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TECHNOLOGICAL DETERMINISM

Prior Reading

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PART I: A MODEL OF THE INTERACTIONS BETWEEN TECHNOLOGY AND THE SOCIO-ECONOMIC SYSTEM

Introduction

As mentioned in the introductory chapter, the central *theoretical* problems in studies of Technology and Society concern the nature and strength of the interactions which take place between technology and society; specifically, to what extent are they outside human control or deterministic. In the first part of this chapter I present a model which supplies the framework for a discussion of technological determinism. In the second part I present a spectrum of attitudes or stances adopted by various schools who accentuate different aspects of the model.

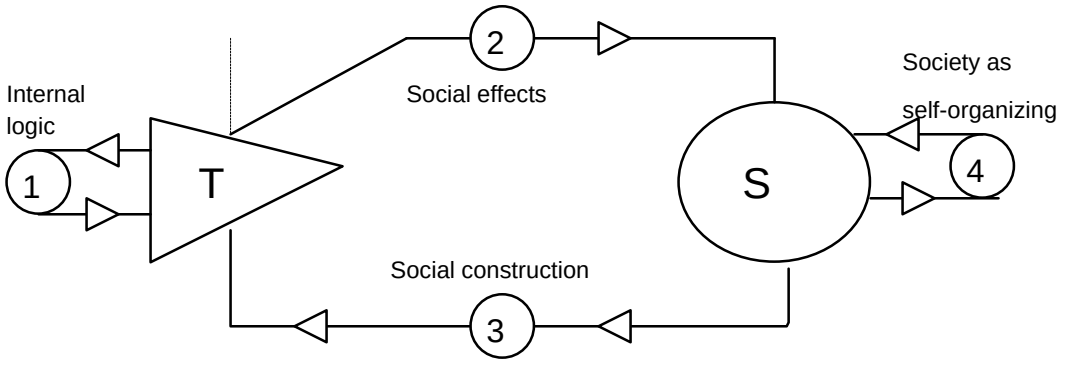


Figure 406. Interactions between Technology (T) and Society (S)

The diagram (Fig. 406) illustrates the fact that this is not a single problem, but a problematique comprising at least four processes (shown on the diagram by numbered loops) in which one element modifies - or possibly "determines" - another:

- **Loop 1**: Internalist laws of technology (intrinsic characteristics of technology arising by *self*-determination);
- **Loop 2**: Effects (or "impacts") of technology on society (note *refraction* by the medium represented by the prismatic shape of the technology icon);[3]
- **Loop 3**: Social shaping (or "construction") of technology; design and selection of technologies in the social context.
- **Loop 4**: Society as a self-organizing system. Human nature and cultural traits arising by *self*-modification;

The loops should not be regarded as independent. There is an interaction between them. The social processes that determine the design of specific technologies and their selection for application (Loop 3) are the product of political negotiation and arrangements of power. They aim at a particular social effect, e.g., increased productivity, or increased control over the labour force, but the effects are influenced or *refracted* by the internal logic (Loop 1) of the constructed technology so that the outcome (Loop 2) is in many cases an unexpected or even undesired effect or "impact".

The overriding psychological predisposition toward technological rather than humanistic solutions to social problems is reinforced by the Loop 3-Loop 2 circle which I explore further in the chapter Technic Frame of Mind. In a nutshell, we build a technical world and the world technicizes our way of looking at the world. This type of relationship is often called 'dialectical'.

Loop 4 is rich in content but beyond the scope of the present work. It embodies the idea of society as a self organizing system and the idea of human nature as self-modifying.

The economic milieu

All the interactions must be assumed to take place within an **economy** governed largely by the self-organizing exchange system known as the Market and driven by the desire for profit. It has, in fact, been argued that economic rather than technological determinism plays the dominant role in the development of technology. In terms of Fig. 406 this suggests that the economic factor, which is a dominant driver of Loop 3 (social construction of technology), is always of greater significance than the intrinsic characteristics of Loop 1 in determining the resultant strength and direction of Loop 2. A leading economist has recently observed:

> The competing themes you mention: technological determinism vs. economic determinism (and thus the need for state intervention to counter them) pose the major dimensions of the socio-economic fault lines of our age. I tend to think that the economic relations are more important....[4]

Christopher Freeman's "technological determinism" is in my opinion "economic determinism".[5] He calls it a third approach to technological change in contrast to change conceived as a rational goal-directed activity or change as the cumulative addition of small modifications. This third approach allows for paradigm changes in technology arising

from new combinations of radical innovations (see chapter on Technological Change II Innovation). Freeman's point is that

> Such "new technological systems" can offer such great technical and economic advantages in a wide range of industries and services that their adoption becomes a necessity in any economy exposed to competitive economic, social, political and military pressures.

To the pressures listed by Freeman we have to add the irrational intoxication to which megaprojects such as space travel give rise in the breasts of politicians about to put large sums of public money into them. But for day-today technological projects the fundamental pressure is economic and this chalenges the whole the idea of technological determinism. The challenge can be met either by substituting some phrase like "techno-economics" for "technology" in the discussion of determinism or by including economics in the concept of 'society'. These are matters of choice and I have tentatively chosen the latter. To accept the dominance of economic over technological determinism is not to deny the importance of the latter. Of course major changes in technology profoundly affect the economy.

Like a Russian doll, the model must be imagined as being contained within the wider environment of "Nature" with which it interacts by modifying it and being modified by it. I have not dared to complicate the model by adding the associated loops.

The context of change

Over the last 150 years, the determinist problematique has been addressed by both sociologists and economists (as well as by political scientists, philosophers and historians). On the whole, sociologists have treated technology as a single static phenomenon while economists have focused on specific technologies in a context of technological change or "innovation".

Although the economists usually leave out of account the imponderables that are the stuff of psychology and sociology, their focus on change is of prime importance. The reader will therefore find it useful reconsider the discussion of Loop 2 and Loop 3 after studying the three chapters on Technological Change.

I start now with a more detailed study of the first three loops.

Internalist laws (Loop 1)

This loop represents the internalist laws of the technological system. That there is an internal logic to technical systems can hardly be doubted, but the degree of flexibility it permits is a matter of keen debate. To one school of thought the system is completely independent or autonomous. It has been claimed that "The most essential feature of technology, the feature that sustains its expansiveness, is autonomy."[6]

Auto means self; nomos is law or custom. Therefore autonomy means governed by its own set of rules. Ellul said that he meant autonomous with respect to:

> economics and politics
> social situation
> morality and spiritual values.

Other students of technology forcefully reject this viewpoint: thus, Bruno Latour "...the 'autonomous' thrust of a technical artifact is a worn-out commonplace made up by

bleeding-heart moralists who have never noticed the throngs of humans necessary to keep a machine alive."[7] The proponents of autonomy, such as Ellul, get round this fact by claiming that the human agents are completely subverted by the system (see quotation below).

Both Jacques Ellul and Marshall McLuhan espoused a theory of technological autonomy. Ellul devoted much of his work to substantiating the idea. McLuhan's outlook has to be pieced together from scattered observations such as "These self-amputations which we call new technologies generate vast new environments against which the individual organism is quite helpless[8]."The theory is difficult to test because both writers tend to aggregate all technologies into one phenomenon of technology -- the normal approach of those who write on a very abstract level (though McLuhan can be quite specific when not in his mood of "gnomic utterance"). Applying the theory to a specific technology, we would imply by calling it "autonomous" either that its developmental trajectory followed some internal laws regardless of external societal aims and concerns or that its use imposed on us a certain pattern of behaviour (this would be called its "bias" as discussed below) regardless of our true intentions . If we found either of these to be the case we would naturally conclude that the technology was "out of control", which is a theme adopted by many writers. In terms of Figure 406, the autonomous claim is that technology is immune to any modifying feedback from the user via Loop 3. Others, particularly historians of technology, have suggested that, on the contrary, technology is entirely a social construct (the constructivist viewpoint). An intermediate position is that technology is "socially shaped". Both these viewpoints regard Loop 3 as dominant over Loop 1. These matters are taken up again under the heading "Loop 3".

A more radical criticism of technological autonomy denies the *logical* validity of Loop 1, since every artefact or device was at one time a human construct. (Shakespeare recognized our tendency to externalize the causes of our acts when he had Edmund say, "An admirable evasion of whoremaster man, to lay his goatish disposition on the charge of a star."[9]) This criticism has been met by Jacques Ellul in an obscure footnote within a book which is seldom cited.

> "It is obvious -- and this comment holds for all the rest of this discussion -- that when I say technology "does not admit," "wants," etc., I am not personifying in any way. I am simply using an accepted rhetorical shortcut[10]. In reality, it is the technicians on all levels who make these judgements and have this attitude; but they are so imbued, so impregnated with the technological ideology, so integrated into the system, that their vital judgements and attitudes are its direct expression. One can refer them to the system itself." Jacques Ellul (translated by Joachim Neugroschel) *The Technological System* New York: Continuum 1980 (1977). Chapter 5, footnote 2, p.335.

Nevertheless I believe that the autonomy of technology is at least partly illusory. The illusion is fostered by a number of processes which I shall now discuss:

Reciprocal bias

One predicted consequence of the theory of "autonomous technology" is that technologies will have a bias (or be refracted) toward specific kinds of practice, as explained in the context of Loop 2. But the observation of bias does not prove the autonomy of technology. The actors themselves (designers, operators) become biased in the course of technological practice as Ellul admits in the quotation

above. This gives rise to feed-back via Loop 3. I call this dual effect "reciprocal bias" and contend that the mindset it engenders reinforces the illusion of technological autonomy. This theory is elaborated in the chapter on The Technic Frame of Mind in which I indicate the special role played by technological metaphors.

Physical and biological constraints

What, when loosely thought about, seems to be a "ghost in the machine" that determines its behaviour can be more realistically interpreted in terms of the natural constraints which the properties of materials and biological systems impart to a technology; for instance, the minimum size of an electron-based switch; the breaking strength of a material; the temperature constraints on protoplasm. This is of fundamental importance. It is obvious that during the development of a technology these constraints limit the opportunity set from which a selection is made and thus set bounds upon ("determine") the path taken.[11] There is a suggestive parallel in biological evolution in which what Stuart Kauffman calls "order for free" spontaneously appears as an outcome of sets of constraints: it shows that a great deal of order can be produced just from the physical attributes of matter and the structural principles of organization. You don't need a special Darwinian argument.[12]

In addition to the natural constraints just discussed, patents held by a rival firm may impose artificial constraints.

Lock-in

The totality of past events, part chance and part choice, presents us with a concrete situation in which freedom of action is limited. If the foundations have been laid for a building for 5 stories, it is not possible to change the plan and erect a skyscraper upon them. If a system of communication is built around twisted pairs of copper wire, those in charge of it will attempt to increase bandwidth through tricks of software rather than rebuild with optic fibre. If a certain standard (e.g. VHS) captures the market, development will follow that path rather than by improving another standard (e.g. BetaMax). There are certain critical junctures in the development of a technology which determine the road ahead. Technologies become "embedded" and thus seem to have a life of their own e.g. the typewriter keyboard.[13]. Seymour Papert seems to have been the first to draw attention to what he called "the QWERTY phenomenon".[14]

"The top row of alphabetic keys of the standard typewriter reads QWERTY. For me this symbolizes the way in which technology can all too often serve not as a force of progress but for keeping things stuck. The QWERTY arrangement has no rational explanation, only a historical one. It was introduced in response to a problem in the early days of the typewriter. The keys used to jam. The idea was to minimize the collision problem by separating those keys that folowed one another frequently. Just a few years later, general improvments in the technology removed the jamming problem, but QWERTY stuck."Papert observes that people try to justify the arrangement by "objective criteria. This illustrates a social proces of myth construction tha tallows us to build a justification for primitivity into any system.

This phenomenon is sometimes described as technological inertia by analogy with "the property of matter by which it remains in a state of rest or, if it is in motion,

continues moving in a straight line unless acted upon by an external force."[15] Ellul's preferred term was "automatism" [of technological choice].

One best way

It is part of the folklore of engineering that, at any given state of technological evolution, there is "one best way" of doing things.[16] Competitors whose operations do not match this pattern attempt to do so by "benchmarking" (looking for outstanding performance and copying it). That a certain way is "the best" is a socially constructed decision (e.g. by the community of engineers), but to the extent that this folklore is true - and there is some truth in it - technological development appears to be convergent and thus autonomous. All home computers end up with a graphic user interface like the original Mackintosh. But there are both theoretical and empirical objections to the very idea. There is the phenomenon of "technological multistability" which is the technological equivalent to the existence of multiple equilibria in economics.[17] Those familiar with "fitness landscapes" will perhaps see an analogy with biological selection; this theme is developed in the chapters on the Trajectory of devices and The Darwinian Evolution of Machines. To illustrate the multistability thesis at the level of a simple tool, consider the evidence of the machete or cutlass whose shape is indeed partly determined by end-use (cocoa versus sugar cane, for instance) but also by chance and local whim. Every tropical region has its characteristic shape. The same observation could be made about cooking pots. Even in an advanced industrial economy, different countries, or even firms within countries, will have inherited a different engineering culture, a preferred way of doing things. For a long time during the 1960s the operating companies of the Royal Dutch Shell Group outside North America used optical analog processing on their seismic traces while Shell USA used digital technology, although both methods were equally available to both parties. On the other hand, it has to be admitted that the greater the level of technological sophistication, the less room for variety[18] and the greater the pressure for uniformity.

This discussion can be illuminated by a quotation from Deforge[19]:

> If we ask a technician in the Office of Methodology how he thought up such and such a factory installation, he replies that given the statement of the problem *he had no choice.* His installation is the solution to the problem. And yet when one takes, as we have done as a test case, some 20 different designs for the fabrication of mechanical pieces; designs coming from three different Offices of Methodology, observers quickly distinguish three styles of solution which employ different principles, in one case mechanical, in a another hydraulic and in a third electro-mechanical electronic; and also different intellectual attitudes in face of the problem. All this demonstrates that *the problem is not as rigidly determined as the technicians of the Office claim.*

It is true that any technological process or device possesses a certain inertia. Our conservative mindset, often reinforced by sound economic considerations, prevents us from wild swings in technology. The examples given above show that, while technology *seems* to pursue a pre-ordained course, its trajectory can more plausibly be explained by a combination of the physical properties of the components and the history of its

development - all within the constraints of profitability which imposes a powerful filter on the course of events (one is unlikely deliberately to adopt a less profitable technological change unless *fascinated* by a certain solution).

Social effects of technology (Loop two)

Obviously, the most important effects of technology are those which its designers and promoters had in mind in the context of Loop 3; by and large the technology does what it is designed to do. But the way in which the technology is used, and thus its effect on society, is strongly influenced by the prior choice of a particular technological form. An early interpretation was supplied by the Canadian historian Harold Innis who introduced the term "bias"[20]. Innis pointed out the correlation between centralized theocracies and the use of clay tablets and contrasted them with far flung empires communicating with papyrus[21]. Shortly thereafter, Jacques Ellul introduced the metaphor of "refraction" meaning that mediated human actions are bent by the medium -- they don't hit the mark as we intend them to, just as a stick poked into a pond misses the stone it was aimed at:

> [Technique] is not a kind of neutral matter, with no direction, quality or structure. It is a power endowed with its own peculiar force. It *refracts in its own specific sense* the wills which make use of it and the ends proposed for it[22]..... any given technical means ...always conceals in itself a finality which cannot be evaded.

Yet another formulation was offered by C.G.Bush who claimed that tools, machines and other means have "Valence" which she described as a bias[23] or "charge" analogous to that of atoms that have lost or gained electrons[24]. The term "valence" seems superfluous in view of the priority of "bias".

Some people have criticized the choice of the term "bias" because they sense that technological devices are being anthropomorphized. They miss the point: it is precisely because the bias is imparted to the technology by a human agent, often with specific motivation, at the time of the design or "exaptation" (see Trajectory) that the term is so suitable. Nevertheless, since the design becomes embodied in the artefact or frozen in the software, it there acquires a quasi-autonomy for the reasons I have explained in my discussion of Loop 1.

Marshall McLuhan, with his usual gift for the memorable phrase, encapsulated the idea in the expression "The Medium is the Message" later turned into a punning book title "The Medium is the Massage". McLuhan focused on communications technologies and the scholarly tradition springing from his work has been called "medium theory"[25].

All these authors are saying the same thing -- what you do is influenced by the technological medium you choose (and you may not have much choice). The medium also changes the user in the course of being used. E-mail messages flame where snail mail messages do not. A married friend of mine attended a conference where he met an attractive woman delegate. He agreed to E-mail her and afterwards felt bad about it because he would never have agreed to enter into ordinary correspondence under these circumstances. The choice of medium had altered his message.

A contemporary instance came to my attention with the publication of the Historical Atlas of Canada. Byron Moldofsky, the computer specialist who collaborated with the cartographer Brian Matthews in this work, observed:

> The technology introduces biases. The computer does allow you to do things at a different scale, to angle and rotate your drawings. But it de-emphasizes things like scale - you don't necessarily see everything on screen at once....There was a lot of compromising on this edition.[26]

Certain technologies are operationally-biased in the course of design (a human activity); that is to say the way in which they are designed to operate limits the range of possible outcomes. This appears to be the case with the introduction of the computer-based "Degree Navigator" atht e University of Calgary. Certain options have been closed down to the student owing to the complexity of their programming requirements. The presence of a new technical device often results in operational ends being adapted to its means. A food processor slices carrots this way and this thick - for every recipe - forget tradition! . You want slivered almonds? Too bad - you have to take them chopped on your *Truite aux amandes*. The microwave evaporates the aromatic compounds that give flavour; so you learn to accept flavourless food.[27]

Socio-Institutional effects

Technological change brings with it socio-institutional effects (incorporated in Loop 2) which vary in profundity with the depth of the innovation. A change in a product may involve re-tooling - the process will be less radical with FMS (Flexible Manufacturing systems). A change in a process may call for re-training and the re-allocation of capital resources to new plant and equipment. A paradigm change brings about widespread structural dislocation i.e. whole groups of firms vanish and others arise; trades skills become useless, new skills are in demand. The overall demand for labour may be permanently reduced. Government reacts in panic -- often with counterproductive measures (e.g. increased immigration quotas for unskilled labour). These effects are important enough to warrant separate treatment (Chapter on Work).

Social construction/shaping of technology (Loop 3)

Technologies are invented, designed and promoted by networks of actors whose interests vary widely (benefaction of the human race, thirst for power, desire for riches, amongst others). Langdon Winner[28] has shown that the process is, in many cases, highly political[29] (i.e., related to power and authority). His theory of technological politics offers a valuable insight into the motives behind the promotion of a number of technologies. I have tried to organize these cases into a classification in Part II of this paper.

Technological developments depend upon contemporary conditions[30] and depend on their relevance to a particular social group. Some of the special conditions identified with technological change are[31]:

war. it gave rise to cannon and fortifications and these led to surveying and maps. Modern warfare has been a major factor in scientific research and its technological spin-offs.

climate, chimney; air-conditioning (William Carrier, 1915), with profound political effects (longer sessions in Washington - more government, more taxes, more bureaucrats).

communications. In Burke's film "Connections" he attributes waves of technological change to the opening up of new communication channels. He claims that there was a surge in invention (he really means innovation) when

I. Safe communication was established between cities. Another surge took place in the 1450s when

II. Gutenberg's press allowed the rapid diffusion of knowledge. But it really had to wait for the technology to produce cheap paper and an essential complementary product - woodpulp 1855. And another surge accompanied

III. Telecommunications. (But was it the communications or the microprocessor's role in process technology that caused it?).

Demographic e.g. unfavourable age pyramid affecting the labour market.[32] Invention of various prostheses in anticipation of the needs of the aged (example of anticipated demand pull).

Economic e.g. strong expansion of the economy negatively affecting the labour market. Labour saving machinery; finding ways round a patent; the inescapable need to adopt a new technical paradigm under pressure of competition.

Socio-institutional e.g. labour unrest leading to a disruption in the allocation of financial resources. Large scale unemployment leading to exponential growth in the surveillance and alarm industry requiring innovation in sensors, monitoring control software, access control

Cultural--Protectionism and import substitution promote innovations to get around patents held by foreigners (Avro Arrow). The importance of cultural control over technology has been documented by Rybczynski[33] with examples from television (in India and Africa), the decision of the Japanese to refrain from the use of the gun in warfare, and other instances. Status may be an important factor in cultural control, as in the design of flashy automobiles or over-elaborate kitchen equipment.

All these exogenous influences add up to the social shaping (weak position) or the social construction (strong position) of technology. The current fashion in STAS is to attribute all technology (really "technological change") to social forces. If these include economic forces then the constructivists have a strong case; but the effects of inertia, embedding and so forth discussed under Loop 1 cannot be disregarded.

This leaves open the possibility of radical changes in the social motivation of the actors and whether this might result in radically different technologies being developed. Are "alternative technologies" possible? Supposing the work force was consulted in the design of technological systems, would a radically different yet still economically viable design emerge? Questions of Alternative Technology have been asked principally in the context of Development Economics (the program sponsored by advanced industrial countries to industrialize the rest of the world). This subject is important enough to merit a chapter to itself, now in preparation.

Society as a self-organizing system (Loop 4)

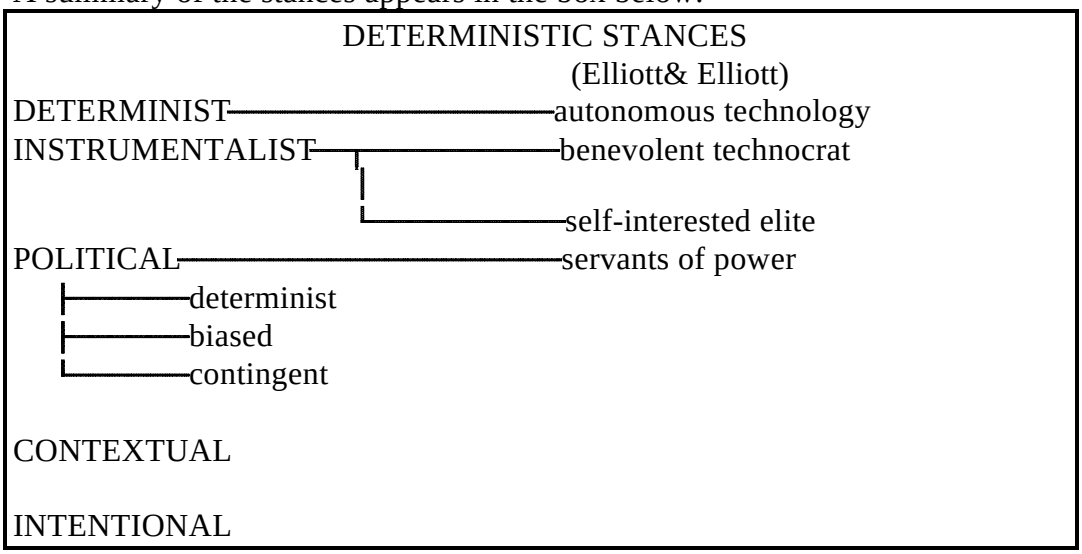
This heading is included in order to complete the diagram. No further explication is offered but readers are referred to the thought-provoking paper on this subject by Loet Leydesdorff.[34]

PART II: DETERMINISTIC ATTITUDES

Introduction

In Part I, I discussed the model of interaction between technology and the socio-economic system. The discussion has already revealed differences in emphasis between different investigators. These attitudes tend to get hardened into firm stances held by different schools in the STAS discipline and others. I shall turn now to a discussion of these stances, attitudes or points of view building on the prior work of Donald Shriver in a much cited paper[35] on "stances", modified in the light of the categories established by Langdon Winner in his essay "Do Artifacts have Politics" and the models of technocratic behaviour proposed by David and Ruth Elliott[36]. Each of these authors uses a different terminology but I have related them all to a common schema. For each category I indicate authors whom I consider to be typical of that point of view. In some cases, those to whom a certain attitude toward technology is imputed acknowledge it as their authentic point of view. In other cases a person might regard himself as holding a certain attitude, e.g. benevolent technocrat, while being seen by others in quite a different light e.g. as a member of a self-interested elite. This paradox is part of "the reflexive problem" of some social theorists: it does not affect the validity of the categories.

A summary of the stances appears in the box below.



I am not concerned at this stage to establish whether the views described are "correct", only to set down the range of views that has been expressed in the literature and to identify the authors associated with these views. Winner's text is somewhat confusing in this respect in that it mingles original interpretations made from his own point of view (for example, the story of the tomato harvester), with a critique of the interpretations of others (for example Engels on the factory).

Determinist stance "Technology as a juggernaut"

The *determinist* view expresses a technological philosophy in which "the technological order is ... the prime mover and the ultimate justification of other orders, moral, aesthetic, cognitive, social and political."[37] In terms of the model of interaction

between technology and society (Fig. 406), this implies the control of Loop 1 over Loop 2. I take Jacques Ellul, with his claims for the autonomy of technology, to be the quintessential determinist in this sense although one can read the attitude into the writings of Brooks Adams (1903), and Robert Ezra Park (1940)[38] and very probably earlier works with which I am not familiar[39]. George Grant, at least in some contexts, seems to adopt this philosophy when he characterizes as "absurd" Robert Bourassa's slogan *American technology, French culture*[40], adding the comment, "as if technology were something external (e.g. machines) and not itself a spirit which excludes all that is alien to itself."[41] That spirit, as I contend in the chapter The Technic Frame of Mind, lies in the group psyche, not in the technology.

In discussing Loop 1 in the first part of this chapter, I have indicated my reasons for rejecting the idea of technological autonomy. Obviously, if there is no autonomy, the determinist stance is untenable.

Taken to extremes, this determinist view treats technology as a demiurge (defined as a creative spirit subordinate to a main god), as History was treated during the Nineteenth Century[42]. Writing during the build-up to the Second World War, Karl Friedrich Jünger[43] called technology "demonic". But let us keep our feet firmly on the ground and affirm that technology is always what Heidegger called "a deed of humankind"[44].

Shriver refers to this stance as *technological value determinism* because its adherents see value as being present *in* technology, rather than exclusively in the humans that interact with it, in a way "that makes shambles of simple means-end analysis."[45] In Elliott and Elliott's typology of technocracy, this stance fits into the "autonomous technology model"[46]. And for Winner[47] it is "Naive technological determinism." The philosopher Albert Borgmann has characterized it as "Substantive theory."[48]

Instrumentalist stance "Technology as just a tool"

At the other extreme are the pure *instrumentalists* who see every technique as "just a tool" over which we have complete control at all times and which is in itself quite neutral (Loop 3 completely controls Loop 2 with Technology as a neutral intermediary). Scarce a day passes without this claim being offered as a sort of talisman to the fearful. Those adopting this stance subscribe to the theory which Winner calls "the social determination of technology"[49]. He admits that it has "an obvious wisdom" and serves as a useful antidote to naive technological determinism (see above). Shriver identifies this stance as *rational value determinism*: "In this view, man is the creature who sets his intent on valued purposes for the future and turns his intelligence to the achievement of these purposes through appropriate means. Tools are made for an end in view...."[50] Emmanuel G. Mesthene's essay "The role of technology in society"[51] illustrates this stance. I believe this attitude is the one held by the largest number of people outside the academic discipline of metatechnics. Those who have this attitude usually act in the world with the "technic frame of mind", described in the chapter with that title. There are two subsets within this category:

Benevolent technocrat

Within the Instrumentalist stance is the (possibly empty!) subset of "benevolent (or altruistic[53]) technocrats"[52]. The ideal of this outlook is enshrined in the political

philosophy known as Technocracy Inc. To an outside observer, however, the stance of the Technocracy movement might be described as a self-interested elite (see below). H.G.Wells fanciful book "A Modern Utopia" (1905) justifies this point of view.

Self-interested elite

The other subset within the instrumentalist stance comprises the self-interested elite[54]. This term seems self-explanatory. It goes without saying that its members seldom apply the term to themselves! Self-interested elites existed long before the advent of the modern technocrat. Craft unions provide a typical example: their justification for restrictive practices was usually couched in instrumentalist terms.

Political stance "Technology is a weapon"

This category includes Shriver's "politicized technology: the servant of corporate interests" and Elliott and Elliott's **"servants of power"** model[55] but is broadened to include the "political" categories studied by Winner who argued that certain technologies *in themselves* had political properties. In advancing this argument, he did not reject the determinist and instrumentalist theories, both of which contained grains of truth, but he emphasized the fact that the objects themselves embodied specific forms of power and authority. I would add that they do so precisely because they are the product of persons with a certain point of view. The political stance can be subdivided into three sub-sets:

I Politically determinist
II Politically biased
III Contingently political

Each sub-set will now be explained in more detail. Clearly, a person could adopt, or be accused of adopting, one of these second-order stances toward one technological system and a different stance toward another technological system without being inconsistent.

Politically determinist

These are the technologies that Winner describes as "inherently political"[56] in that they *require* specific social arrangements in order to function effectively. These arrangements may be internal, as, for instance, the organization within a factory that is based on a transfer line ("conveyor belt") must be authoritarian and hierarchical whether the factory is located within a "free enterprise" or a "command" economy. Or they may be external, as, for instance, the atom bomb can be safely deployed only in a society with a strong military and police presence to protect from theft or sabotage.

A weaker version of this stance claims only that certain technologies are *compatible* with specific internal or external arrangements. Railroads and airlines have been proposed as examples of technologies that are most compatible with authoritarian internal structure.

Lewis Mumford's essay on "Authoritarian and Democratic Technics"[57] establishes him as a typical representative of this point of view.

Politically biased

Unlike those in the politically determinist category, those who adopt the "politically biased" stance make no claims about the intrinsic bias of the technology itself, but infer that the social arrangements in which the technology is placed result

in changes in, or reinforcements of, power and are thus political. Winner does not give this category a name but it comprises "instances in which the intention, design or arrangement of a specific technical device or system becomes a way of settling an issue in the affairs of a particular community [what I refer to as a "social group"]".

Once again, we find a strong version in which the construction of the socio-technical system in question was consciously planned in advance to achieve certain (usually corporate) ends, and a weaker version in which the result is due simply to a lack of foresight or of social concern. John McDermott's interpretation is that the strong view usually prevails and he is quite extreme in applying this interpretation to the whole of technology rather than to specific instances.[58]

Langdon Winner gives two examples of the strong interpretation.[59] One claims that Robert Moses's New York parkway overpasses were built low specifically to exclude the bus-travelling sector of society from the parks and beaches.[60] The other[61] example was the introduction of pneumatic moulding machines into the McCormick agricultural equipment plant which Winner claims was deliberately done in order to destroy the craft union.

Winner's interpretation of the tomato harvester[62] illustrates the weak position. He claims that it transformed the social relations between growers and pickers without prior specific plans to decimate the labour force.

The fact that the harvester will handle only hard fruit is an entirely separate issue. That is a question of operational, rather than political, bias, discussed in the chapter on Intrinsic characteristics.

I place the choice of numerical control over record/playback automated machine tool systems in the "politically biased" category.[63]

Contingently political

This is the stance that some critics adopt toward certain artifacts whose design has political effects, such as the exclusion of certain social groups, in some circumstances but not in others. Many architectural features are described by Winner in terms that place his interpretations in this category[64] in spite of the fact that he does not distinguish them from the weak version of the politically biased category. The installation of heavy hydraulic door closers in a building could be considered from this point of view. In a private dwelling, such a closer might be neutral or it might be a legitimate expression of a parent's power to protect a small child from a steep flight of basement stairs. In a public building it could be construed as an illegitimate exclusion of the frail or the handicapped.

Andrew Feenberg[65] offers a "critical theory of technology", ostensibly as a third way contrasted with substantive theory and instrumentalist theory. Critical theory has much in common with the Political Stance in recognizing that capitalist technical systems are constructed and interpreted in conformity with the requirements of a system of domination. But in Feenberg's hands critical theory goes much further in providing the theoretical basis for a future transformation of technology to adapt it to the needs of a free society. I shall come back to this theme in the chapter Appropriate Technologies.

Contextualist stance "Sociotechnical systems need individual study."

As Shriver observed, neither the determinist nor the instrumental stance attends adequately to the actual historical complexity of social systems. Harry Marks wrote: "the historian would rather talk about particular networks of individuals, the ways in which their technical practices and judgements are embedded in personal, group and institutional histories."[66] Any realistic interpretation has to take account of the specific contexts in which the interaction takes place, because there are numerous actors involved. Bruno Latour writes "The context is not the spirit of the times which would penetrate all things equally. Every context is composed of individuals who do or do not decide to connect the fate of a project with the fate of the small or large ambitions they represent."[67]

Writers such as Victor C. Ferkiss, who wrote in the 1960s, use a "contextual" or "historical" approach to the problem of determinism.[68] Shriver places Ferkiss's stance in the category he calls *Evolution and Interaction*. The contextual stance **does not exclude the political: it broadens it.** Ursula Franklin[69] is a writer whom I would place in the contextual/political category and I would aspire to that position myself. In the chapter Green Revolution I describe a major technological change in which the importance of context is unmistakable.

Intentional Stance[70] "Technology has a mind of its own."

A stance that does not fit readily into the above classification is the intentional stance. The "intentional stance is the strategy of interpreting the behaviour of something, whether a person, animal or machine, as if it had beliefs and desires ... The intentional stance is particularly useful in describing very complex machines, such as chess-playing computers, when it becomes difficult to avoid saying that the machine "wants" to win or is "determined" not to allow a particular piece to be taken."[71] Stuart Brand's "extravagant aphorism"[72] "Information wants to be free." is of this genre.

This is what Ellul has referred to as a "rhetorical short cut". It seems to me that it leads to confusion. It leads people to think one is adopting a determinist stance, when in fact one is not.

Conclusion

Although proponents of the various stances often give the impression that it is a question either of instrumentalism or of technological determinism, there is some degree of truth in each of them and in the political stance. The contextual stance is intended to embrace them all. The problem is to establish, for each technological system, the balance of forces operating within the network of actors or agents in the broad sense of the term (which includes the inanimate objects whose internal constraints set boundaries to human action).

I am not suggesting that an awareness of the complex interplay of forces disclosed in this chapter will completely protect one from the unexpected. As Michael Oakeshott observed, the results of events are largely unascertainable, for some will remain obscure. Grasp of this truth may induce an attitude of scepticism toward all innovation or it may serve merely to temper one's enthusiasm for the power of technology as an agent for the betterment of the human condition.

Review Questions

1. What are three common stances or psychological attitudes to technology?
2. What do you understand by politicized technology? Give an example from The Whale and the Reactor.
3. Describe a technological phenomenon using the intentional stance.
4. Read the history of the chair in any reliable encyclopedia and interpret it in terms of the model in figure 406.

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[1]I was prompted to revise the first version by reading an essay by Dr. Samuel Ebersole of the Regent Business School VA published on the World Wide Web.
[2]©P. Fitzgerald-Moore (pfitzger@acs.ucalgary.ca)
[3]Leydesdorff, Loet (1993) "Is society a self-organizing system" *Journal of Social and Evolutionary Systems*, 16(3), 311-349.
[4]Ron Stanfield, personal communication 1995 06 05.
[5]Freeman, Christopher (199?) "The case for technological determinism" In .....
[6]Barry Cooper *Action into Nature* p.65
[7]Bruno Latour in *Shaping Technology:/Building Society: Studies in Sociotechnical Change* MIT, 1992.
[8]Marshall McLuhan and Quentin Fiore (1968). *War and Peace in the Global Village* Bantam. p.136.
[9]King Lear 1, ii, 141.
[10]This is what Daniel Dennett calls "the intentional stance". See the section with that heading at the end of this chapter.
[11]Raymond Williams, in his *Marxism and Literature* (1977) interpreted Marx's "determinism" as "establishing limits" but also "exerting pressures" p.67.
[12]Stephen Jay Gould quoted by John Brockman in *The Third Culture*, p.341.
[13]Geoffrey Hodgson's "Lock-in and chreodic development." in *The Elgar Companion to Institutional and Evolutionary Economics*, edited by Geoffrey Hodgson, Warren Samuels and Marc Tool. Aldershot: Edward Elgar, 1994.
[14]Papert, Seymour. 1980. *Mind storms: children, computers and powerful ideas* New York: Basic Books, p.32-33.
[15]*Oxford Paperback Dictionary* 1979.
[16]The clear statement of this idea goes back at least to Frederick Winslow Taylor (quoted in C. Pursell, 1994)
[17]W. Brian Arthur
[18]Simondon, Gilbert (1989). *Du mode d'existence des objets techniques*. Edition augmenteé d'une préface de John Hart et d'une postface de Yves Deforge. Paris: Aubier.
[19]Simondon, Gilbert (1989). *Du mode d'existence des objets techniques*. Edition augmenteé d'une préface de John Hart et d'une postface de Yves Deforge. Paris: Aubier. (trans. PF-M)
[20]Innis, Harold A. (1951) *The bias of communication* Introduction by Marshall McLuhan. Toronto: University of Toronto Press.
[21]Recommended reading: *Empire and Communications* by Harold A. Innis, edited by David Godfrey, 1986.
[22]Ellul, J. (1964). *The technological society*. New York: Vintage. p.141 [T 14 E441]
[23]Harold Adams Innis
[24] Corlann Gee Bush (1983) "Women and the assessment of technology" reprinted in Teich 6th Edition p.192
[25]Joshua Meyrowitz, *op.cit.*
[26]Val Ross "Atlas a project of Herculean proportions" (G&M n.d.)
[27]*New Scientist* 18 Jan. 1992 p.20
[28]*The Whale and the Reactor*. University of Chicago Press, 1986.
[29]Herbert Marcuse in *One-Dimensional Man* (1964), p.168, goes further, saying "..the process of technological rationality is a political process."

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[30]Recent work of importance by Wiebe E. Bijker (Of Bicycles, Bakelites and Bulbs: Toward a Theory of Sociotechnical Change) is conveniently summarized by Steve Woolgar in *New Scientist*, 9 Dec. 1995, 48-49.
[31]Le Bas, C. (1981). *Economie des innovations techniques*. Paris:Economica. 228 p.
[32]Note effect of waves of age-groups on future markets and hence the planning of innovation (New Scientist "Ideas for Industry" Supplement; Issue 1638, 1988).
[33]Rybczynski, W. (1983). *Taming the tiger: The struggle to control technology* Penguin. [T 49.5 R93 1983].
[34]Leydesdorff, Loet (1993) "Is society a self-organizing system." *Journal of Social and Evolutionary Systems*, 16(3), 311-349.
[35]Donald W. Shriver Jr. (1972). Man his machines: four angles of vision. *Technology and Culture*, v. 13, no.4, 531-554. The main importance of this paper is in the discussion of the interaction between technological, social and value systems.
[36]Elliott, David & Elliott, Ruth (1976) *The Control of Technology* London: Wykeham Publications
[37]H.Skolimowski, 371.
[38]Park, Robert E. (1940). "Physics and society." *Canadian Journal of Economics and Political Science*, v 6, no.2, 125-152. (Park quotes Adams from a secondary source).
[39]James, William (1884) "The dilemma of determinism." in *The will to believe and other essays in popular philosophy*. The Works of William James. Cambridge MA: Harvard University Press. This essay has only minor relevance to our topic.
[40]Premier of Quebec at the time.
[41] *Lament for a Nation*. Introduction to 1970 edition p.ix
[42]John Kenneth Galbraith, in *The good society* (1996, p.9) still says "In reality it is history that is in control." But I interpret this to mean "technical change".
[43] *Die Perfektion der Technik.*
[44]"Ein Tun des Menschen"
[45] Shriver *op. cit.* p. 534.
[46]Elliott, David & Elliott, Ruth (1976) *The Control of Technology* London: Wykeham Publications, p.66.
[47]Winner, op. cit. p.21
[48]Borgmann, A. (1984). Technology and the character of contemporary life: A philosophical enquiry Chicago University Press.
[49]Winner op.cit. p.20-21.
[50] Shriver *op. cit.* p. 532.
[51] In *Technology and the future*, 6th ed. Albert H. Teich ed.
[52]Elliott, David & Elliott, Ruth (1976) *The Control of Technology* London: Wykeham Publications. p.57-60, 70-85.
[53]McDermott, John (1969). "Technology: the opiate of the intellectuals." *New York Review of Books*, July 31.
[54]Elliott, David & Elliott, Ruth (1976) *The Control of Technology* London: Wykeham Publications, p.56-57.
[55]Elliott, David & Elliott, Ruth (1976) *The Control of Technology* London: Wykeham Publications. p.63
[56]Winner, op. cit. p.22.
[57]Technology and Culture (1964) v.5, p.1-8.
[58]"Technology, the opium of the intellectuals" in Teich
[59]Winner, op. cit. p.23)
[60]Bruno Latour, in *Aramis* (p.195) describes a Parisian equivalent of Robert Moses Parkway. (Maurice Daumas ed. Analyse historique de l'évolution des transports en commun dans la région parisienne 1855-1930. Paris: Editions du CNRS, 1977.) When the radical mayor of Paris decided around 1880 to construct the Paris metro, his office was producing a highly unfavourable interpretation of the great railroad companies as "wild capitalists. human beasts." To exclude them forever, elected officials cast their unfavourable interpretations in bronze, iron, cement, steel. So they dug the tunnels of their new

metro so that even the smallest of the capitalist wagons would not be able to penetrate them, even if the radical mayor should lose future elections.

[61]Winner, op. cit. p.24

[62]Winner, op. cit. p.26

[63]Winner, op.cit. p.28.

[64]op.cit, second paragraph on p.25.

[65]Feenberg, Andrew (1991).*Critical theory of technology*. New York and Oxford: Oxford University Press.

[66]Correspondence on the STS e-mail list, 1997.

[67]*Aramis or the love of technology* p.137

[68] *Technological man: the myth and the reality* 1969.

[69]*The real world of technology* CBC Massey Lecture Series, 1990.

[70]This is not the same concept as the "intentionality" of Daniel Dennett which is the interpretation of an artefact in terms of what the designers had in mind. See *Darwin's dangerous idea: evolution and the meanings of life*. Simon and Schuster/ Touchstone, 1995, p.229.

[71]Marian Stamp Dawkins in a review of *Kinds of Minds* by Daniel Dennett *(New Scientist* 4 Aug. 1996, p43)

[72]Duguid, Paul . (1996). Material matters: the past and futurology of the book. In Nunberg, Geoffrey (ed.) *The future of the book.* Berkeley CA: University of California Press. p.73