Definitions and Examples of Technology Practice

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The Classical Greek Philosophers, Plato and Aristotle, reflected on the relationship between moral life and the use of tools and techniques to transform raw material into useful and artistic artifacts. They saw connections between the training of artisans and the development of the whole person. An analysis of the roots of the word "technology" helps to explain why.

The word "technology" comes from the Greek technologia, whose roots are *techne*—meaning art or skill, and logos—meaning word or study. Technologia means the systematic treatment of *technikos* (art object or building) by using techne (artistic or artisan skill). *Logia* refers to the systematic study and treatment of a subject or undertaking; it is the root from which we derive the word "logic". If we consider the meanings of the combined root words we can initially define "technology" as: the systematic organization of techniques and skills, so as to produce some product, by means of reorganizing a raw material or some other appropriate medium. Given this definition, we would not use the word "technology" to refer just to the products of technological activity, nor to techniques alone. So, for example, it would be a mistake to refer to the hand-to-hand techniques of a martial art as a technology. "Martial technology" is not equivalent to "martial art", for the latter is more comprehensive and includes a whole range of skills, discipline and training of persons who participate in the larger traditional art using weapons and equipment. Clearly, the systematic practice of techne is part of the training of an artisan who undertakes to master an art. Hence, we can see possible connections between this type of discipline and cultivation of character. Such arts do make use of technological devices in their practices, but this does not make them a technology practice, for a technology practice is an organized activity that includes four dimensions:

- technical knowledge and skill,
- organizational structure,
- cultural purposes and values, and
- resource use, raw materials and the environment.

From the above we can see that the word "technology" as popularly used is vague, for sometimes it is used narrowly to refer just to the technical aspect of a whole technology practice, and sometimes it is used to refer to a whole process. To avoid possible ambiguity we will follow Arnold Pacey's use of the term "technology practice" to mean whole technological activities that include the above dimensions: technical, organizational, cultural and environmental. Pacey does not include the environment as a separate dimension in his analysis, but an integrated, holistic account of technological activities should list it as one. With this modification we define "technology practice" as: an organized activity that applies scientific and other knowledge to practical tasks by means of ordered systems involving people and organizations, living things and machines; using natural systems and materials; to produce goods, services and other values. This definition expands the root meanings of the term technology and adds to it the moral and spiritual dimensions of a practice.

As Pacey notes, we can think of "technology practice" as analogous to "medical practice". "Medical practice" refers not just to medical science, but to the delivery and use of all medical knowledge, scientific and otherwise, for purposes of health care. It involves cultural and professional values, economic concerns, organizational, interpersonal and technical skills, as well as sophisticated devices, scientific knowledge and pharmaceuticals. The practice of medicine is an art and is not limited only to science. There can be no complete scientific knowledge of human well-being and illness, since both are defined partly in terms of cultural values. We live in a cultural context shaped by a world-view that embodies values and ideals, including an ethos of progress and codes of ethics not based on science. Our science, in fact, is in part based on these usually unquestioned givens. Moreover, humans are capable of creative action and trans-personal awareness, both of which involve freedom to go beyond what is known. Scientific knowledge, by its very nature, is fragmented, specialized, abstract and too limited to guide our lives by. Its division of labor and its methods lead to increasing professionalization and specialization. In contrast, the practice of medicine includes the whole person and it must draw from all of a physician's knowledge and sensitivities. A physician needs to consider not just the patient's liver or kidneys but his or her whole being, a being whose health and illness are part of a meaning-rich, purposeful context. As Susan Sontag `shows', illness is part of a culture's literary (mythic) understanding of itself. A specific illness is often seen as a metaphor for more general existential concerns.

These, then, are some of the reasons why the practice of medicine cannot be pure science, but, considered as a whole, is what we here call an art. In general, the same considerations apply to any whole practice of technology. The above observations help to explain why it is possible to design theoretically complex technological systems that seem attractive on paper, but when applied, their calculated economies disappear in a sea of red ink. The nuclear power industry is a perfect example of this. In theory, nuclear power looks attractive and cost-effective. In reality, however, the application of nuclear power to generate electricity for civilian use has been a disaster whose costs will be borne for generations. Without going into all the details, it is enough to note that problems of quality control and other limitations inherent in the workforce have contributed to the escalation of costs in nuclear power plant construction and operation. The quality control and other standards demanded by such complex facilities are far greater than those usually required in the construction and operation of most facilities in industrial society. Delivering such high levels of quality in construction and operation proves to be difficult and costly. In addition, there are other problems overlooked by theory, such as those of waste management, to say nothing of public fear and political opposition to the large-scale use of atomic power. These are all part of the cultural reality in which any technology must operate.

The practice of any technology, then, is like the practice of medicine, and requires the coordinated and harmonious functioning of all four major dimensions we have outlined. If any of these is seriously out of harmony with the others, or is simply not available in appropriate ways, either the practice will not be established, or it will fail. Examples of failures in technology transfers to third world nations illustrate this same point. One of the lessons learned from development aid is that the transfer of a technology practice from one country to another will fail if there are significant cultural differences between them. Transferring techniques and hardware alone will not establish a technology practice, for the cultural and organizational dimensions of the country must mesh with them, if the practice is to be established.

Consider the following simple example as an illustration. The transfer of water pumps and the necessary technical knowledge to support their operation and maintenance seems a simple, straightforward matter. There are many non-industrialized nations that could benefit from such technology. The designs and concepts are simple and the potential benefits seem great. And yet there are cases where such transfers have not had the expected benefits and in some circumstances have even created serious problems. Sometimes the pumps broke down simply because there was no organizational structure to provide for regular servicing of the equipment. In other cases, the introduction of pumps to existing wells led to alteration of nomadic patterns of life, and this in turn led to over-grazing of arid lands by increasing numbers of cattle. These changes precipitated political conflicts, starvation and violence.

The question of whether or not technology is value-neutral can be readily answered if we adopt the concept of technology practice, for it includes purposes and values among its essential elements. While a technological device for which there is no context of practice can be said to be value-neutral, such a device cannot be meaningfully defined outside of a context that is part of a larger cultured valuational setting. As we indicated in our discussion of the stories in Chapter One, a technological device or artifact totally foreign to a culture, which has no place there, is something that the culture will not be able to define in terms of the object's original purpose. A computer is a computer only in the context of practices that recognize it as such, and in those contexts its design and production are bound up with values in every way. Computers, therefore, are not value-neutral in our culture. They are designed, built and deployed by means of value considerations that operate at every level of their use. The same considerations apply to all technological devices.

The organizational dimensions of technology practice include unions, corporations, consumers and their organizations, professional organizations, economic structures and industrial organization. Even though we have all these different levels of organization in our culture, and they make possible the practice of large-scale technological activities, the introduction of new methods and mechanisms, for example for handling information, often requires modification of existing infrastructures. Such existing organizational structures are necessary for the practice of ongoing technological activity, but they also enable us to introduce a continuous stream of modifications to existing practices, such as in maintenance and production. Nonetheless, these organizational structures cannot be totally altered; all new devices, techniques and practices are shaped in various ways to conform to the system as a whole. This explains in part why it is difficult to alter our practices rapidly, even though we might have the technical knowledge and see the need to do so. Let us consider this in more detail by means of a concrete example.

We might each see the need to do something to halt the destruction of farmland, forests and the atmosphere. However, our means of transport, the way we heat and cool our houses and businesses, and our personal and industrial habits all work against this recognition. Short of declaring a national emergency, it is difficult to see how a government, once it did understand the need, could do much to alter, except gradually, the patterns that are now part of our established technology practices. To be sure, it is not impossible. However, solutions to these problems will not be forthcoming if we continue to think and act from within the existing limitations of our dominant technocratic philosophy. Our imaginations must be freed from the dominant paradigm.

As a further illustration let us consider the current North American controversy over old-growth forests. It is now abundantly clear, given our knowledge of ecological processes, that it would be a grave mistake to clearcut all remaining natural, old-growth forests. Given the greenhouse effect, the importance of standing forests in the carbon and other atmospheric cycles, and the necessity of restoring genetically natural forests (not tree plantations), it is obvious that we should preserve all standing ancient forests and naturally reforest as much denuded land as possible. And yet deforestation is accelerating. Politically, the issue is often characterized as a choice between Spotted Owls and jobs; the outcome of preserving the old forests is seen as eliminating lumber as a building material, and so on. Nevertheless, it can be shown that removing a whole forest by clear-cutting is a poor and unwise practice, and although it might provide short-term gain for a few, for the whole economy and for long-term values it is foolish. It is equivalent to dismantling our factories and selling their parts; we are left only with bare ground and have lost most of our productivity. In other words, we are removing not just tree trunks but whole ecosystems with all their many complex processes, diverse beings and productivity. And yet there are alternative ways to obtain the raw materials we need while preserving the natural forest processes which generate them—at no cost to us!

These natural forests also provide a whole range of other services that we cannot begin to produce for ourselves, such as water quality, flood control, wildlife habitat, atmospheric cleansing and weather moderation, to name just a few. What folly, then, to remove most of a complex, natural, self-maintaining ecosystem and to replace it with highly vulnerable and unstable tree plantations that provide few of the above services and values. Yet we do not focus our debate on forest practices! Instead we debate whether we can afford not to cut down the natural forests because without logging them we will lose the use of their raw materials and the jobs associated with this whole industrial process. But the choice is not between old-growth forests and jobs. The choice is between bad forestry practices and ecologically responsible forestry (ecoforestry). The choice is between healthy natural forests and unsustainable tree plantations. A sustainable forest products industry depends on a sustainable forest, and current practices are destroying self-sustaining natural forests. The forests support us, we do not support them, to paraphrase Herb Hammond (1992). Continuing current practices will ultimately destroy most forest-related jobs within ten years. More jobs and higher levels of economic activity can be generated by adopting alternative, ecosophic forest practices, which would at the same time contribute to ameliorating major environmental problems. Despite these obvious advantages, there is as yet no concerted effort to move in new directions, because of structural and political barriers. Current bad practices also continue because some powerful organizations realize large short-term profits by liquidating forests, just as corporate raiders realize short-term profits by selling off the assets of a pirated corporation. In such a sale, the production skills, capacities and management capabilities of the existing company are lost, and while stockholders might realize some short-term gains, they and the economy stand to lose more in the long run.

The same sorts of observations apply to industrial farming practices. Farming in North America has become agribusiness. Even though many small farms remain, the scale of producing major commodities is large and capital intensive. The major producers base their practices on the industrial model, and applying this model has many negative consequences. Neither farmer nor consumer ultimately realizes the greatest benefits from current practices, and in addition, these practices adversely affect both the land and ecosystems. Many authors have succinctly described these effects (e.g., Berry, 1977, Carson, 1962, Hyams, 1976). Alternative, ecologically sound practices have been developed and shown to work (Howard, Š1956, Jackson, 1984, 1985). They are cost-effective. Moreover, consumers prefer food raised by organic means. And yet, although all this has been known for some time, there has been very little movement toward eco-agricultural practices. Some say that this lack of progress is a direct result of the entrenched, powerful, wealthy interests that resist change, since it is to their benefit to continue the status quo. While there is truth to this claim, it is also true that the institutional structures developed to pursue industrial goals make change difficult, driven as these structures are by market forces and government policies, and influenced by social, political and other factors.

The history of agriculture in North America reveals a variegated pattern of development. The production trends in every sector of Western economies have been toward increasing scale. This movement toward large-scale production and increased worker productivity reflects the general features of the process of industrialization. This process is not peculiar to agriculture. Agriculture, in fact, has lagged behind other sectors of production in realizing totally controlled, mechanized, industrial organization. The reasons for this are many, but some of them have to do with the difficulties of large-scale control of soil types, land forms, variable weather patterns and unpredictable biological activity. Even highly mechanized farming today is risky because there are so many variables that cannot be controlled. In contrast to the factory owner, who can shut out the weather and control the space in which the activity takes place, the farmer can control none of these variables. Even when following the most tightly organized schedules of production using highly mechanized techniques, the farmer can still lose an entire year's crop to a hail storm in less than an hour. Farming involves essentially geo-biological processes, and no matter how tightly engineered its practices, it still cannot control these larger forces unless, of course, it becomes greenhouse gardening. The larger biological and ecological context is clearly more evident in agriculture than in manufacturing. Given this, it is not surprising that farmers sought and obtained many forms of insurance, subsidy and support from large institutions. Politicians, wanting cheap food for consumers and support from farmers, developed policies aimed at satisfying both groups. In pursuing these aims they also provided benefits for other establishments within the economy. They encouraged a whole system of research and development that spurred application of mechanized forms of production to farming. Such efforts continue to this day.

Considering the history and the organizational structures of current agricultural practices, it is not surprising that the system resists fundamental change. Many groups and organizations have vested interests in continuing with business as usual. Even when it can be shown that we would be better off in the long run if practices were changed, it is difficult to alter whole practices, since we often do not understand all the elements of these practices, and consequently have no clear idea of where and how to initiate needed changes. Even when it is clear that alterations of government policies would help to spur needed changes, it is difficult to gain consensus in legislative bodies, since they represent the established organizational power of different interest groups who make competing claims and have different views of what the priorities are and what should be done.

We have illustrated so far the extent to which technological processes must be understood as whole practices, and why technological innovation often does not lead to new technology practices, but simply extends existing structures. Since some might think that forestry and farming are not representative of technological activity as a whole, let us consider an example that clearly is. The introduction of computers and software for word processing did not change the basic technology practices of office workers. It increased their productivity and employer monitoring of work stations, but the nature of the work, its aims, basic processes and its production oriented organizational structures have remained essentially unchanged. The computer, as it has been introduced and operated, represents just one more stage in the long process of industrialization of work. The forms of organization inherent in most computer software are based on the same underlying models of production and organization as earlier practices. They are not revolutionary. As a tool the computer is adapted to existing structures, part of a whole technology practice into which it must fit. If, as some hope, the computer does provide a means to free people to work away from offices, unsupervised except for the products and services they provide, then it could lead to alternative technology practices. But to stress a point already made: the alteration of tools and technical knowledge does not in itself change a technology practice, so long as its other dimensions remain unchanged. Revolutionary changes in tools and technical knowledge can lead to new possibilities and new forms of production and thus to new practices, but there is no necessity here. There are numerous other counter-examples such as wheeled toys among the Incas, who never applied the principles of the wheel to transportation, or steam engines among the Romans, who made no practical use of this technical knowledge and skill.

The concept of technology practice we have outlined requires that we consider the ecology of technology in reflecting on our practices. The word "ecology" is used broadly here to emphasize that we want to understand technology in all its dimensions and interrelationships as both an activity and a process. When we approach the philosophy of technology with this ecology in mind, we will not overlook its four fundamental aspects and the complex relationships among them. These are, to repeat, technical, organizational, cultural and environmental. When these are carefully described for any given technology practice, and their interrelationships spelled out, then the full significance of the practice becomes clear. We see how the metaphoric and literary, the philosophical and spiritual, the practical and the political, the scientific and technical, the economic and the material interconnect, and how their interaction affects the self, community and Nature.

Technology practices exist within a context of complex relationships. These relationships are part of ongoing processes and activities, part of the self, community and society, and as such, are also part of the larger ecosphere. To design technology practices in an integrated way so that they are ecosophic (ecologically wise) requires attending to all of these relationships. This is why the design and study of ecosophic technology practices must be trans-disciplinary and cross-cultural. It must include historical, aesthetic, philosophical, spiritual, scientific and other considerations. The philosophy of technology includes the study of technology practices in this integrated and holistic way, for the ultimate aim of philosophy is always *sophia* or wisdom. This wisdom is not mere theoretical knowledge, but practical understanding that empowers us to lead our lives in such a way that we become better humans. In order to do this we must deepen our capacities for learning and loving through deep self-knowledge. As modern humans we are culturally defined by our technology practices, for these, more than any other single factor of our lives, are what make our culture and time unique. These technological processes form part of the ever-present milieu that surrounds us and have become part of almost everything we do.

The technostructure we have created reaches beyond the Earth to the planets; it permeates the airways with the clutter of electronic media and traces of its chemical processes; its satellites are moving stars in the night sky; the odors it produces reach us even in wild places. So, even though one might sit alone in the silence of a mountain retreat far from roads and trails, one gazes into a night sky and sees the moving edge of industrial society, the silence shattered by jets. One catches a whiff of smoke from a distant human-caused fire. One drinks water from a plastic bottle, and sits on a nylon parka. Time is measured by an electronic quartz digital watch. It takes effort and practice to return to the natural mind buried beneath the technological structures that permeate our lives as a result of existing practices. We will return to consider the disciplined pursuit of the natural mind later in this book.

The aim of our description of modern technology practices here has been modest: to describe the concept of technology practice so as to recall things we all tacitly know. We have attempted to make these explicit, accessible and more systematic.

Alan Drengson, *Practice of Technology* (New York: SUNY Press, hardcover 1995; paper back 1996), chapter 2.