Information Ecologies

Using Technology with Heart

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advocacy—is not for everyone. There are other ways to engage with technology, especially at the local level of home, school, workplace, hospital, public library, church, and community center. We all have personal relationships with some of these institutions. We can influence them without having to change broad governmental policy, though that might happen in some cases.

In our research studies, we have seen examples of responsible, informed, engaged interactions among people and advanced information technologies. We think of the settings where we have seen these interactions as flourishing *information ecologies*. Each of these ecologies is different from the others in important ways. Each has something unique to teach us, just as we learn different things about biology from a coral atoll, a high desert, a coniferous forest. We suggest that these examples be read as stories that model a holistic, ecological approach to technological change. Using the metaphor of an ecology, we will discuss how all of us can find points of leverage to influence the directions of technological change.

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A Matter of Metaphor: Technology as Tool, Text, System, Ecology

We have been talking about the ways that we have conversations about technology. We have visited dystopian and technophile perspectives, but there are other themes in other writings that we would like to turn to now. What we would like to highlight about these writings is the ways they use metaphors to reveal certain facets of technology.

Our concepts about technology are often embodied in highly packed metaphors. Metaphors are a useful form of shorthand. We believe it is important to look closely at these metaphors, because the way we use language conditions our thinking. The metaphors we discuss both illuminate and obscure the relationships between people and technology.

We use the term "metaphor" perhaps a bit loosely, but our goal is to suggest a sharp image that provides a neat encapsulation of a whole set of assumptions and questions. For example, people often talk about a technology as a *tool*. Because the purpose of tools is to accomplish something useful, talking about technology as a tool prepares us to think about the particular tasks people can accomplish with technology. The tool metaphor suggests that a person is in control of a technology she uses, because tools are objects we control. We often talk about technology as a tool in this book, because this usage is so common in the design community.

But it is important to recognize that all metaphors channel and limit our thinking, as well as bring in useful associations from other contexts. That is the purpose of a metaphor, after all—to steer us to think about the topic this way rather than some other way. Because we want to challenge traditional assumptions about how technology should be developed and used, we must also recognize and challenge some of the

familiar metaphors that are commonly used to simplify and explain technology development. We will discuss in this chapter the metaphors of technology as *tool, text,* and *system,* to prepare for the discussion of our favorite ecology metaphor in the next chapter. Each of these metaphors, but most particularly the idea of technology as a system, raises the issue of autonomous technological change. Who is really in control of technology development? Is anyone?

For decades, public awareness of technological change has been colored by images of technology that has gone completely out of control, proceeding forward under its own strange logic, beyond the direct influence of individuals. This is in part what *Metropolis* depicted—autonomous machines exploded, malfunctioned, and finally led to the destruction of the city they were intended to support.

Lang's final images of technology were dark. But even when new inventions are received optimistically, our public discourse assumes that technological change moves ahead under its own steam, with no one in particular at the wheel. The sheep cloning stories we discussed earlier featured statements from scientists and government representatives that denied society's right to choose whether and how to proceed with cloning experimentation, including the nonsensical assertion that if cloning were outlawed only outlaws would clone. We ought to be able to do better than appeal to bumper-sticker slogans when we talk about fascinating and important developments such as cloning. Why do we resort to this ridiculous level of discourse?

Perhaps we find it more comfortable to assume that nothing can be done to change things than to face the question of what we should do. It is easier to believe that influencing technological change is someone else's business, and that our role is primarily to be appreciative consumers.

Public conversations and ideas about technological change also may be oversimplified because the big picture is overwhelmingly complicated. This complexity can be dismaying even for those who approach technology in the role of critical friend.

A whole school of thinkers in social and political theory, including Lewis Mumford, Jacques Ellul, Neil Postman, Langdon Winner, and Ivan Illich, have tried to come to grips with the interrelationships among technology and history, technology and social institutions, and technology and politics.[1] They point out that nothing about tool use is fundamentally new to us as a species, but that our ability to absorb new tools—and the different ways of *doing* and *being* that emerge with technological change—are challenged by the avalanche of innovation we are experiencing. Since the publication in 1954 of Ellul's masterful *The Technological Society,* social critics have sounded alarms about the stress to the human mind and soul of having to adapt constantly to the new. These scholars point to the erosion of tradition and identity entailed by the constant necessity of moving on to the next tool, the next technology, the next fundamentally different way of doing things. We are adapting to technology rather than controlling its fruitful and pleasurable use.

Ellul, Winner, Postman, and others present analyses and interpretations that are exhaustive, often very convincing, and extremely sobering. Readers are left with a formidably complex and essentially pessimistic picture that suggests few leverage points for purposeful human intervention. We will depart from the analyses offered by these writers in some important ways in the next chapter, but their construction of arguments about the potentially dehumanizing effects of out-of-control technology deserves careful consideration. Other writers (mostly insiders in the technology design world) are more optimistic about the effects of technology, but few of them address the systemic issues, the tightly woven interdependencies between technologies and their contexts of use.

Metaphors matter. People who see technology as a tool see themselves controlling it. People who see technology as a system see themselves caught up inside it. We see technology as part of an ecology, surrounded by a dense network of relationships in local environments. Each of these metaphors is "right," in some sense; each captures some important characteristics of technology in society. Each suggests different possibilities for action and change.

TECHNOLOGY AS TOOL

One way of understanding technology is to see each technology as a *tool,* something made to fit the hands and minds of individual human beings. This is the most commonsense definition of technology, and indeed "tool" seems to be merely a synonym for technology. But as we explore all the metaphors—tool, text, system, ecology—it will be clear that tool

is only one way of looking at technology. There are other meanings of technology. Technology goes far beyond the notion of device-used-by-an-individual-to-get-something-done, which is the way we think of it in everyday terms.

The idea of technology as tool is so obvious that it hardly seems appropriate to attach a particular author to it, but for convenience in our discussion we can refer to Donald Norman's popular books, *The Design of Everyday Things, Turn Signals Are the Facial Expressions of Automobiles,* and *Things That Make Us Smart.*[2]

In these entertaining and enlightening books, Norman takes readers on a tour of everyday objects such as doors, cars, typewriters, faucets, and telephones. He shows how designers can help people figure out what to do with these objects by making the appropriate actions visible and obvious and by exploiting the inherent constraints of materials and things. If they are cleverly designed, objects can provide people with accurate clues about their use. This is the goal of the designer—we should not have to read instructions to know whether a door opens by pushing or pulling or to know how to turn on a faucet. It should be apparent that one ought to pull here and push there.

Norman's books are entertaining because he illustrates over and over again how often designers fail to achieve this goal. People will, in fact, get stuck behind doors they can't open and they will turn on the wrong burner on the stove. Designers may claim that users are quirky and users may claim the reverse; we only know that such design mishaps are commonplace.

The psychologist J. J. Gibson called intrinsic features of technologies (or of anything) *affordances.*[3] Gibson noted that we are pretty good at not falling over cliffs because we can see what would happen if we stepped over the edge. There is a strong visual affordance to a cliff edge. Gibson's original concept of affordances did not include much of a social context—he was looking at perception. But now we understand that many tool affordances have an important social dimension. We can think of affordances as those properties of an object that neatly support the actions people intend to take with the object.

If we think about tool affordances, a pencil provides a good example. It affords writing because it fits well in the human hand, it leaves an erasable mark, and the eraser is attached. The Roman alphabet has turned out to have interesting affordances for the electronic age—it is much easier to create electronic text with the alphabet because it is so small and general-purpose, compared to picture-based systems with tens of thousands of ideograms. (Although ideograms have other affordances, such as suggesting the meanings and derivations of words graphically.) It is interesting to look around to see what kinds of affordances tools have and do not have.

Some of a tool's affordances emerge during use, unanticipated by designers. Refrigerators are designed to keep things cool, but they also have a well-known affordance of providing a magnetic surface for hanging up notes, children's artwork, cartoons, and other family information. An industry of refrigerator magnet accessories has sprung up around the "extra" affordance—which is no less real than the affordance of cooling food.

Norman's books draw attention to the affordances of designed objects, and he offers valuable precepts to designers of tools of all kinds. As a psychologist, Norman naturally bases his advice to designers on how to support human cognition effectively. In his analyses of design successes and failures, he takes into account how human memory, perception, and reasoning work. He focuses on what happens when individual human beings interact with singular material objects—with little or no reference to the social situations or even the surrounding physical context in which these encounters take place.

Using the tool metaphor to describe technology suggests several tactics to users. Before starting to work, it is important to choose the right tool for the job. There is a matching process in looking at the task at hand and deciding on the best tool for that task. With the right tool, the task can be straightforward to accomplish. With the wrong one, it can turn into an amateurish mess. Once a good tool has been identified, it is important to learn how to use it well. In technology design settings we sometimes talk about "power users," talented people who can use "power tools" with great skill.

The tool metaphor also offers pointed suggestions to technology designers. Part of the delight of doing technology design is working with the materials (software, computer displays, networks) and making them

do interesting, unexpected, and clever things. Thinking about technology as a tool helps designers remember that there is someone on the other end—people who are using the tool. It is not enough to think about the *tool's* inherent elegance and capabilities; one also has to think about the handles it offers to its users.

The area Norman has chosen to mine is rich and yields useful material. But it does not tell the whole story. We know that technological tools are embedded in a larger context, and that this context is important to understanding how tools are designed and used. For example, there are no design criteria that could emerge from Norman's tool-centric analysis that would guide developers of Web browsers in deciding whether or how to support filtering of selected web sites when the browsers are used in elementary schools. This is not a matter of efficient cognition, but a matter of providing tools to meet differing social values in differing contexts. The same could be said for encryption and its relationship to government control, the rights of individuals to keep information about themselves private, facilities for blocking email "spamming," and any issue that requires social as well as technical discussion. Physical context may also be crucial: how much space is there for equipment, can a child carry (and not break) a device, will there be enough phone lines?

Norman doesn't claim that designing tools is easy—on the contrary, he provides very convincing evidence that it is hard to do good design. He points out that it often takes a half-dozen design iterations before a new tool can be considered truly usable. But his discussion does not address issues that extend beyond individual human capabilities and cognitive needs. Some design problems originate in a larger context—the social, organizational, or political setting in which a tool is used.

We consider this larger context to be a legitimate focus of attention when we evaluate how technology works in a given setting. Evaluation should not be limited to cognitive issues such as whether menu items are easy to find or recognize, though these fine-grained questions must also be addressed. We would like to move beyond the human-machine dyad, expanding our perspective to include the network of relationships, values, and motivations involved in technology use.

The tool metaphor is useful for questions and discussions about utility, usability, skill, and learning. We need to keep this metaphor in mind, but we also need to look outside its boundaries.

TECHNOLOGY AS TEXT

Another very different way to understand technology is to see it as *text* —as a form of communication, a carrier of meaning that may be reinterpreted as the technology passes through different social situations. This is a favorite analytical approach of recent postmodern critical theorists such as Bruno Latour and Michel Callon.[4] There are many writers who theorize about texts, but we will only touch on the ideas of some to give a sense of how they are relevant to our understanding of technology.

Critical theory has changed the way social scientists look at commonplace objects and experiences. This perspective challenges us to see that a written text—a book, newspaper article, or other familiar written form—is not something whose meaning is stable, reliable, and created solely by the author. Every reader has an active role in constructing the text, to make it meaningfully present in the reader's own world.

A reader's construction is developed in a cultural setting that may be quite different from the writer's. As a result, the reader's understanding and appropriation of ideas can be very different from the writer's. The writer cannot command the unknown reader to develop one interpretation or another. He can only make suggestions within the language and structures of the text. He will succeed to the extent that his suggestions are intelligible and appealing to his readers.

It seems natural to extend this understanding of writers and readers to designers and the designed-for. The French sociologist Bruno Latour has written engagingly about the messages both sent and received through the design of technological artifacts. First, he points out that we can delegate certain functions either to human beings or to mechanisms. So, for example, we can delegate the task of closing a door behind us either to a human porter or to an automatic door-closing mechanism. Once a function has been delegated to a mechanism, the mechanism then "prescribes" to (tells) its users what they ought to do for the system to work properly. Consider the careful choreography needed to use a revolving door. You must scurry through the door at just the right moment to avoid a brief but embarrassing moment with a stranger in a small space, or the ignominy of watching several perfectly empty partitions rush past as you hesitate.

Ivan Illich, in a less playful mood than Latour, makes the same point about prescription, which he regards as an intrusive aspect of modern life. He says, "In . . . designed goods, the shape, color and provoked associations speak to the user about the way the item must be handled."[5] For Illich, there is something coercive and impersonal about a design intruding into our consciousness its information about "the way the item must be handled." In cultures where tools do not change quickly (perhaps not in a lifetime), tool use is learned in interaction with others, not through manipulations staged by unseen designers.

Prescriptions are written into technologies when they are designed. Prescription in the Latourian sense does not mean that a technology says once and for all how it will be used—or that it will be used at all—but rather that it makes claims on our attention in a particular way. Technological artifacts have a certain authority and presence.

Latour notes that "there might be an enormous gap between the prescribed user and the user-in-the-flesh."[6] When the gap between the designer's concept of the user and the actual user is too great, we end up with tools that are a very poor fit. In current design practice, engineers have few opportunities to interact directly with users. For the most part, the technology itself is the only medium for communication. As it moves from one group of people to another, it carries its own messages and meanings along with it—its prescriptions.

Textual analysis suggests different tactics than the tool metaphor does. Now we are encouraged to *read* the technology to understand its messages and imperatives. By thinking about technological artifacts as a form of communication, we can have a richer sense of the roles they play, and we can more easily look beyond a tool as a physical object to a tool as a kind of stand-in for other people who are not physically present. It can be easier to raise problematic social issues in the context of this metaphor. For example, questions of privilege (who decides which conversations in a video conference are recorded and where they are broadcast?) are more likely to arise here than in a discussion of a tool's functionality.

Technologies carry implicit suggestions from their designers, implementors, and purchasers about how to do things. However, these are only suggestions. There must be other active people in the picture too, who can modify or override the messages inscribed in artifacts. This metaphor of technology as text leaves us with an image of a clamor of voices, all bidding for attention. But what makes one voice louder than another? How do people decide among competing ways of doing things? How do people learn and change the way they do things over time? The text metaphor does not distinguish very clearly between talk and action. That is part of its point—it is useful to remember that talk is a form of action and action is a form of talk. But the metaphor doesn't tell us how people's judgment, creativity, and values can or should come into play when they choose to act. The text metaphor is useful as a way of prompting discussions of intentionality and meaning, but other discussions require further conceptual support.

TECHNOLOGY AS SYSTEM

Of all that we have read, the work that treats technology as system provide the richest, most troubling, and most mind-altering perspectives. If we are looking for breadth of vision, we can find it here. The complex systemic perspective taken in these writings yields provocative analyses of the pervasive influence of technology on our lives.

We gather these ideas together under the general heading of technology as *system,* but "system" here is not used as a metaphor of some familiar object or activity in the same style as tools and texts. The term is too big and vague for that purpose. Jacques Ellul, Langdon Winner, and others are attempting to bring together ideas about phenomena of immense scope, and the difficulty of this shows in the variety of metaphors, concepts, and examples they assemble. In their writing, they are clearly grappling to understand what it is they have their hands on.

There are important differences in the work of these writers, so it is in a sense unfair to lump them together this way, but what they have in common is a broad scope of vision and a deep concern about large-scale social and technical systems. Nor are they the only social commentators to present these ideas—we are focusing on their work as examples of a particular vein of thinking about technology.

Jacques Ellul, the late French sociologist and the earliest of the cultural critics we discuss here, presents a sweeping vision of technology in his book *The Technological Society* (in French, *La Technique,* first published in 1954). Ellul's argument turns on his notion of what he calls *technique.* There is no simple English translation for this term, so we will use the

French word. *Technique* is a cultural mindset in which pure, unadulterated efficiency is the dominant human value. This does not sound apocalyptic, but Ellul details, in relentless, chilling detail, how efficiency drives out every other human value. Technology comes into play because machines are so efficient; they are the standard of excellence in the world of technique. Everything else is to be compared to them. Everything—even people—evolves in the direction of mechanical efficiency. Ellul's most troubling argument is that technique is *autonomous*, that it proceeds under its own momentum without significant control by people.

Ellul defines *technique* this way:

> The term *technique*, as I use it, does not mean machines, technology, or this or that procedure for attaining an end. In our technological society, *technique is the totality of methods rationally arrived at and having absolute efficiency* (for a given stage of development) in *every* field of human activity.[7] [italics in original]

Ellul claims that his definition of technique is not a theoretical concept. Instead, he says, he has arrived at it empirically by looking at examples of human activity in many different realms and noticing how completely intertwined our technologies, social institutions, politics, and economics have become. Other writers, such as Winner, point out that these factors have always been intertwined, but they agree that certain fundamental changes in society have taken place since the Industrial Revolution.

Reading Ellul is a heady experience, not to be undertaken by the faint of heart. Ellul does not pull back from even the most thunderous proclamations. A few examples will provide a flavor of his themes.

Technique, says Ellul, leads people to adapt themselves to technological and institutional arrangements, rather than the other way around:

> Technique integrates everything. It avoids shock and sensational events. Man is not adapted to a world of steel; technique adapts him to it. It changes the arrangement of this blind world so that man can be a part of it without colliding with its rough edges, without the anguish of being delivered up to the inhuman. Technique thus provides a model; it specifies attitudes that are valid once and for all. The anxiety aroused in man by the turbulence of the machine is soothed by the consoling hum of a unified society.[8]

Technique is inextricable from people in society; it is now part of who we are:

> [W]hen technique enters into every area of life, including the human, it ceases to be external to man and becomes his very substance. It is no longer face to face with man but is integrated with him, and it progressively absorbs him. In this respect, technique is radically different from the machine.[9]

Technique moves forward on its own, with new layers of technique building on previous layers with great speed, ignoring tradition that came before:

> Technique has become autonomous; it has fashioned an omnivorous world which obeys its laws and which has renounced all tradition. Technique no longer rests on tradition, but rather on previous technical procedures, and its evolution is too rapid, too upsetting, to integrate the older traditions.[10]

Technique has its own rules and criteria and sets itself apart from moral values:

> [T]echnical autonomy is apparent in respect to morality and spiritual values. Technique tolerates no judgment from without and accepts no limitation. . . . Morality judges moral problems; as far as technical problems are concerned, it has nothing to say. Only technical criteria are relevant.[11]

There are many similarly urgent passages in the brilliant but exhausting pages of *The Technological Society*. The tone of these assertions may cause readers to bristle, since there is little room here for ambiguity or hesitation. Ellul is operating without a safety net, and at times his argument seems precarious. He proffers no academic hedges, no protective disclaimers. Though it is tempting to dismiss his claims as exaggerated, we find that they do set up a resonance with our everyday experience.

For example, to return to the sheep cloning stories again, when we hear that we can't decide *not* to do cloning once we've learned that it can be done, we are hearing about autonomous technique in the practice of science, with its own rules and criteria that are distinct from moral values. The Scottish scientists who successfully cloned sheep find the idea of cloning human beings to be morally unacceptable and the United Kingdom has passed a law to that effect. But in the United States, the idea of applying moral principles to the process of scientific discovery was itself a topic of debate. There was no consensus on whether it was even appropriate to talk about ethics in this scientific research context.