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Technology and Ethics

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Aristotle (384–322 B.C.) pointed out in Book III of the *Nicomachean Ethics* that one can deliberate only about what is within one's power to do. Technologies such as gene splicing and nuclear fission were not within the power of the Greeks, so there was no ethical deliberation about them until centuries later. Throughout history, technology (knowledge associated with the industrial arts, applied sciences, and various forms of engineering) has opened new possibilities for actions. As a result, it has also raised new ethical questions.

Most of these questions have not generated new ethical concepts; instead they have expanded the scope of existing ones. For example, because hazardous technologies threaten those who live nearby, ethicists have expanded the notion of "equal treatment" to include "geographical equity," equal treatment of persons located different distances from dangerous facilities.

Because new developments force the expansion of ethical concepts, those who investigate technology and ethics need both technical and philosophical skills. To assess the ethical desirability of using biological (versus chemical) pest control, for example, one must know the relevant biology and chemistry, as well as the economic constraints on the choice. Although such factual knowledge does not determine the ethical decision, it constrains it in important and unavoidable ways.

Since policymakers evaluate virtually all technologies, at least in part, by methods such as benefit-cost or benefit-risk analysis, knowledge of economics is essential for informed discussions of technology and ethics. Philosophers investigate both the ethical constraints on developing or implementing particular technologies and the ethical acceptability of various economic and policy methods used to evaluate technology.

Philosophical questions about technology and ethics generally fall into one of at least five categories. These are (1) conceptual or *metaethical* questions; (2) *general normative* questions; (3) *particular normative* questions about specific technologies; (4) questions about the ethical *consequences* of technological developments; and (5) questions about the ethical justifiability of various *methods* of technology assessment.

Examples of (1) are: "how ought one to define 'free, informed consent' to risks imposed by sophisticated technologies?" or "how ought one to define 'equal protection' from such risks?" Examples of (2) are: "does one have a right, as Alan Gewirth argues, not to be caused to contract cancer?" or "are there duties to future generations potentially harmed by various technologies?" Examples of (3) are: "should commercial nuclear power licensees, contrary to the Price–Anderson Act, be subject to strict and full liability?" or "should the US continue to export banned pesticides to developing nations?" Examples of (4) are: "would development of a plutonium-based energy technology threaten civil liberties?" or "would deregulation of the airline industry result in less safe air travel?" Examples of (5) are: "does benefit-cost analysis ignore noneconomic components of human welfare?" or "do Bayesian methods of technology assessment ignore

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the well-being of minorities likely to be harmed by a technological development?"

The leading philosophical issues concerning technology and ethics are the following:

How to Define Technological Risk

Engineers and technical experts tend to define "technological risk" as a probability of physical harm, usually as "average annual probability of fatality." Philosophers and other humanistic critics claim both that technological risk cannot be defined purely quantitatively, and that it includes more than physical harm. Instead they argue that technology often threatens other goods, such as civil liberties, personal autonomy, or rights such as due process.

The technologists argue for a quantitative definition of risk, claiming that we need a common denominator for evaluating diverse technological hazards. They also claim that it is imposible to evaluate nonquantitative notions, such as the technological threat to democracy. Those who oppose the quantitative definition argue not only that it excludes qualitative factors (like equity of risk distribution) affecting welfare, but also that the nonquantitative factors are sometimes more important than the quantitative ones. Hence they argue, for example, that an equitably distributed technological risk could be more desirable than a quantitatively smaller one (in terms of probability of fatality) that is inequitably distributed.

How to Evaluate Technologies in the Face of Uncertainty

Whether one technological risk is quantitatively greater than another, in terms of average annual probability of fatality, however, is often difficult to determine. Most evaluations of technology are conducted in the face of probabilistic uncertainty about the magnitude of potential hazards. Typically this uncertainty ranges from two to four orders of magnitude. It arises because the developments most needing evaluation, e.g., biotechnology, are new. We have limited experience with them and hence limited data about their accident frequency.

How should one evaluate technologies whose level of risk is uncertain? According to John Harsanyi, the majority position is that, in such situations, one should either use subjective probabilities of experts, or assume that all uncertain events are equally probable. The desirable technological choice is then the one having the highest "average expected utility," as measured by the probability and utility of the outcomes associated with each choice. Critics of the majority position, like John Rawls, maintain that it has all the flaws of utilitarianism. It fails, they say, to take adequate account of minorities likely to be harmed by high-consequence, low-probability risks. Rawls argues instead that we should use a maximin rule in situations of probabilistic uncertainty. Such a rule, like the difference principle, would direct us to avoid the outcome having the worst possible consequences, regardless of its alleged probability.

Critics of the Rawlsian position claim that it is irrational to choose so as to avoid worst-case technological accidents. They claim that taking small chances with technology often brings great economic benefits for everyone. Opponents of the majority Bayesian position respond, however, that such benefits are neither assured nor worth the risk, and that the subjective probabilities of experts often exhibit an "overconfidence bias" that there will be no serious accidents or negative health effects from a given technology.

Technological Threats to Due Process

Ethicists also charge that technology threatens due-process rights. To the extent that hazardous technologies cause (what Judith Thomson calls) "incompensable risks," like death, due process is impossible because the victim cannot be compensated.

One of the most controversial due-process debates concerns commercial nuclear fission for generating electricity. Current United States law limits liability of the nuclear licensees to less than three percent of total possible losses in a catastrophic accident. Critics maintain that this law (the Price–Anderson Act) violates citizens' due-process rights. Defenders argue that it is needed to protect the industry from possible bankruptcy, and that a catastrophic nuclear accident is unlikely. Critics respond that if a catastrophic nuclear accident is unlikely, then industry needs no protection from bankruptcy caused by such an event.

How Safe Is Safe Enough?

Because a zero-risk society is impossible, philosophers and policy makers debate both how much

risk is acceptable and how it ought to be distributed. The distribution controversies raise all the classical problems associated with utilitarian *versus* egalitarian ethical schemes. Conflicts over how much technological risk is acceptable typically raise issues of whether the public has certain welfare rights, like the right to breathe clean air. The controversies also focus on how much economic progress can be traded for the negative health consequences of technology-induced risks.

Philosophers are particularly divided about how to evaluate numerous negligible risks, from a variety of technologies, that together pose a serious hazard. Small cancer risks that are singly harmless, but cumulatively and synergistically harmful, provide a good example of such cases. They raise the classical ethical problem of the contributor's dilemma. This dilemma occurs because the benefit of avoiding imposing a single small technological risk is imperceptible, although the cumulative benefit of everyone's doing so is great. Some philosophers view such small risks as ethically insignificant, while others claim they are important. Those in the latter group argue that agents are responsible for the effects of *sets* of acts (that together cause harm) of which their individual act is only one member.

Consent to Risk

The sophistication of many technologies, from genetically engineered organisms to the latest nuclear weapons, makes it questionable whether many individuals understand them. If they do not, then it is likewise questionable whether persons are able to give free, informed consent to the risks that they impose. Critics of some contemporary technologies point out that those persons most likely to take technological risks (e.g., blue-collar workers in chemical or radiation-related industries) are precisely those who are least able to give free, informed consent to them. This is because they are often persons with limited education and no alternative job skills.

Those who claim that both workers and the public have given consent to technological risks use notions like "compensating wage differential" to defend their position. They say that, since workers in hazardous technologies receive correspondingly higher pay because of the greater risks that they face, they are compensated. Likewise they maintain that accepting a risky job constitutes a form of consent. They also claim that society's acceptance of the economic benefits created by hazardous technologies constitutes implicit acceptance of the technologies.

In response, more conservative ethicists argue both that economic analysis does not show the existence of a compensating wage differential in all cases, and that mere acceptance of a job in a risky technology does not constitute consent to the hazard, especially if the worker has no other realistic employment alternatives. They also argue that acceptance of the benefits of hazardous technologies does not constitute acceptance of the technologies themselves since many people are inadequately informed about such risks.

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