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The Concept of Function in Critical Theory of Technology

Andrew Feenberg

Abstract

The concept of function is a hinge between the material world and the cultural world. Analytic philosophy of function has made considerable progress in the conceptual analysis of function, but it has not considered the link between function and culture. That is the purpose of this chapter. We know from social constructivist investigations of technologies that the problems to which technical solutions are addressed depend on the interpretations of actors with the power to influence design. Corresponding functions are designed into technical artifacts. The interpretations and therefore the functions depend on the cultural framework within which the actors understand their own needs and the constraints of the environment. The theory of function must situate it in relation to the culture and way of life it serves. Heidegger and Lukács offer perspectives on this relation. This chapter explains their approach as it has been appropriated in critical theory of technology.

Function, Technology, Heidegger, Lukács, Rationality

Introduction

What is a technical object? How is a rock changed when it is used to crack open a shell? What transformation does a branch undergo when it is swung high to knock down an out of reach piece of fruit? Clearly the objective properties of these simple objects are not altered by their technical employment. The functions they have acquired are purely relational, that is, they would not exist except for the role human beings assign the objects in their practices. But the assignment cannot be arbitrary, as it would be in the case of a purely social function such as the meaning of a new word in the language. In these technical examples, there is a relation between the assignment and the properties of the objects. Those properties are part of what motivates the choice of these specific types of objects. The stick only acquires its fruit-gathering function because of its weight and length, the rock its shell-opening function because of its hardness. Technical objects have a foot in two worlds, a world of human intentions and a world of objective properties.

The analytic theory of technical function has attempted to tease out the exact nature of this relation, in some cases emphasizing the objective properties, in other cases human intentions, and in the most convincing formulations, achieving a balance between the two sides of the relation. The purpose of these theories is to explain how engineers use the word function, or how the word is used in everyday speech, or in both contexts where the theorists can identify a common basis. This approach abstracts from many social and cultural aspects of function in order to achieve conceptual precision.

Wybo Houkes and Pieter Vermaas have proposed the "use-plan" or "ICE" theory of function which synthesizes many analytic contributions[1].[2] Their concept of plan is meant not as a psychological description but as a way of reconstructing the nature of artifact use after the fact. Thus the theory allows for informal and incomplete interactions with objects which are more common than the prior elaboration of a detailed plan. In their theory the subjective side of functionality consists in beliefs and intentions together constituting a use-plan, while the objective side of functionality consists in specific physical properties. The beliefs about those properties must be justified for the functional ascription to count as rational. Justifications may be based on direct experience or on information obtained from experts. Either alternatives makes it possible to formulate a rational plan for using an object. The theory is tested against several desiderata, such as whether it can support a distinction between "proper use" and occasional or accidental use, and whether it can explain the malfunctioning of useful objects.

> In summary, we arrive at an analysis of artefacts as objects with a twofold dual nature: they are objects that have intentional characteristics and that have physical characteristics, as well as objects that are used and that are man-made. Functional descriptions are relevant to the first, intentional-physical duality since these descriptions allow users and engineers to connect and disconnect teleological and structural descriptions of artefacts. Hence, technical function is a useful concept, that serves as a conceptual hinge between the two natures of artefacts.[3]

Although I can agree that the assignment of a function does presuppose belief about the properties of the object, I want to better understand what we *do* when we envisage the world with a technical intention. What is the orientation of the subject toward the object in this particular kind of belief? As I will show, answering this question involves understanding the specific type of object that underlies the assignment of function and the corresponding form of subjectivity.

We know from social constructivist investigations of technologies that the problems to which technical solutions are addressed depend on the interpretations of actors with the power to influence design. Corresponding functions are designed into technical artifacts. The interpre-

[1] Wybo Houkes and Pieter E. Vermaas, *Technical Functions: On the Use and Design of Artefacts*, Philosophy of Engineering and Technology, v. 1 (Dordrecht; New York: Springer, 2010).
[2] Another important synthesis of a wide range of literature on function is Beth Preston, "Why Is a Wing Like a Spoon? A Pluralist Theory of Function," *Journal of Philosophy* 95, no. 5 (1998): 215–54.
[3] Houkes and Vermaas, *Technical Functions*, 11–12.

tations and therefore the functions depend on the cultural framework within which the actors understand their own needs and the constraints of the environment. The theory of function must situate it in relation to the culture and way of life it serves. This has implications for our conception of modernity as a rational form of society and for the related notion of progress. Martin Heidegger and Georg Lukács have written about technology in ways that reflect an implicit concept of functionality. In so doing they work with a very different ontology from analytic philosophy. They understand the functional object in terms that have much in common with neo-Kantianism and phenomenology. The object is not "real" in any of the usual senses of the term, but rather it is the correlate of a subjective apprehension or intention. This type of object is not simply a sum of physical properties but is what might be called a "relevance structure." Such objects are routinely invoked in discussing academic disciplines: physics has matter in motion as its object, biology, living things, and so on.

These objects are not subjective but nor are they substantial entities; they are meaningful, coherent aspects of the infinite stuff of experience. This conception of artifacts as objects does not contradict the analytic philosophers' concern with physical properties in the attribution of function, but it calls attention to the selection that privileges some types of properties over others. For philosophers of technology in the Continental tradition artifacts are objects of the subjects of such selection. In what follows I will show how the technical object and subject is construed in Heidegger, the early Marxist Lukács, and in my own attempt to synthesize their contributions in the critical theory of technology.

Technical Function and World in Early Heidegger

Heidegger developed two theories of technical artifacts, an early one based on craft and a later one that concerns modern technology. The early theory as presented in *Being and Time* is a phenomenology of the everyday technical lifeworld. By "world" Heidegger means a system of meaningful entities that refers back to an agent capable of interpreting its environment, entertaining purposes and acting. This phenomenological concept of world is difficult to separate from the usual common sense and naturalistic concepts. Because it presupposes meaning and intention, "world" is not identical with the totality of entities, as common sense would have it, nor with the cosmos studied by natural science. Common sense and science treat what Heidegger calls "world" as a system of subjective attributions with no ontological significance. But Heidegger regards world in his sense as ontologically fundamental and claims that our ordinary common sense and natural science are founded on it.

Heidegger develops his concept of world as an "existentiale," that is, as a universal feature of being in its relation to human being. World is a "category" in the Aristotelian sense, but a category dependent on the human subject. The universality of such categories overleaps any particular cultural limitation to define the human as such in its relation to being. What is generally called culture enters this picture under the name "*das Man*," the "they."

Heidegger's analysis of worldhood is intended to overcome the subject/object ontology he identifies with the tradition of modern philosophy. The world is referred ultimately to a subject that Heidegger calls "*Dasein*" to avoid confusion with consciousness, the idealist subject. Under the influence of Dilthey, Heidegger originally called this subject "factical life." This designation indicated the two features that distinguished his concept of subjectivity from the traditional one. On the one hand the subject is not to be conceived as a spiritual entity, a substantial thought, a *cogito*, but as a living being, hence a being essentially connected to its surroundings. On the other hand life must be grasped from the inside as a way of being rather than from the outside as an object. "*Dasein*" continues to signify this lived relationship of life to itself.

Being and Time explains the concept of world on the model of the workshop and its tools.[4] The tools are linked together by their relations in the work. They do not stand alone. Their functionality is granted by their place in the whole of the workshop. In sum, artifacts serve in a context. He writes,

> Now in the production of equipment the plan is determined in advance by the serviceability [*Dienlichkeit*] of the equipment. This serviceability is regulated by anticipating what purpose the piece of equipment or indeed the machine are to serve. All equipment is what it is and the way it is only within a particular context. This context is determined by a totality of involvements [*Bewandtnisganzheit*] in each case (Heidegger 1995a, 215).

This totality is a system of references between the entities in *Dasein's* world. Heidegger calls this system "significance" (*Bedeutsamkeit*) and treats it as an open space of meaning within which particular usages are enabled.

The workshop example illustrates this unitary subject-object, which he calls "being-in-the-world." *Dasein* and its tools belong together. "Being-in-the-world" consists in the connections between technical artifacts and the ordering role of the human being at the center of the technical network.

Heidegger also defines world as "beings in their accessibility" (Heidegger 1995a, 199). By "accessible" he means understandable *as*, taken *as*, enacted *as*. Thus the chair on which I sit is not simply there as an object but is treated by me *as* a chair, that is, as intended for sitting. No such relation to the chair is possible for the papers I stack on it temporarily in my preparations for leaving the office. Those papers are supported by the chair, but not *as* a chair. *Dasein* establishes a different type of relation from the causal relations among things, a relation of meaning. In this sense, then, worlds are existential situations, not collections of things. Perhaps the closest our everyday talk comes to Heidegger's own usage is in expressions such as "the world of the theatre," "the Medieval world." Such worlds are not merely subjective but nor are they the sum of the things they encompass. They are essentially related to *Dasein* without being reducible to it.

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[4] The principal discussion of tools is in Heidegger, *Being and Time*, part 1, section III; the distinction in world relations is developed at length in Heidegger, *The Fundamental Concepts of Metaphysics : World, Finitude, Solitude*, part 2, chapter 3.

Dasein's principal characteristic is concern with its own being. This concern is played out in the constitution of an environment distinct from the totality of nature as understood by natural science. Nature as an object of knowledge includes much that is of no concern to the living subject. Those irrelevant aspects are discovered in objective contemplation but are not part of the original world constituting relationship. That relationship consists in the network of functional references that enables *Dasein* to get around and to further its aims. "*Das Man,*" culture, sets the terms of the references.

The common sense view of the difference between the cognitive stances of the actor and the objective observer comes down to a difference in focus. In the first case the focus is on what ties the object into the network of references. Heidegger's workshop is full of objects understood exclusively through their functional properties. The hammer is hard, has an appropriate weight in the hand, and can be swung in a specific arc at the nails to which it "refers" in performing the work for the actor who wields it. It is, says Heidegger, "ready-to-hand." It is not composed of iron atoms nor is it made in a certain factory on a certain date, nor was it formerly owned by Mr. X or Ms. Y. Those objective "present-at-hand" attributes are of course accessible to the subject in principle but they are not focused in the active employment of the artifact; they are not part of the subject's world.

The "sight" associated with action is not explicit propositional knowledge but is what we now call "tacit" knowledge, practical know-how, "circumspection" in the English translation (Heidegger 1962, 98). Correspondingly, the subject of this knowledge is to be understood through its involvement in the technical network. It is not a separate *cogito*, a pure mind, but is an active being enmeshed in a world of objects with which it is essentially concerned and to which it is essentially connected.

The ultimate basis of the world is that "for-the-sake-of" which it is constituted, the identity of *Dasein*. This is not another instrumental moment in the network of the ready-to-hand but rather establishes the network in terms of a specific self-understanding. *Dasein*'s identity is this or that type of being and as such gives meaning to the instruments that serve it

Although he is not interested in developing a theory of function as such, his argument illuminates important aspects of a phenomenology of function and invites completion along lines compatible with his contribution. His essential insight is the concept of "involvement." He says that entities must be "freed" for their involvement through entry into the system of references. The entry of an entity takes place through establishing connections to those attributes that make it available for the referential relation. Today we might call this the "affordances" of the object. Heidegger develops this concept in an unusual account of production that has suggestive implications for the understanding of functionality.

In *Being and Time* Heidegger is more interested in explaining everyday action than technical production. His comments on production are accordingly quite brief, but they do clearly distinguish the materials of production from present-at-hand nature. He points out that production incorporates natural materials into technical objects, but he rejects the notion that these ma-

terials are identical to the objects of natural science. They belong to the world even before they are worked up into a specific technical object for a specific purpose (Heidegger 1962, 100-101). Exactly how they belong Heidegger does not say.

The closest he comes to a theory of production in the early work is an analysis of Aristotle's concept of *dynamis* in the *Metaphysics* (Heidegger 1995b). On phenomenological terms, the materials of production are "freed" in some non-specific way that invites a variety of uses. The selection of some among those possibilities would, in removing the ambiguity of the materials, remove them from the context in which they are originally revealed in their indeterminate multiplicity and reduce them to their useful qualities in a specific context of use.

Thus the materials are not objective things in the full sense, nor are they already technical objects; they belong to the world through their *potentialities,* i.e. through what they can "bear" or "tolerate" (*pathein*), the many referential relations in which they *could* be involved even before they enter a specific production process. The production process that realizes one among those potentialities is a narrowing down, a limitation (*peras*), through incorporation of the material into a specific network of references. Heidegger concludes that production actualizes the *telos* of its materials. Employing the example of pottery, he writes, "With the transformation of the clay into the bowl, the lump also loses its form, but fundamentally it loses its formlessness; it gives up a lack, and hence the tolerating here is at once a positive contribution to the development of something higher" (Heidegger 1995b, 74).

A tree can serve as an example of the implications of the theory. Even while it grows it belongs to the world as a potential source of useful objects, such as a telephone pole, lumber, paper, etc. The reduction of the tree to a single potential begins by removing it from the growth setting in which it was potentially referenced in these various ways, and stripping its branches and bark. This is done in terms of a choice of a specific referential system, for example, one that involves the tree as lumber for building a house. Certain useful qualities of the tree are privileged over others. Those qualities tie the lumber into the referential system of carpentry, its tools, procedures, and designs. Further references are supplied by the detailed specifications of the particular house to be built. Ultimately a product is realized through imposing successive limits on the potentials of the growing tree and in so doing actualizing a house.

There is an ambiguity in Heidegger's theory of function. This is clear in the example of the house. From his descriptions of tool use one might think that only hammers, nails and lumber are involved, but we know that the referential framework of a house includes much more than this bare technical minimum. In the final design the lumber acquires qualities it would not otherwise possess, such as aesthetic features, conformity to rules of the trade, and so on.

The boards in the American construction system are posed horizontally, whereas in Scandinavia they stand vertically. The rules of the trade differ as does the aesthetic effect. There are also legal regulations to which the house must conform, the building code determined by local legislation. These additional references are normative mediations of the construction process which intervene at various stages to further narrow the range of possibilities. They compen-

sate for the simplifications that enable the materials to appear as materials for this or that specific project. All this would be included in what Aristotle calls "form" and what we might call "cultural meaning." Through these mediations the final product takes its proper place in a social context, a cultural system. Functionality in the narrow sense of the term to which we are accustomed is an abstraction from this always present, richer system of references.

In everyday non-phenomenological language this amounts to removing the object from its natural context, reducing it to its useful properties, systematizing it in a new humanly created context, and mediating it in terms of norms that correspond to qualities it did not possess in nature. But Heidegger resists this explanation because it presupposes an understanding of the object as a thing prior to its involvements in a world. For him practical relatedness comes first and is fundamental. The decontextualization and reduction operates within the world, not in a relation of the subject to objective nature. Similarly, the process of systematization and mediation is not an engagement with objective things but addresses objects only insofar as they already belong to the world. The difference between these two accounts is of great significance to Heidegger but less so for a theory of function. The four basic operations essential to the functionalization process, *decontextualization*, *reduction*, *systematization* and *mediation*, are performed on the terms of both accounts, naturalistic and phenomenological.

This concept of functionalization can be articulated with the notion of assigning a function in the use-plan conception of Houkes and Vermaas. In their framework a functional assignment presupposes the belief that the object possesses the causal properties necessary to perform the function. What are those properties? Clearly they are not the sum total of what an objective view of the object would reveal, nor are they the product of disinterested observation. In making a functional assignment, the subject must know about those properties of the object that are relevant to its technical operation. That small subset corresponds on the side of "belief" to Heidegger's concept of "circumspection."

For example, the individual who assigns the function of hammering nails to the hammer must believe that it is hard enough to do the job. But that belief is contingent on understanding the hammer exclusively in its belonging to the workshop, as a carpentry tool, as opposed to understanding it in relation to the infinite variety of contexts in which it participates as a thing. The belief that enables the assignment focuses on the hardness of the hammer as the condition of its functionality to the exclusion of an infinity of other properties. The positive quality of the hammer as a technical object is thus also a limit. In actual use the same limit makes the hammer available for the user's activity. Whether one calls that limit the constitution of a world (Heidegger) or a belief about things (ICE), it is essential to the nature of function.

Technification in Heidegger

The analytic concept of "belief" in ICE is vague. It is stretched to cover the teleological understanding of tools and the objective knowledge underlying modern technology. Heidegger's early work relates objectivity to science, but not to technology. It is only after World War II that

he develops a full fledged theory of technology. That theory is an account of how science depends on and supports a practical intent to control and dominate nature. Heidegger interprets this technical relationship to reality as an ontological clue, just as he did in his earlier analysis of tools. But technology reveals a very different reality.

Modern science, he claims, is essentially technological. It sets out a "ground plan" of being as a lawful order of facts. This is the constitution of a realm of objects subject to scientific explanation. On that basis it makes predictions that guide the technological transformation of what is. Technology is thus the opposite of world in *Being and Tim.* The world is a totality of ready-to-hand things engaged with *Dasein,* By contrast technology is a representation of present-at-hand things before a cognitive subject. Technology is the triumph of detached representation of things, and of the subject of such representation, over the involved stance of the acting subject described in the early work (Heidegger 1977).

Technology does not construct a world in the sense in which Heidegger originally understood that concept, but de-worlds its objects and reduces them to raw materials in a process planned in advance in view of predictable results. Modern technology "enframes" man and nature. It "challenges" nature and makes "unreasonable demands" on it. Things no longer realize potentialities within a world but are stripped bare of qualities, of their very thinghood, to take their place in a technological system. They are no longer objects in the sense of having a being that confronts us (*Gegenstand*); they have become mere resources (*Bestand*).

This Heideggerian theory of technology treats functionality in the modern context as the loss of substantial reality. Functionalization leaves only matter and energy (Zimmerman 1990, 212). Things are reduced to what Heidegger calls "standing reserve." They are extracted from their surroundings, stored up, moved, and transformed to perform unnatural feats. What this amounts to on the terms of the earlier analysis is the loss of the complex systematizations and mediations that situate objects in a world, the meanings and norms imposed along with the manipulations in which technical practice consists. What remains is the bare minimum required to exercise control. "The outstanding feature of modern technology lies in the fact that it is not at all any longer merely 'means' and no longer merely stands in 'service' for others, but instead...unfolds a specific character of domination" (quoted in Zimmerman 1990, 214).

Heidegger's theory of technification provides still more specification of the beliefs associated with functional attributions. As noted above these beliefs concern only those properties of the object that are relevant to its operation in its technical setting. Heidegger's late work adds to this limitation the specific property of being law-governed. The relevant beliefs must include the idea of a law under which the object can be made to serve technically. This explains the privileged role of causality in the beliefs associated with functional attributions in modern societies. By contrast the role of cultural meaning and the significance of the lifeworld described in Heidegger's earlier work are eclipsed in modern times by an implicit ontology that takes the nature of natural science as the only real. The theory of technification also offers a hint of a theory of modern technical subjectivity, emphasizing the detached cognitive standpoint from which a plan

is constructed.

Heidegger's negative evaluation of modern technology presupposes an implicit critical standard, the teleological view of nature underlying his early theory. But he does not defend the earlier view explicitly in his later work. He never advocates the teleological concept of production even as he criticizes modern technology. To do so would be to regress to a premodern conception of *poiesis*, and Heidegger does not believe it possible to go backward in what he calls the "history of being" (Heidegger 1977, 136). But the way forward is obscure.

There is a further difficulty with Heidegger's later theory. It is unclear whether he believes that the simple attribution of function to an object changes its essence, or if that attribution initiates a material process of transformation. He argues for example that the hydro-electric plant placed on the Rhine river transforms the river into a resource (Heidegger 1977, 16). But is it the simple functional ascription of the river that has this effect or the actual material intervention represented by the power plant?

Contemporary critics of technology inspired by Heidegger generally maintain the ambiguity, but offer more concrete accounts of the material transformations that objects and human relations undergo when they enter the functional realm. Technification is a process with specific characteristics that flow from the nature of functionality. The cognitive narrowing and limitation associated with a modern functional perspective cuts off dimensions of objects and persons that are worthy of preservation and respect, but modern culture privileges the causal characteristics of artifacts above all else. Albert Borgmann gives the example of the family dinner, a ritual occasion shattered by the reduction of dining to a functional minimum through the mere ingestion of micro-waved or fast food (Borgmann 1984, 105).

Such arguments imply that the spread of a functional standpoint beyond certain purely technical bounds is a spiritual catastrophe. The theorists plead for limitation of the functional realm at least as it is realized technologically (Böhme 2012, 194). This plea responds to the radical simplifications involved in constructing the technological object. Those simplifications are incompatible with many other relations to objects that sustain them in their thinghood and worldly character. The problem from this standpoint is thus not the existence of function but its imperialism in modern societies.

This type of critique depends on a teleological interpretation of the *human* context from which a technical function is extracted. Thus the focus shifts from technology itself to the reordering of human relations and the associated objects around technical mediations. In this way the critique of the generalization of functionality in modern societies is saved from the reactionary nostalgia that sometimes threatens Heidegger's own discourse. But a social critique is substituted for the ontological intent of Heidegger's theory. We are squarely in the domain that the early Marxist Lukács explored with his theory of reification.

Lukács's Philosophy of Technology

Georg Lukács was a Hungarian philosopher and literary critic who wrote most of his

work in German and participated in his early years in the German cultural world that also shaped Heidegger's philosophy. However, the politics of these two philosophers could not be more different. Lukács became a Marxist at the end of World War I and in 1923 published a classic work of Marxist philosophy entitled *History and Class Consciousness.* In this book Lukács put Marxism in touch with contemporary sociology and Hegel. The result is a remarkably original reconstruction of Marxism as a critique of modern rationalized society. Lukács had a profound influence on the Frankfurt School and on what Merleau-Ponty called "Western Marxism" (1955).

It is interesting to note that Lukács's *History and Class Consciousness* anticipates Heidegger's later theory of technology, first proposed in a speech in 1949. Both argue that modernity (in Lukács's case *capitalist* modernity) is characterized by the tendency to functionalize the entire world in terms of a scientific-technical conception of the law-governed order of nature and society. Like Heidegger, Lukács contrasts the concrete objects of premodern societies with the stripped down products of modern technology (Lukács 1971, 97, 236). No doubt Lukács's economic focus is due as much to the less prominent role of technology before World War II as to his Marxism, which offers hope that a socialist society can radically alter the role of technology. Heidegger treats all modern societies as similar, after the demonstration of the absolute power of technology in the War and the betrayal of the promise of the Soviet Union.

Lukács was no more interested than Heidegger in contributing a philosophy of function but his reflections are rich in implications for such a philosophy. As noted at the outset, functionality is a two-sided affair, referring to both the subject and the object. Heidegger's theories of worldhood and technification have been helpful in thinking about the objective phase of functionality, but we have not yet explored its subjective phase. Lukács's theory of reification is useful for this aspect of the theory of function. Furthermore, Lukács's theory makes explicit the technical character of the whole technosystem, including administrations and markets.

Lukács notes the similarity between the economic laws of political economy and the laws of nature discovered by natural science. He argues that the capitalist economy is actually law governed as though part of the natural world. It is a kind of second nature, resembling the first nature insofar as it too is subject to technical manipulation on the basis of its laws. Lukács thus treats the economy as a realm of technical action. He writes,

> What is important is to recognize clearly that all human relations (viewed as the objects of social activity) assume increasingly the form of objectivity of the abstract elements of the conceptual systems of natural science and of the abstract substrata of the laws of nature. And also, the subject of this 'action' likewise assumes increasingly the attitude of the pure observer of these—artificially abstract—processes, the attitude of the experimenter (Lukács 1971, 131).

Even though the economic and social system comes to resemble the nature of natural science, there is a difference of principle between them. In the case of nature, the laws are matters of fact, whereas the laws regulating the capitalist economy are the product of human actions,

specifically, the technical manipulations through which individuals pursue their economic interests. Lukács calls the capitalist economy "reified" in the sense that it appears as a thing when in reality it is an unconscious process of human relations. However, the thing-like appearance of the economy is not an illusion. It has real consequences to the extent that the appearance motivates people to perform the type of actions that reproduces it.

The circular relation between economic laws and the technical manipulations which both generate the laws and take advantage of them is fundamentally different from the case of nature in which the technical manipulations have no role at all in generating the laws. The individuals can break out of the circle through cooperative action to change the system. This de-reifying practice is synonymous with the proletarian revolution. It is not a technical manipulation of the economy in accordance with its laws but the overthrow of those laws through a transformation of their practical basis.

From the standpoint of a theory of function, Lukács's contribution is a conception of the functional subject. This is an individual subject that stands at a distance from its objects. It is autonomous, uninvolved in the objects it functionalizes. Lukács calls its practice "contemplative" in the sense that it does not aim to change the nature of its objects but only to manipulate them. Manipulation posits the law of the object as fixed and unchangeable in order to control superficial features of things that stand under the law. This manipulative orientation blocks feedback from the objects. The subject posits itself as outside the system in acting on it.

In economic terms, this amounts to taking up a position with respect to what the objects will become in any case under the control of their laws. This is most obvious in the case of the stock market. The action of the "contemplative" subject consists in buying stocks it expects will increase in value. The subject positions itself with respect to the lawful development of the economy rather than attempting to shape that development. For Lukács this is the "model" of practice throughout capitalist society (Lukács 1971, 83, 98). In a technologically advanced production process the worker stands in a similar contemplative relation to the self-acting machinery he or she operates. The bureaucrat too operates manipulatively under the rule rather than acting to change the rule.

This is a narrowed relationship to which corresponds a narrow subject. The functional subject is stripped bare of personal qualities that would only interfere with successful manipulation. What is lost in this narrowing is far richer than Heidegger imagines, not simply self-knowledge as the site of revealing, but concrete human qualities and needs. Despite this critical perspective, Lukács is not opposed to technical practice in principle; it will after all be required by any modern society, including a socialist society. But he believes that a world and a subjectivity narrowed down to the measure of technique cannot fulfill the human potentials (Lukács 1972, 6). Once again, as in Heidegger, the universalization of the technical is the problem, not technology as such.

Lukács develops this argument in terms of the tension between reified form and living human content. Technology and other reified systems impose a formal structure on life and be-

havior. The form, reification, consists in fragmenting and isolating social objects as though they were self-subsistent things, like things of nature, related only externally, causally. Under capitalism that structure is oriented toward the production of profit. Human beings, in the fullness of their existence and needs, are forced into the structure without regard for consequences. This process both generates a potential and represses it. What human beings can become is laid out in their relations within the reified system, but only as potentiality, not as actuality. This tension between form and content motivates the revolution. Thus once again, as in Heidegger, the concept of potentiality provides an alternative to technical domination. This alternative can be realized where functional relationships are set in place within the higher level of a collective political subject. But whereas for Heidegger potentiality lies in the Greek past, for Lukács it awaits in the communist future.

The analytic theory of function remains at the level of individual technical action on nature and so does not venture onto the terrain of the social arrangements which set the conditions for individual action. The theory conforms more or less to Lukács's concept of contemplative action. The functional subject's beliefs concern laws over which it has no control and which it can only use, not change. This seems self-evident in the case of nature, which provides most of the examples in the analytic theory. These examples are appropriate for a subject conceived as an individual engaged in a single round of action based on a conscious goal.

But in the real world functionalization extends far beyond the kitchen utensils, guitars, and cars that provide examples for the theory. As Heidegger and Lukács argue, technological and bureaucratic systems structure much human action and cannot be regarded as mere means. They shape and damage human life even as they serve. And Lukács is not wrong to view economic action in terms of functional relations. Entering a store, the buyer confronts the salesperson in his or her function as an economic agent. Of course sympathy may arise between seller and buyer, or antipathy for that matter, exceeding the limits of a functional relation. But in the normal case the two parties to the transaction "use" each other for their own ends in accordance with an intention and associated beliefs. The point is not that this is inherently bad, but that multiplied millions of times over it constructs a coherent system, the capitalist economy, which compels the adoption of a technical stance in more and more of social life, thereby creating a world characterized by inequality and domination.

As in the case of Heidegger's concept of world, so with Lukács's concept of the functional subject and its practice, the focus is excessively narrow. I note two such limitations. First, Lukács omits the general consequences of technical practice for identity to focus exclusively on the role of reification. But technical practice shapes subjects in far more complex ways than he allows. And second, Lukács has no concept of social imagination with which to understand original initiatives, creative action. But we know that creativity drives capitalism forward and would be essential to any fundamental social change.

The contemplative stance of the reified subject has a paradoxical effect. At the same time as the subject withdraws from involvement, the technical relation to the world determines its

identity. Thus in avoiding causal feedback from its objects, the subject of technical practice simply shifts the interaction to the higher level of meaning. Lukács mentions only two cases but others can easily be imagined. He argues that the journalists and bureaucrats, individuals who invest their personality in their work, form an identification with the reified system. These middle class individuals have a sense of self and beliefs about the world in which the limitations of capitalism have become personal limitations of character and understanding. By contrast, workers' identity cannot be formed by their work since the production process is so much more profoundly reified. They retain a certain independence since only mechanical physical gestures are required of them (Lukács 1971, 99-100). Insofar as their participation in technical practice is identity forming, this is through their realization that they are more than the social role to which they are condemned. They are thus capable of initiatives that challenge the system as a whole. For Lukács this is the origin of class consciousness.

Now, for class consciousness to lead to positive initiatives, imagination is required but Lukács does not discuss this aspect of the revolution. He underestimates the role of the imagination through which individuals may transcend the narrow limits of their position in the economy and take unprogrammed initiatives in which new functions are discovered. This is as true of the middle class individuals he criticizes for their reified consciousness as of the workers whose ability to transcend their situation he attributes to the poverty and injustice they suffer. Initiative and imagination are powerful forces under capitalism, though often exploited or repressed, and their importance must not diminish in a socialist society.

Such initiative is not to be conceived as *ex nihilo* creation but rather as rooted in conditions which can be dereified in specific ways that release the potentialities those very conditions create and block. This notion of dereification bears some resemblance to Heidegger's description of authentic resoluteness. This is release from the pre-given references, the cultural system provided by *das Man,* to an original decision (Heidegger 1962, 345). Indeed, initiative in a technologically advanced society must have an innovative character that breaks with sterile conformism. But neither Heidegger nor Lukács applied this insight specifically to technological change.

In his early work under Heidegger's supervision, Herbert Marcuse developed the implications of political initiative for revolutionary communism. [5] His unusual synthesis of Heidegger and Lukács draws together the concepts of authenticity and revolutionary praxis. In these early writings Marcuse is on the verge of a positive concept of initiative. His late work completes the picture, relating revolution to the imagination of alternative social and technological institutions. Technology now enters directly into the theory as an object of imaginative reconstruction. Thus Marcuse can be interpreted as theorizing the aspects of initiative and imagination that are underdeveloped in Heidegger and Lukács, but only within the specific historical framework of Marxism, and not in a general theory of functionalization (Marcuse 2005, 31-32; Marcuse 1964, 228, 239-240; Feenberg 2005, chapter 5).

This brief discussion of Lukács's theory of reification in relation to Heidegger and Marcuse highlights four aspects of functional subjectivity. It shows the autonomy of the subject role with respect to the objects of technical practice, while also hinting at the consequences of that practice for identity. It contrasts positioning as contemplative practice with initiatives transcending the reified framework.

The Double Aspects of Technology

I will turn now to my attempt to synthesize the arguments of Heidegger and Lukács in a framework for understanding technology. I call this framework the "instrumentalization theory." It is the result of a long evolution that to a certain extent parallels the "dual nature" project exemplified by the analytic use-plan theory of function (Kroes and Meijers 2002). My own project began in 1975 with an invitation to a conference at the Villa Serbelloni on "Technology and Communist Culture." This was a first opportunity to think seriously about the nature of technology. As a democratic socialist I was faced with a dilemma. The then widely held deterministic theory of technology argued that democratic control of the economy was incompatible with technological "imperatives." I rejected this conclusion yet also rejected the instrumentalist notion that technologies are value-neutral means. That technology has social impacts I had no doubt, but I argued that a democratic socialist regime could develop technology with different social impacts compatible with its values.

A footnote to the conference proceedings summed up the basis of this argument I have been developing ever since.

> At the Bellagio Conference I suggested a terminology with which to distinguish the neutral from the socially determined aspects of what might be called the 'technosphere.' I would reserve the term 'technique' for specific technical elements such as the lever, the wheel, the electric circuit, and so on, all of which are in themselves neutral applications of objective knowledge of nature. These elements are like the vocabulary of a language; they can be strung together to form a variety of 'sentences' with different meanings and purposes. 'Technologies,' defined as developed ensembles of technical elements, are greater than the sums of their parts. They meet social criteria of purpose in the very selection and arrangement of the intrinsically neutral units from which they are built up. These social criteria can be understood as 'embodied' in the technology and not simply as an extrinsic use to which a neutral tool might be put (Feenberg 1977, 114).

In sum, technology has a foot in two worlds, a world of rational structures and a world of human intentions that organize those structures for a purpose. I later called this a "double aspect" theory of technology with the implied reference to double aspect theories of the mind/body relation (Feenberg 1991, 78, 83; 1992, 311). When Descartes separated mind from body, he relegated the body to the mechanical realm. I wanted to block Cartesian dualism in the understanding of the mechanical itself. A purely mechanical explanation of technology threatened a return to naïve instrumentalism or technological determinism.

In the remainder of this section I will outline the contribution of critical theory of technology to an understanding of functionality. The treatment differs from analytic approaches to the same theme; rather than conceptual analysis, I propose a focus on social aspects of the phenomena. The analytic discussions emphasize cognitive aspects: the ascription of a function rests on a belief that the materials are appropriate to fulfilling their function. Drawing a more complete picture of the functionalization is a descriptive phenomenological task. The theory is action-theoretic not just in attending to beliefs and intentions of actors, but in the sense that it describes the nature of the subjects and objects of technical action. Thus instead of analyzing the *concept* of function in detail, the argument concerns *the subjective and objective conditions of functionalization as a social process*.[6] Understanding that process has normative implications insofar as it opens up possibilities of change foreclosed in the deterministic theories of technology that still have great influence in policy circles.

The following table sums up these conditions. In the remainder of this section I will explain the terms of the table.

Table 1
Instrumentalization Theory (adapted from Feenberg 1999, 208)

	Causal Functionalization	**Cultural Functionalization**
Objectification	Decontextualization Reduction	Systematization Mediation
Subjectivation	Autonomization Positioning	Identity Initiative
Cognitive Relation	Nature	Lifeworld

[6] Ted Cavanagh (2008) worked out a useful example of the application of the theory to building construction. The terms of the theory at that time were somewhat different. I called "causality" and "culture" "primary" and "secondary" instrumentalization in earlier versions. This led to confusion between secondary instrumentalization and processes of reinvention or creative appropriation which occur after the technical artifact is released on the public whereas my intent was to describe complementary aspects of all designing.

The causal level concerns the construction of objects and subjects as nature, again in a "meta" sense, that is, as subject to rules or laws that regulate their behavior as materials. The causal level corresponds to a mental capacity possessed by a few higher animals and especially by human beings. It is a particular way of relating to the world that makes technical usage possible. The cultural level concerns the meanings artifacts acquire in the lifeworld to which they belong. This is a uniquely human aspect of the technical for only human beings are capable of both technical mentality and cultural creation.[7] These meanings are not merely ascribed after the causal level is set in place, but guide the choice and configuration of the causal level. The specific cultural assumptions may be universally shared as in primitive societies, or they may be imposed by social forces. In the latter case these social forces are exercised directly by influential groups, "actors" in the terminology of social constructivism. In every case a combination of causality and culture is involved in creating the framework within which function is perceived by the makers and users of technical artifacts.

The causal and cultural layers of the design process are analytically distinguishable phases. They are visible from different perspectives but cannot be separated and laid out side by side. One phases involves the conditions of the relevant rule-based or causal foundation of the functional ascription, and the other posits the guiding cultural meanings that determine relevance and signify the object. The two phases together identify potentials that are selected and combined in the realization of the design. The layers interpenetrate in the sense that a causal relation is realized only insofar as it has been invested with cultural meaning. In this respect the instrumentalization theory goes beyond the use-plan theory of function.

Except in the case of the very simplest of artifacts, the functional investment of an object involves more than a subjective intention; it determines a choice of components and the relations between them, that is, a design. Realization in a design can take many different paths. There is no universal rule under which to make the choice of functions from among the infinite possibilities, although all such choices must conform to causal principles. It is this contingency of design which opens the way to a politics of technology as I will argue in a later section of this chapter.

This initial distinction in layers can be analyzed further into the objective and subjective conditions of design. In the phenomenological language of Husserl and Heidegger we would say that the "object is revealed as…" and the "subject constitutes itself as…." We have seen that for Heidegger the object is "freed for" entry into a world. In ordinary language this means roughly that the object is envisaged under the aspect of its technical potential and the subject adopts a technical attitude toward it, that is, again in Heidegger's terms, acts toward it out of its concern with its own identity or "being" as he calls it.

The ascription of function requires more than a general belief in causal appropriateness;

[7] Gilbert Simondon has written an important article on the technical mentality, but he mistakes the cultural level of the technical artifact for a distraction from an imagined pure technique. See Simondon (2009).

it also requires a specific type of cognitive operation, a technical mentality that goes beyond the immediate form of the object and reveals it in the light of its technical potential in a specific cultural context. In the instrumentalization theory the initial correlates of this operation on the side of the object are called decontextualization and reduction. Technical potential is uncovered through isolating the object from its natural context and reducing it to its usable qualities. On Lukács's terms, the object is reified.

The object must be processed in order to be incorporated into an artifact. The processing does violence to the object in its original state, transferring it from nature to lifeworld. As we have seen Heidegger conceptualizes this process in two different ways corresponding to different stages in the development of technology, either as the actualization of a potential or reduction to raw materials.

Realization takes place in a system of technical and social contexts that guide decontextualization and reduction. This involves systematization and mediation. The technical object is taken up in the system of references that Heidegger describes as a world. This system involves more than simple causal relations. The object cannot enter the social world without acquiring a social meaning. This concept of meaning refers to the many associations of the object with other aspects of the culture, including aesthetic and ethical mediations of the design. The object may be signified socially by its price, as Lukács argues following Marx, but it has a use value as well. At that level the object belongs to a lifeworld in which it is imbricated with many other aspects of nature and human life. Technical objects thus not only lose qualities as they are reduced, but acquire qualities as they are integrated to a social world.

The instrumentalization theory identifies a basic technical attitude that allows objects in the world to be envisaged as artifacts or components. This attitude constitutes the technical subject. It has two aspects I call autonomization and positioning. The basic attitude is autonomous in the sense that it precludes sympathy or identification, the attitudes that are associated with human relations, i.e. relations with another subject. In the technical relation the subject is not involved in reciprocal interactions. It is protected from feedback from its objects. The point of technical action is to change the world, not the technical subject.

As Lukács argues, the subject does not strive to create something entirely new but takes up a position with respect to what the object is and will become, a position that opens up its useful potentials. This is a manipulative attitude, one that seeks control of the object through an understanding of its properties, the "law" of its movement.

Correlated with these causally related functionalizations are two other aspects on the cultural side of technical activity, identity and initiative. The technical subject acquires an identity through its association with its objects. This may minimally signify that the subject can be described by its use of its objects as when we say of persons driving that they are drivers. Where there is extensive and long term technical work, professional identities are established by repeated functional involvements. Both Heidegger and Lukács hint at this concept of identity in showing the intimate connection between technical subjects and objects.

In every case but most importantly in professional activity, the technical subject exercises a certain freedom or initiative in the discovery of the potentials of its materials. The scope for initiative varies but it is an inevitable result of placing individuals in a technical relation. At a minimum, the initiative is defined by the range of activities enabled by the design of the object. But it may go beyond the normal range and explore potentials unsuspected by the designers. This is the basis of the creative appropriation or reinvention of technologies by users. This concept of initiative appears too in Heidegger and Lukács, although it is limited by being tied to notions of authenticity and revolution.

Political Implications

In conclusion I will return to the question of the political implications of the philosophy of technology as they now appear to me many years after my initial work on the question of technology. My original socialist argument with determinism has not been abandoned, but it has been supplemented by a broader political theory of technology capable of interpreting social movements such as the environmental movement.

The instrumentalization theory is intended to open up the imagination of the future to a possible transformation of industrial society. It does so by showing how the level of technology that is causally determined is contingent on the evolution of culture. The deterministic argument depends on conflating the binding rationality of the first level with the contingent social choices involved in the second. It claims that the causally coherent pattern of technology is the product of a process of development determined by scientific knowledge, as though no cultural mediations intervened between scientific discovery and the making of artifacts. The trajectory of development can then be projected independent of changes in social organization and culture. A technocratic politics corresponds to this approach

The instrumentalization theory is central to my approach because it blocks the two reductionisms that distort the understanding of technology and lead directly to this technocratic politics. On the one hand, there is a tendency to reduce the cultural level of technology to the causal level. This takes the form of explaining what are in fact culturally imposed guidelines in the specification of technology as consequences of those very technical specifications. For example, if the Internet is used for human communication that is *because* it is technically specified to support that usage, not because a process of social and cultural change guided the development of the specification. This makes it seem as though technology is purely technical, its form and workings entirely independent of society. On the other hand, there is a related tendency to reduce the social world as a whole to its technical underpinnings, as though technology, as a material "base," could determine the "superstructural" features of society. This tendency, derived from a certain interpretation of Marxism, has technocratic political consequences in both standard strategies of modernization and in the failed communist experiment.

The instrumentalization theory provides an alternative to reductionism by showing the true relations between the different aspects of the technical domain. It shows the role of culture

in the configuration of the causal aspect of technology from which it can only be distinguished analytically. This counter-argument to determinism opens up a role for social struggle and politics in technological development.

The instrumentalization theory depends on the constructivist notion of "under-determination." There are always alternative designs with different implications for social groups, hence designs are "under-determined" by purely technical considerations. As Pinch and Bijker write, "The different interpretations by social groups of the content of artifacts lead by means of different chains of problems and solutions to different further developments…" (Pinch and Bijker 1987, 42). The point is that the "content," the actual causal concatenation that goes into the design, is socially contingent. The instrumentalization theory attempts to explain the fundamental relationship between technical and social aspects of technology in an under-determined technical world.

This conception has liberating political implications. The future is no longer bound in its basic design by a continuation of the trajectory of the existing technologies. Indeed, even the existing technology is revealed as contingent and subject to radical transformation. Technology can be placed on a different trajectory in conformity with different values. Examples of incipient changes of this sort are not hard to find.

Consider deskilling, the reduction of the skills required to operate the ever more powerful machinery of industry. This was my principal concern at the 1975 conference that started me on the way to a philosophy of technology. At the end of the deskilling trajectory human beings are simply replaced by intelligent machines. This trajectory has two effects: it increases the availability of consumer goods even as it erases the vocational identity of the workers who make them. Can we imagine a different trajectory of development in which the advance of technology opens opportunities to apply intelligence at work instead of replacing it with mechanical substitutes? There are in fact experiments in alternative types of development, but how are these to be evaluated? Can they be dismissed out of hand for violating the supposed imperatives of technology? The instrumentalization theory makes no predictions, but it offers a stimulus to the imagination of a socialist alternative where the deterministic theory shut down the very idea of a different future with its mantra of inevitability.

Environmental problems raise similar issues. We are told that environmental reform is incompatible with industrial progress, that we must burn fossil fuels and pollute the planet to enjoy a modern way of life. But again the deterministic premise is challenged by the many initiatives taken in recent years in response to environmental problems. Innovation and regulation stimulated by social protest are transforming industry. How we evaluate that process depends on our philosophy of technology. An alternative technological system is possible on the terms of the instrumentalization theory in contrast with determinism.

The evolution of the Internet offers the best evidence for the instrumentalization theory. The system was originally designed for a completely different purpose than the ones it now serves. Its technological trajectory was set by the military and the research community and fo-

cused on the efficient use of computing resources. But once the Internet was released on a different public, the usages changed. It turns out that what these users want from the Internet is opportunities for human communication. A tremendous flowering of new social forms and usages has changed our understanding of both the computer and society. Deterministic approaches take these changes so much for granted they appear as the inevitable result of the development of computing, but the instrumentalization theory allows us to focus on the concrete initiatives that have led to the present situation.

In sum the instrumentalization theory is politically significant not because it advocates or supports any particular politics but because it makes politics thinkable in a world completely penetrated by technologies and technical systems. In the absence of a theory supporting a social understanding of technology technocracy beckons as the only rational organization of a society based on scientific knowledge. Philosophy of technology is called to challenge this conclusion with an account of the reciprocal relation of society and technology.

Conclusion

In this chapter I have contrasted the instrumentalization theory with the analytic theory of function, specifically the ICE theory introduced by Houckes and Vermaas. ICE explains the relation of the individual to technical artifacts and natural objects of technique. This is an important context of human action, however, it is always contextualized by a social world that the instrumentalization theory brings into the picture. Thus the approaches are complementary. The use-plan theory can be conceived as an abstraction from a larger social context explored in the instrumentalization theory.

Together the two theories offer a powerful approach to understanding the concept and nature of function, however, neither theory is complete. The instrumentalization theory as formulated here lacks an account of the structure of the interactions between the two levels of functionalization it describes. Are these interactions purely contingent or do they exhibit general features that ought to be theorized to complete the theory? The ICE theory too can be extended by incorporating an approach to non-technical functions in fields such as economics and administration. This would no doubt require modifications and perhaps the instrumentalization theory has indications useful to such an extension of the range of the ICE theory.

Much philosophy of technology is concerned with the human relation to technical artifacts and nature. Various models have been proposed, among which the two considered in this chapter. They have in common a focus on the technical relation as a specific type of action in the world. Both theories delve far more deeply into the nature of this relation than the standard accounts which emphasize control as the single most prominent aspect of technical action. That emphasis often leads to simplistic evaluations of technology. But before one can reach such normative conclusions, a better understanding of the significance of technology in human life is required. Further work on both approaches will contribute to that goal.

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