization, and the widespread use of questionable food additives.

Another characteristic of technological developments that seems to be a significant source of concern to the public is the tendency of large-scale technologies to entail centralization of control. Many people con-

cerned about the risks of new technological developments perceive them to require supporting social systems that are inscrutable, highly centralized, and controlled by small elites. These are seen to be strongly biased in favor of the beneficial aspects of new technologies: the risks are downplayed. Governmental and industrial bureaucracies involved in making decisions on utilization and large-scale application are also perceived to be largely insensitive to the needs expressed by a growing portion of the public for broader-based participation in these decision-making processes.

THE EMERGING DISCUSSION OF TECHNOLOGICAL RISKS: SOME KEY ISSUES

This brief review of some of the key hypotheses about the changing attitudes toward technology reveals the broad and unstructured nature of the discussion to date. The process of viewing technological developments in a critical light is still developing and is gradually being extended to cover a wide variety of other issues. The interrelationship between the various elements in the debate remains unclear; some problems attributed to technology are, when examined in greater detail, actually part of other policy areas and only indirectly related to the heart of the issue. In some cases, for example, it has been found that people are in fact dissatisfied with the supporting systems (the legal and economic arrangements through which technologies become available and are subjected to social control) rather than with the technology itself (*Technology: Processes of Assessment and Choice, Report of the National Academy of Science, Washington D.C., 1969, p. 16*). According to the Brooks Report,

If science policy is entering a period of uncertainty and reassessment, it is not so much due to failings in science policy itself, as to the fact that government policy in general and the goals of society, after a long period of consensus, are themselves passing through a period of uncertainty and conflict (p. 38).

While the scope of the debate is still undefined and far too little is known about the nature of all the issues involved, it is possible to outline some of the key problems.

1. People are beginning to question the validity of expert calculations as a basis for decision-making on technological issues. The old adage "war is too important to be left to generals" appears to have been extended to science and technology. Public distrust of

the ability of scientists and technicians to evaluate technologies first became evident in the nuclear industry. But some activities responding to DNA experimentation indicate that this distrust is spreading to other areas of science and technology. This questioning of expert calculation is reinforced by the polarization of the scientific community itself on many key issues. Experts are finding it difficult to reach a consensus on the risks entailed in certain technologies as, for example, the storage of nuclear wastes and levels of dioxin emissions. Additionally, the nature of the issues faced is such that many policy decisions must be made on the basis of insufficient technical data, therefore requiring the decisionmaker to use personal judgment based on experience and intuition. The dangers of cloaking policy decisions, which by nature involve subjective judgment and value judgments, in technical data, particularly in areas where technical information is known to be lacking, are increasingly being criticized by the public, citizen action groups, and government policymakers, as well as by scientists.

2. A key policy issue concerning decisions on risk concerns equity. According to Rowe, "an equitable risk involves the freedom of choice to accept or reject a condition that imposes risk through a balancing of the risks and benefits to the risk agent" (*An Anatomy of Risk*, p. 122). But the case is not always such that the risk agent is in a position to make the choice. Often the people reaping the benefits from the new technologies are not those bearing the costs. For example, the risks and benefits of a particular technology may occur in different locations, as when an electrical plant produces energy for people living in a distant area. Another case in point are occupational health hazards, which often reveal a conflict between worker safety and general public benefits. The risks faced by the worker in an asbestos plant are far greater than the benefits he will receive from his product, while society at large bears few of the risks involved in the production process. A third type of problem in this category is the inclusion of the interests of future generations in the calculations of risks and benefits. The nuclear wastes produced today and stored temporarily are but one example of the decisions made in the present that may have significant effects on the lives of future generations. The question at the root of this issue is who is to make the decision that places certain groups at a disadvantage.
3. Another key question that remains unanswered is the extent to which individuals should be permitted to manage the risks they face, and when government should exert control. No consistent policy has been developed to deal with this problem. A glance at

case histories seems to indicate that government has usually intervened only after the public has expressed strong demands for such external control (Lowrance, *Of Acceptable Risk*, p. 128). For example, while considerable consumer pressure has led to the establishment of strict regulations on food additives, the individual is given a relatively great amount of freedom in controlling the risks associated with driving automobiles. The areas in which the citizen is willing to accept government regulation—or even to request it—are not defined. The factors involved in determining the most appropriate strategy are not clear. Researchers have yet to examine the ways in which people can control risks without government regulation while still satisfying public demands for safety and preserving a certain degree of sovereignty.

4. A central issue that appears to underlie all the problems outlined thus far is the lack of acceptable consensus with respect to government decisions. People are more frequently challenging the legitimacy of decisions made on those technological risks having a potentially significant impact on the environment and society. This concern is one aspect of the intensified criticism of government decisionmaking as a whole. The increase in the power of bureaucratic structures seems to have been accompanied by a reduction in the power of parliamentary bodies the public feels capable of influencing. As a result, people are demanding greater public accountability of decisionmakers whom they perceive to be operating in ways that are neither open nor responsive to public interests.

Cases of public opposition to regulatory attempts seem to indicate that the degree of consensus is diminishing in at least some areas. The value-laden nature of decisions relating to technological development is gradually being recognized, making it clear that unanimous acceptance of a decision is impossible no matter what the data provided by expert calculations indicate the level of risk to be. Policymakers in all industrialized countries are searching for means to arrive at an acceptable level of consensus, to diminish the sense of disfranchisement experienced by a growing proportion of informed citizenry.

CHANGING VIEWS OF TECHNOLOGY: A CHALLENGE, NOT A THREAT

Science and technology policy is entering a difficult period of uncertainty and reassessment of some of its major outcomes: new technologies, products, and improvements. More factors than ever before,

and difficult ones, have to be taken into consideration when weighing the risks and benefits of specific technological developments and deciding on their large-scale utilization. There is also a demand for more openness in these kinds of decisions.

These developments should be seen by the scientific community as well as by decisionmakers as a challenge rather than a threat. These difficult new challenges will improve decisionmaking in this area because they will force the development of careful, scientifically based information for the technical parts of the decisions and will require the development of procedures for including the interests of more people in those parts of the decisions requiring consensus. This is exactly what is needed.

Consider these challenges in more detail. First, for the scientific community, there are challenges in three main areas: (1) there needs to be a concerted effort in the natural sciences to promote useful knowledge, especially in terms of long-term and indirect consequences of technology; (2) the social sciences need to increase the understanding of attitudes and beliefs toward technological developments and mechanisms of acceptance and consensus; and (3) the research community as a whole needs to communicate such research results more often and more effectively to a larger audience. Second, decisionmakers face the challenge of experimenting with new decisionmaking structures that permit a wider range of consequences to be acknowledged in the decision procedure and that at the same time allow more response to concerns and attitudes about technological progress expressed by public groups.

To sum up, one must still follow the advice of Georgescu-Roegen (1958): "Get all the facts and use good judgment." Today, however, you must get more facts, and you must prove that your judgment is good.

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