Introduction: On the Nature of Technology

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Recommended Citation
There is nothing so difficult to understand as the obvious, because the assumptions underlying it are rarely examined or challenged. Technology has become just such an obvious facet of our existence at the start of the twenty-first century. Our daily lives are shaped and directed by technology; it dominates our work and our leisure, constructs our home and work and our means of traveling between them, in ways so obvious it remains, for the most part, unexamined.

Technology has the Janus-like character of being both benefactor and threat. Unfortunately, neither aspect of technology is well understood by most of the participants in our current global culture. Until we understand the nature of technology, however, we will not recognize the assumptions and choices inherent in the technology that, at the moment, holds as much peril as promise for our future. Without that critical understanding, we will accept as inescapable what is in fact open to choice. We may make poor choices without recognizing that we are even choosing, and we may miss the opportunities to choose wisely for ourselves and for future generations.

To better understand technology, therefore, we need to unpack the obvious and examine technology more closely, both to identify some prevalent assumptions about it, and to provide the conceptual tools we need to make wise choices about the technology we develop and use.

These twelve statements about the nature of technology are a starting point for such an examination, a framework for conversation among the choosers and users of technology.

1. **Technology is instrumental knowledge and its practice.**

Technology is not just an object; it is also the web of interactions that enmesh the tools we make, choose and use. The misperception that technology refers solely to objects is one of the assumptions that hides from view many of the choices we make about it. Technology is knowledge that is used for a purpose, to accomplish some desired end or goal; in this sense, it is instrumental knowledge. Technology may be both actual and potential, but whether we use a technology or not, the instrumental character of the knowledge we have identified, learned or invented, is indisputable. Understanding technology, then, requires us to do more than merely examine the inner workings of some gadget or object; we must also recognize a particular kind of knowledge -- instrumental knowledge – that gives meaning to the object.

2. **Technology is as old as thinking humans.**

The first example of technology was when Grok the Caveperson first picked up a rock, and thought of using it for some purpose (instrumental knowledge). In turn, the subsequent attempt by other
tribemen to acquire Grok’s rock was the first instance either of commerce, or of technology-based conflict. Therefore, we cannot escape from technology, or return in the face of the threats of modern technologies to some simpler and happier time when technology did not exist. We could, in fact, describe ourselves as “Homo Faber,” Man the Maker, because the first evidence of humanity (and thus of civilization) is the use of tools. Tools only become tools because the human mind has acquired or discovered the instrumental knowledge required to choose and use something as a tool.

Western society has a tendency to view itself as “more technological” than other cultures, especially past ones. However, it is more accurate to say that Western society has emphasized and developed more of certain types of technology, especially in the last 150 years. Whether this is a good or a bad thing is open for debate, but it should warn us against believing that other cultures were (or are) more “primitive” than our own. When we view technology as instrumental knowledge, rather than tools by themselves, we are alerted to the fact that each culture, each society, has its own technology, its own body of instrumental knowledge suited to its own circumstances.

3. **Instrumentality lies in the mind of the user, not in the object of technology itself.**

The potential ability of Grok’s rock to grind food, stun game or crush human skulls resides entirely in the mind of the user. While “made” items have more potential use built into them than those occurring in nature, ultimately it is still the user who chooses which of the potential dimensions is realized. As we saw on 11 September 2001, a passenger aircraft can be turned into a weapon, even though its maker designed it for a very different purpose.

4. **Technology is never “value-neutral;” all technology has values embedded within it.**

Because technology involves instrumental knowledge (and not simply tools), and because instrumentality lies in the mind of the user, technology involves choice. In turn, the choices we make reflect values. Specifically, the choices surrounding the development and use of technology reflect the values of the chooser, which can be a society, a culture, or an individual. There is never only “one way” of doing things, because technology is both a product and the embodiment of values, which differ between individuals, cultures and time periods.

5. **Technology is both product and producer of the culture within which it is found.**

While there is obviously overlap between the technologies of different cultures or societies – the result of fundamental human needs and desires -- the differences between groups lead to a different set of choices that reflect a different set of values.

While technology is found in all times and places within all human cultures, the technology which most concerns us today is the technology of comparatively recent western European culture. The science and technology of western European culture has been globalized, but it still reflects the values of the culture that produced it. Technology has helped create that culture but technology itself equally has been shaped by that culture. This interdependent relationship between technology and culture is important to remember: just as there are no simple linear answers to social and cultural problems, there are no simple linear answers to the problems posed by technology today.

6. **Technology is always expressed in systems.** A technological system is two or more instances
of technology combined to produce an expected and repetitive result.

Because technology is instrumental knowledge, and instrumentality lies in the mind of the user, it does not exist in the abstract, or in isolation from its context. Whether it is a rock to stun game that fits within the pattern of the hunter/gatherer society, the use of a scratch plough to prepare a certain type of soil to plant a certain type of crop, or a particular alloy to improve conductivity in a microchip, technology always exists within technological system. In every culture, moreover, those technological systems are interwoven with related human systems – which is why one of the growing edges in contemporary engineering is “human factors engineering” (that is, how people interact with technological systems).

If technology is old, so are technological systems. While it is a fiction that old technology (or primitive technology) is simple (complexity is not a modern innovation) the number of elements within our human constructions has increased. Complex systems require increasingly complex means of control, particularly if there is an emphasis on components rather than patterns, themes or trends. Natural and organic systems have evolved such complex systems of coordination over thousands of years, systems that computers are only attempting to mimic with limited but increasing success.

Predictability of operation in repeated circumstances is a necessary characteristic of western technology. Because the machine has been the dominant analogy of life in western thought for hundreds of years, only those things that can be identified as “mechanical” have a place in the “reality” either recognized or constructed by western technology. Mechanical operations are observable and predictable. In a mechanical system, there is no place for gods, spirits, feelings, or elements of other human systems. In cultures where an explanation of results rather than their predictability is most important (“why did this happen?” as opposed to “how does this work?”), technological systems might include supernatural or philosophical/religious elements. While difficult perhaps for westerners to appreciate because western technology tends to ignore human factors, prayers to a deity (or invocations of fertility spirits) may be an integral part of technological systems.

7. Technological systems are dynamic, not static.

Only by ignoring processes can any technological system even for an instant be seen as closed. Even in their most mechanical versions, technological systems are of necessity dynamic; they interact with other systems (including organic ones), with human systems, and with the environment. Attempts to represent technological systems as anything but dynamic misrepresents their character, and disguises the choices that humans make to perpetuate them.

8. There are three types of technological systems: production (T1), control (T2), and distribution (T3), and these reflect an increasing level of system complexity.

All technological systems can be broken down into three types (described below), which are dynamic, rather than static in character. Each individual system may share the same characteristics as the larger system within which it fits. (This triad may be represented by other equivalent terms, such as Making, Ordering, and Moving or Concept, Application, and Extension.)
9. Production systems (T1) involve the making of a single piece of technology, for the first time.

This is the process of invention or discovery, when a piece of technology is made for the first time. It can be a discovery of something already existing (as Grok realizing the use of a rock), or it can be the deliberate construction of a device to fulfill a use envisioned by the inventor (widget). In terms of craft technology, where each item is unique and therefore made once, T1 or production technologies are more prevalent than T2 or T3 systems.

10. Control systems (T2) involve the mass production of the item created at T1.

When more than one copy of the T1 widget is required, and especially when mass production is desired, other elements are introduced into the system. Control technologies relate to the issues involved in mass production (availability and costs of materials, labour costs, etc.) As a result, requirements at T2 level can drive a redesign of the widget at T1 if the materials initially used are in too short supply for the mass production of widgets, or if the design is too complicated to be handled by machinery or lower-skilled (but cheaper and more numerous) workers. At a T2 level, the unique characteristics of a craft technology disappear; in mass production philosophy, this loss is compensated by increases in volume and average quality, and a lower cost per unit.

11. Distribution systems (T3) involve the marketing, distribution, or communication of the mass of items produced at a T2 level.

Just as T2 issues can drive a redesign of widgets at a T1 level, issues relating to the distribution of an item at a T3 level can drive the same sort of redesign at both the T1 and T2 levels. This is the marketing and distribution phase: everything from the name and colour of a product, to its ability to be shipped long distances, to the tastes of a particular group of consumer can force a redesign of the initial technology. Whereas issues relating to the production of the widget (which may tend to be material and pragmatic) affect the T2 level, T3 issues are more apt to reflect issues in environment, society and culture. If an item that is mass produced cannot be “sold,” then the whole system (at all levels) falls apart.

While the systems are laid out in order here (Statements 9, 10 and 11), the relationship is more interdependent and reflexive than linear. An idea may appear at a T3 level (such as the desire for electric lighting in homes), and then move to a T1 level for the invention/discovery of what the system requires, and to a T2 level for the mass production of its elements, before returning to a T3 level for the issues relating to its distribution.

This model of technological systems fits best with the types of choices made about technology in western culture since the first Industrial Revolution, including the production, control and distribution of military forces. Two short examples will illustrate these systems:

The Railroad:

The success of the railroad required a host of inventions and discoveries at a T1 level, from the design of powerful and efficient high-pressure steam engines to the nuts and bolts that held the locomotives – and the track -- together. At a T2 level, there were a host of issues related to mass
production, including the volume of rail required, availability of coal, and other factors. This entailed a massive increase in high quality iron and steel, at a price low enough to build a railroad across continents. At a T3 level, the “distribution” required the acquisition of railway rights-of-way, the changing of settlement patterns around rail lines, and – most importantly – the willingness of the public to make use of this new method of transportation.

The Modern Industrial Army:

The modern industrial army required a soldier to be trained to use specific weaponry, and to follow orders in a prescribed way both in drill and in the heat (and smoke) of battle. The creation of the individual infantryman was a T1 issue, but as large numbers were required, everything down to the kit on the foot soldier had to be rationalized in terms of the mass production of what he carried or wore. The foot soldier had to be “redesigned” to suit these T2 issues, and (if one considers the weight of kit carried by a World War One soldier, for example), the plight of the foot soldier as a human being was rarely considered. Later, as the high cost of training a replacement soldier was identified as an issue at the T2 level, more efforts were made to ensure the foot soldier’s survival, whether in terms of pre-combat training, better weaponry, suitable food and water, rapid medical treatment in the event of injury, or psychological supports. At a T3 level, getting troops to the battlefront (think of effects of the train timetables on the mobilization efforts before World War One) or keeping them supplied once there became a dominant factor in military success, which is why the Battle of the Atlantic assumed such huge importance in both World Wars.

This triad of T1, T2 and T3 applies to every level of the construction, deployment and management of military forces, just as it applies to the production, control and distribution of other products of industrial society.

What needs to be remembered, however, is that all of these technological systems are interrelated with human social, political and cultural systems. Just as importantly, these technological systems are also interrelated with the organic and environmental systems on which all life – including our own – depends.

12. Sustainability needs to be considered as a central element in our technology and in our technological systems.

While western science and technology has reshaped the planet in many ways, the longer term effects are making the earth less hospitable to existing life forms, including humans, than before. A society’s use of a process that entails its own termination is, in other contexts, properly viewed as suicidal. Measuring the effectiveness of a culture's technology by its ability to transform nature instead of living with it requires choices that pass virtually without comment in western society, but they are frequently choices no sane person or culture would knowingly make, if given the opportunity for reflection.

We need to bring out into the open the choices we are currently making about the tools we use. We need to be aware of our choices, and our responsibilities, not in order to turn our backs upon technology, but to choose what kinds of technology we need to create a sustainable future for ourselves and for future generations. Every day we make choices as individuals, as members of western society, and as participants in twenty first century consumer culture. These choices reflect
our values. We need to consider those values carefully, keeping what will create a sustainable future and discarding what threatens to destroy it.

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These ideas about the nature of technology have informed the selection and editing of the following papers in this issue of Essays in Philosophy on the philosophy of technology. The call for papers cast the net wide for possible contributions:

For too long the philosophy of technology has been considered something of an oxymoron. There is nothing philosophical, it would seem, about driving nails, plowing fields or building bridges.

Both the reciprocal relation between technology and culture, and the realization that epistemology and values are reflected in all technology, however, require us to reach a different conclusion. We may be descendants of *homo faber*, but the tools we make and the way we choose to use them pose crucial questions for the future of the global village we all share.

This issue of *Essays in Philosophy* is devoted to the philosophy of technology. Papers that consider the philosophy of technology in any of its forms are welcome; papers on the relationship between values and technology; the nature of technology in western scientific culture; or philosophical aspects of indigenous or non-western technology, are particularly welcome.

The large number of excellent submissions, from all points of the philosophical compass, has to my mind justified both this initial approach and the further conviction that much more should be thought, written and discussed on the subjects included below.

The issue begins with three papers that consider the ramifications of a relationship between philosophy and technology.

In “Philosophy Regarding Technology,” James Farris explores the loss of collective memory with respect to the ethical dimensions of *techne* and the more recent “technology,” demonstrating that as a series of human stories, interwoven with the larger earth story, a uniform conclusion about linear “progress” is both untenable and unsatisfying.

In “Technology: History and Philosophy,” Keekok Lee compares the as yet undeveloped philosophy of technology with the more accepted philosophy of science, arguing that the history of technology has created the circumstances in which the philosophy of technology has languished for too long.

In “(En)Framing Heidegger’s Philosophy of Technology,” Ronald Godzinski unpacks Martin Heidegger’s understanding of technology, reflecting on the points of comparison between different works by Heidegger on the subject.

The next three papers deal with the implications of technology for ethics, how the development and use of technology entails choices that in various ways reflect the values of the individuals and the cultures that do the choosing.
In “If the Truth Be Told of Techne: Techne as Ethical Knowledge,” Frances Latchford compares, contrasts and discusses the views of Hans Georg Gadamer and Michel Foucault on the relationship between ethics and technology, or more specifically, techne and ethics, ultimately relating the two thinkers through a consideration of Heidegger’s Question Concerning Technology.

In “Ethics, Technology and Posthuman Communities,” Steven Benko affirms the intimate relation between technology and ethics, focusing on the future of what it means to be human that emerges from an extension of postmodern thinking he dubs “posthuman” (after Francis Fukayama’s Our Posthuman Future).

In “Technology and the Evolution of the Human: From Bergson to the Philosophy of Technology,” Michael S. Ruse takes another tack on a similar theme, arguing for the essential place of “technology” in the fields of ontology, epistemology and social/political philosophy, as a consequence of the “technological impulse” being a part of every field of human endeavor, and illustrating his ideas from the work of Henri Bergson.

In the next two papers, the relationships among science, technology and culture are explored, recognizing the need to identify which elements are products of choices specific to western European culture.

In “The Many Faces of Science and Technology Relationships,” Ana Cuevas further develops the ideas of Ronald Giere on the science/technology relationship and the variety of its potential forms.

In “Aboriginal Cultures and Technocratic Culture: Two Ways of Relating to Reality,” Humberto Ortega Villasenor and Genaro Quinones Trujillo muse on the aspects of “technology” that are in fact a product of the technocratic culture specific to western society, and how these aspects of technology might be seen differently from the perspectives found in aboriginal cultures.

To give a sense of the physical reality to which the philosophy of technology needs to speak, the next two papers deal with understanding “water” in the context of current assumptions about Nature as well as the technology that mediates our perception and interaction with an aquatic “reality.”

In “The Domestication of Water: Filtering Nature Through Technology,” David Macauley explores how our experience of “water” is mediated through techniques and instruments, from large hydrological projects to the emergence of bottled water.

In “Sonar Technology and Shifts in Environmental Ethics,” Christine James identifies a “new relationship” that has emerged between sonar technology and environmental ethics as a consequence of changes in understanding of the effects of sonar technology on the aquatic environment being investigated.

In the last four papers, a variety of approaches to issues in the philosophy of technology lead their authors in unique directions, demonstrating how the philosophy of technology has abstract as well as concrete applications.

In “Chess, Games and Flies,” Stefano Franchi examines theories about Artificial Intelligence,
making the wry parallel between the use of the fruit fly to test genetic theory and the use of chess to test AI theory.

In “A Framework to Systematize Positions in Neuroethics,” Nicolas Neubauer and Saskia Nagel discuss some of the key ethical issues in the emerging field of neuroethics that result from the ability to alter brain function by chemical, electrical and other means.

In “Thoughts on the Theory and Practice of Speculative Markets qua Event Predictors,” Mason Richey offers thoughts and opinions on the problems associated with market prediction (specifically, the Policy Analysis market or PAM), and how predictability in the post-9/11 era depends on more imponderables that such theory can control.

A fitting end to the volume, John Scott Gray explores the technology of time in western culture (and on a deserted island) in his “The Problem With the Technology of Time: Understanding the Ethics of Erazim Kohak’s Concept of Authentic Time Through an Analysis of the Motion Picture Cast Away.”

Finally, some thanks are required:

- to the various authors for their good-natured responses to my requests for changes;
- to Red River College, for the time and facilities to work on this issue;
- to Michael F. Goodman, General Editor, for his humor, insight, and patience in the preparation of a very large number of papers;
- to Humboldt State University, for sponsoring Essays in Philosophy as part of its institutional commitment to encouraging scholarship in many places -- including those far colder than California.

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1. For comments on the ideas developed in this article, I thank my students in the history of technology courses I taught at the University of Winnipeg from 1998 to 2001, and my current students and colleagues at Red River College. My special thanks to Dr. Jim Kenny and Dr. Erika Behrisch of the Royal Military College of Canada for their comments on the article itself, which has been incorporated in an earlier draft into the course reading materials for HIE 475 (“Technology and Warfare”) that is part of the Officer Professional Military Education program at RMC.

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