The Culture of Technology

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Questions of neutrality

Winter sports in North America gained a new dimension during the 1960s with the introduction of the snowmobile. Ridden like a motorcycle, and having handlebars for steering, this little machine on skis gave people in Canada and the northern United States extra mobility during their long winters. Snowmobile sales doubled annually for a while, and in the boom year of 1970–1 almost half a million were sold. Subsequently the market dropped back, but snowmobiling had established itself, and organized trails branched out from many newly prosperous winter holiday resorts. By 1978, there were several thousand miles of public trails, marked and maintained for snowmobiling, about half in the province of Quebec.

Although other firms had produced small motorized toboggans, the type of snowmobile which achieved this enormous popularity was only really born in 1959, chiefly on the initiative of Joseph-Armand Bombardier of Valcourt, Quebec. He had experimented with vehicles for travel over snow since the 1920s, and had patented a rubber-and-steel crawler track to drive them. His first commercial success, which enabled his motor repair business to grow into a substantial manufacturing firm, was a machine capable of carrying seven passengers which was on the market from 1936. He had other successes later, but nothing that caught the popular imagination like the little snowmobile of 1959, which other manufacturers were quick to follow up.

However, the use of snowmobiles was not confined to the North American tourist centres. In Sweden, Greenland and the Canadian Arctic, snowmobiles have now become part of the equipment on which
many communities depend for their livelihood. In Swedish Lapland they are used for reindeer herding. On Canada's Banks Island they have enabled Eskimo trappers to continue providing their families' cash income from the traditional winter harvest of fox furs.

Such use of the snowmobile by people with markedly different cultures may seem to illustrate an argument very widely advanced in discussions of problems associated with technology. This is the argument which states that technology is culturally, morally and politically neutral – that it provides tools independent of local value-systems which can be used impartially to support quite different kinds of lifestyle.

Thus in the world at large, it is argued that technology is 'essentially amoral, a thing apart from values, an instrument which can be used for good or ill'². So if people in distant countries starve; if infant mortality within the inner cities is persistently high; if we feel threatened by nuclear destruction or more insidiously by the effects of chemical pollution, then all that, it is said, should not be blamed on technology, but on its misuse by politicians, the military, big business and others.

The snowmobile seems the perfect illustration of this argument. Whether used for reindeer herding or for recreation, for ecologically destructive sport, or to earn a basic living, it is the same machine. The engineering principles involved in its operation are universally valid, whether its users are Lapps or Eskimos, Dene (Indian) hunters, Wisconsin sportsmen, Quebeccois vacationists, or prospectors from multinational oil companies. And whereas the snowmobile has certainly had a social impact, altering the organization of work in Lapp communities, for example, it has not necessarily influenced basic cultural values. The technology of the snowmobile may thus appear to be something quite independent of the lifestyles of Lapps or Eskimos or Americans.

One look at a modern snowmobile with its fake streamlining and flashy colours suggests another point of view. So does the advertising which portrays virile young men riding the machines with sexy companions, usually blonde and usually riding pillion. The Eskimo who takes a snowmobile on a long expedition in the Arctic quickly discovers more significant discrepancies. With his traditional means of transport, the dog-team and sledge, he could refuel as he went along by hunting for his dogs' food. With the snowmobile he must take an ample supply of fuel and spare parts; he must be skilled at doing his own repairs and even then he may take a few dogs with him for emergency use if the
machine breaks down. A vehicle designed for leisure trips between well-equipped tourist centres presents a completely different set of servicing problems when used for heavier work in more remote areas. One Eskimo 'kept his machine in his tent so it could be warmed up before starting in the morning, and even then was plagued by mechanical failures'. There are stories of other Eskimos, whose mechanical aptitude is well known, modifying their machines to adapt them better to local use.

So is technology culturally neutral? If we look at the construction of a basic machine and its working principles, the answer seems to be yes. But if we look at the web of human activities surrounding the machine, which include its practical uses, its role as a status symbol, the supply of fuel and spare parts, the organized tourist trails, and the skills of its owners, the answer is clearly no. Looked at in this second way, technology is seen as part of life, not something that can be kept in a separate compartment. If it is to be of any use, the snowmobile must fit into a pattern of activity which belongs to a particular lifestyle and set of values.

The problem here, as in much public discussion, is that 'technology' has become a catchword with a confusion of different meanings. Correct usage of the word in its original sense seems almost beyond recovery, but consistent distinction between different levels of meaning is both possible and necessary. In medicine, a distinction of the kind required is often made by talking about 'medical practice' when a general term is required, and employing the phrase 'medical science' for the more strictly technical aspects of the subject. Sometimes, references to 'medical practice' only denote the organization necessary to use medical knowledge and skill for treating patients. Sometimes, however, and more usefully, the term refers to the whole activity of medicine, including its basis in technical knowledge, its organization, and its cultural aspects. The latter comprise the doctor's sense of vocation, his personal values and satisfactions, and the ethical code of his profession. Thus 'practice' may be a broad and inclusive concept.

Once this distinction is established, it is clear that although medical practice differs quite markedly from one country to another, medical science consists of knowledge and techniques which are likely to be useful in many countries. It is true that medical science in many western countries is biased by the way that most research is centred on large hospitals. Even so, most of the basic knowledge is widely applicable and relatively independent of local cultures. Similarly, the design
of snowmobiles reflects the way technology is practised in an industrialized country – standardized machines are produced which neglect some of the special needs of Eskimos and Lapps. But one can still point to a substratum of knowledge, technique and underlying principle in engineering which has universal validity, and which may be applied anywhere in the world.

We would understand much of this more clearly, I suggest, if the concept of practice were to be used in all branches of technology as it has traditionally been used in medicine. We might then be better able to see which aspects of technology are tied up with cultural values, and which aspects are, in some respects, value-free. We would be better able to appreciate technology as a human activity and as part of life. We might then see it not only as comprising machines, techniques and crisply precise knowledge, but also as involving characteristic patterns of organization and imprecise values.

Medical practice may seem a strange exemplar for the other technologies, distorted as it so often seems to be by the lofty status of the doctor as an expert. But what is striking to anybody more used to engineering is that medicine has at least got concepts and vocabulary which allow vigorous discussion to take place about different ways of serving the community. For example, there are phrases such as 'primary health care' and 'community medicine' which are sometimes emphasized as the kind of medical practice to be encouraged wherever the emphasis on hospital medicine has been pushed too far. There are also some interesting adaptations of the language of medical practice. In parts of Asia, para-medical workers, or para-medics, are now paralleled by 'para-agros' in agriculture, and the Chinese barefoot doctors have inspired the suggestion that barefoot technicians could be recruited to deal with urgent problems in village water supply. But despite these occasional borrowings, discussion about practice in most branches of technology has not progressed very far.

Problems of definition

In defining the concept of technology-practice more precisely, it is necessary to think with some care about its human and social aspect. Those who write about the social relations and social control of technology tend to focus particularly on organization. In particular, their emphasis is on planning and administration, the management of research, systems for regulation of pollution and other abuses, and
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professional organization among scientists and technologists. These
are important topics, but there is a wide range of other human content
in technology-practice which such studies often neglect, including
personal values and individual experience of technical work.

To bring all these things into a study of technology-practice may
seem likely to make it bewilderingly comprehensive. However, by
remembering the way in which medical practice has a technical and
ethical as well as an organizational element, we can obtain a more
orderly view of what technology-practice entails. To many politically-
minded people, the organizational aspect may seem most crucial. It
represents many facets of administration, and public policy, it relates to
the activities of designers, engineers, technicians, and production
workers, and also concerns the users and consumers of whatever is
produced. Many other people, however, identify technology with its
technical aspect, because that has to do with machines, techniques,
knowledge and the essential activity of making things work.

Beyond that, though, there are values which influence the creativity
of designers and inventors. These, together with the various beliefs and
habits of thinking which are characteristic of technical and scientific
activity, can be indicated by talking about an ideological or cultural
aspect of technology-practice. There is some risk of ambiguity here,
because strictly speaking, ideology, organization, technique and tools
are all aspects of the culture of a society. But in common speech,
culture refers to values, ideas and creative activity, and it is convenient
to use the term with this meaning. It is in this sense that the title of this
book refers to the cultural aspect of technology-practice.

All these ideas are summarized by Figure 1, in which the whole
triangle stands for the concept of technology-practice and the corners
represent its organizational, technical and cultural aspects. This
diagram is also intended to illustrate how the word technology is
sometimes used by people in a restricted sense, and sometimes with a
more general meaning. When technology is discussed in the more
restricted way, cultural values and organizational factors are regarded
as external to it. Technology is then identified entirely with its technical
aspects, and the words ‘technics’ or simply ‘technique’ might often be
more appropriately used. The more general meaning of the word,
however, can be equated with technology-practice, which clearly is not
value-free and politically neutral, as some people say it should be.

Some formal definitions of technology hover uncertainly between
the very general and the more restricted usage. Thus J. K. Galbraith
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defines technology as 'the systematic application of scientific or other organized knowledge to practical tasks'. This sounds a fairly narrow definition, but on reading further one finds that Galbraith thinks of technology as an activity involving complex organizations and value-systems. In view of this, other authors have extended Galbraith's wording.

For them a definition which makes explicit the role of people and organizations as well as hardware is one which describes technology as 'the application of scientific and other organized knowledge to practical tasks by . . . ordered systems that involve people and machines'. In most respects, this sums up technology-practice very well. But some branches of technology deal with processes dependent on living organisms. Brewing, sewage treatment and the new biotechnologies are examples. Many people also include aspects of agriculture, nutrition and medicine in their concept of technology. Thus our definition needs to be enlarged further to include 'liveware' as well as hardware; technology-practice is thus the application of scientific and other knowledge to practical tasks by ordered systems that involve people and organizations, living things and machines.
This is a definition which to some extent includes science within technology. That is not, of course, the same as saying that science is merely one facet of technology with no purpose of its own. The physicist working on magnetic materials or semiconductors may have an entirely abstract interest in the structure of matter, or in the behaviour of electrons in solids. In that sense, he may think of himself as a pure scientist, with no concern at all for industry and technology. But it is no coincidence that the magnetic materials he works on are precisely those that are used in transformer cores and computer memory devices, and that the semiconductors investigated may be used in microprocessors. The scientist's choice of research subject is inevitably influenced by technological requirements, both through material pressures and also via a climate of opinion about what subjects are worth pursuing. And a great deal of science is like this, with goals that are definitely outside technology-practice, but with a practical function within it.

Given the confusion that surrounds usage of the word 'technology', it is not surprising that there is also confusion about the two adjectives 'technical' and 'technological'. Economists make their own distinction, defining change of technique as a development based on choice from a range of known methods, and technological change as involving fundamentally new discovery or invention. This can lead to a distinctive use of the word 'technical'. However, I shall employ this adjective when I am referring solely to the technical aspects of practice as defined by figure 1. For example, the application of a chemical water treatment to counteract river pollution is described here as a 'technical fix' (not a 'technological fix'). It represents an attempt to solve a problem by means of technique alone, and ignores possible changes in practice that might prevent the dumping of pollutants in the river in the first place.

By contrast, when I discuss developments in the practice of technology which include its organizational aspects, I shall describe these as 'technological developments', indicating that they are not restricted to technical form. The terminology that results from this is usually consistent with everyday usage, though not always with the language of economics.

Exposing background values

One problem arising from habitual use of the word technology in its
more restricted sense is that some of the wider aspects of technology-practice have come to be entirely forgotten. Thus behind the public debates about resources and the environment, or about world food supplies, there is a tangle of unexamined beliefs and values, and a basic confusion about what technology is for. Even on a practical level, some projects fail to get more than half way to solving the problems they address, and end up as unsatisfactory technical fixes, because important organizational factors have been ignored. Very often the users of equipment (figure 2) and their patterns of organization are largely forgotten.

Part of the aim of this book is to strip away some of the attitudes that restrict our view of technology in order to expose these neglected cultural aspects. With the snowmobile, a first step was to look at different ways in which the use and maintenance of the machine is organized in different communities. This made it clear that a machine designed in response to the values of one culture needed a good deal of effort to make it suit the purposes of another.

A further example concerns the apparently simple hand-pumps used at village wells in India. During a period of drought in the 1960s, large power-driven drilling rigs were brought in to reach water at considerable depths in the ground by means of bore-holes. It was at these new wells that most of the hand-pumps were installed. By 1975 there were some 150,000 of them, but surveys showed that at any one time as many as two-thirds had broken down. New pumps sometimes failed within three or four weeks of installation. Engineers identified several faults, both in the design of the pumps and in standards of manufacture. But although these defects were corrected, pumps continued to go wrong. Eventually it was realized that the breakdowns were not solely an engineering problem. They were also partly an administrative or management issue, in that arrangements for servicing the pumps were not very effective. There was another difficulty, too, because in many villages, nobody felt any personal responsibility for looking after the pumps. It was only when these things were tackled together that pump performance began to improve.

This episode and the way it was handled illustrates very well the importance of an integrated appreciation of technology-practice. A breakthrough only came when all aspects of the administration, maintenance and technical design of the pump were thought out in relation to one another. What at first held up solution of the problem was a view of technology which began and ended with the machine — a
Technology is about 'systems that involve people and machines', and many of the problems they use import are largely

FIGURE 2 Technology is about 'systems that involve people and machines', and many of the people concerned are users of machines such as hand-pumps or snowmobiles.
view which, in another similar context, has been referred to as tunnel vision in engineering.

Any professional in such a situation is likely to experience his own form of tunnel vision. If a management consultant had been asked about the hand-pumps, he would have seen the administrative failings of the maintenance system very quickly, but might not have recognized that mechanical improvements to the pumps were required. Specialist training inevitably restricts people's approach to problems. But tunnel vision in attitudes to technology extends far beyond those who have had specialized training; it also affects policy-making, and influences popular expectations. People in many walks of life tend to focus on the tangible, technical aspect of any practical problem, and then to think that the extraordinary capabilities of modern technology ought to lead to an appropriate 'fix'. This attitude seems to apply to almost everything from inner city decay to military security, and from pollution to a cure for cancer. But all these issues have a social component. To hope for a technical fix for any of them that does not also involve social and cultural measures is to pursue an illusion.

So it was with the hand-pumps. The technical aspect of the problem was exemplified by poor design and manufacture. There was the organizational difficulty about maintenance. Also important, though, was the cultural aspect of technology as it was practised by the engineers involved. This refers, firstly, to the engineers' way of thinking, and the tunnel vision it led to; secondly, it indicates conflicts of values between highly trained engineers and the relatively uneducated people of the Indian countryside whom the pumps were meant to benefit. The local people probably had exaggerated expectations of the pumps as the products of an all-powerful, alien technology, and did not see them as vulnerable bits of equipment needing care in use and protection from damage; in addition, the local people would have their own views about hygiene and water use.

Many professionals in technology are well aware that the problems they deal with have social implications, but feel uncertainty about how these should be handled. To deal only with the technical detail and leave other aspects on one side is the easier option, and after all, is what they are trained for. With the hand-pump problem, an important step forward came when one of the staff of a local water development unit started looking at the case-histories of individual pump breakdowns. It was then relatively easy for him to pass from a technical review of components which were worn or broken to looking at the social context
of each pump. He was struck by the way some pumps had deteriorated but others had not. One well-cared-for pump was locked up during certain hours; another was used by the family of a local official; others in good condition were in places where villagers had mechanical skills and were persistent with improvised repairs. It was these specific details that enabled suggestions to be made about the reorganization of pump maintenance.6

A first thought prompted by this is that a training in science and technology tends to focus on general principles, and does not prepare one to look for specifics in quite this way. But the human aspect of technology—its organization and culture—is not easily reduced to general principles, and the investigator with an eye for significant detail may sometimes learn more than the professional with a highly systematic approach.

A second point concerns the way in which the cultural aspect of technology-practice tends to be hidden beneath more obvious and more practical issues. Behind the tangible aspect of the broken hand-pumps lies an administrative problem concerned with maintenance. Behind that lies a problem of political will—the official whose family depended on one of the pumps was somehow well served. Behind that again were a variety of questions concerning cultural values regarding hygiene, attitudes to technology, and the outlook of the professionals involved.

7/This need to strip away the more obvious features of technology-practice to expose the background values is just as evident with new technology in western countries. Very often concern will be expressed about the health risk of a new device when people are worried about more intangible issues, because health risk is partly a technical question that is easy to discuss openly. A relatively minor technical problem affecting health may thus become a proxy for deeper worries about the way technology is practised which are more difficult to discuss.

An instance of this is the alleged health risks associated with visual display units (VDUs) in computer installations. Careful research has failed to find any real hazard except that operators may suffer eyestrain and fatigue. Yet complaints about more serious problems continue, apparently because they can be discussed seriously with employers while misgivings about the overall systems are more difficult to raise. Thus a negative reaction to new equipment may be expressed in terms of a fear of 'blindness, sterility, etc.', because in our society, this is regarded as a legitimate reason for rejecting it. But to take such fears at
face value will often be to ignore deeper, unspoken anxieties about ‘deskilling, inability to handle new procedures, loss of control over work’.7

Here, then, is another instance where, beneath the overt technical difficulty there are questions about the organizational aspect of technology – especially the organization of specific tasks. These have political connotations, in that an issue about control over work raises questions about where power lies in the work-place, and perhaps ultimately, where it lies within industrial society. But beyond arguments of that sort, there are even more basic values about creativity in work and the relationship of technology and human need.

In much the same way as concern about health sometimes disguises work-place issues, so the more widely publicized environmental problems may also hide underlying organizational and political questions. C. S. Lewis once remarked that ‘Man’s power over Nature often turns out to be a power exerted by some men over other men with Nature as its instrument’, and a commentator notes that this, ‘and not the environmental dilemma as it is usually conceived’, is the central issue for technology.8 As such, it is an issue whose political and social ramifications have been ably analysed by a wide range of authors.9

Even this essentially political level of argument can be stripped away to reveal another cultural aspect of technology. If we look at the case made out in favour of almost any major project – a nuclear energy plant, for example – there are nearly always issues concerning political power behind the explicit arguments about tangible benefits and costs. In a nuclear project, these may relate to the power of management over trade unions in electricity utilities; or to prestige of governments and the power of their technical advisers. Yet those who operate these levers of power are able to do so partly because they can exploit deeper values relating to the so-called technological imperative, and to the basic creativity that makes innovation possible. This, I argue, is a central part of the culture of technology, and its analysis occupies several chapters in this book. If these values underlying the technological imperative are understood, we may be able to see that here is a stream of feeling which politicians can certainly manipulate at times, but which is stronger than their short-term purposes, and often runs away beyond their control.