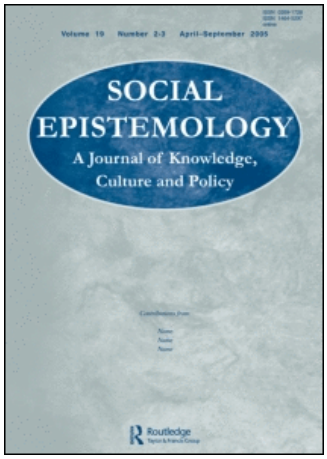

Social Epistemology
A Journal of Knowledge, Culture and Policy
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713765921

From Critical Theory of Technology to the Rational Critique of Rationality

Andrew Feenberg

Online Publication Date: 01 January 2008
To cite this Article: Feenberg, Andrew (2008) 'From Critical Theory of Technology to the Rational Critique of Rationality', Social Epistemology, 22:1, 5 - 28
To link to this article: DOI: 10.1080/02691720701773247
URL: http://dx.doi.org/10.1080/02691720701773247

Social Epistemology
Vol. 22, No. 1, January–March 2008, pp. 5–28

From Critical Theory of Technology to the Rational Critique of Rationality

Andrew Feenberg

This paper explores the sense in which modern societies can be said to be rational. Social rationality cannot be understood on the model of an idealized image of scientific method. Neither science nor society conforms to this image. Nevertheless, critique is routinely silenced by neo-liberal and technocratic arguments that appeal to social simulacra of science. This paper develops a critical strategy for addressing the resistance of rationality to rational critique. Romantic rejection of reason has proven less effective than strategies that conceptualize modern artefacts, systems, and organizations as rationally underdetermined. This approach first appears in Marx's analysis of capitalist economics. Although he lacks the concept of underdetermination, Marx gets around the silencing effect of social rationality with something very much like it in his discussion of the length of the working day. Frankfurt School Critical Theory later blended romantic elements with Marxian ones in a suggestive but ambiguous mixture. The concept of underdetermination reappears in contemporary science and technology studies, now clearly articulated and philosophically and sociologically elaborated. But somewhere along the way the critical thrust was diluted. Critical theory of technology attempts to recover that thrust. Here its approach is generalized to cover the three main forms of social rationality.

Keywords: Rationalization; Technology; Bureaucracy; Markets; Critical Theory

Social Rationality

Types of Rationality

Modern societies are said to be rational in a very special sense that distinguishes them from premodern societies. Theories of rationalization and modernization enshrined

Andrew Feenberg is Canada Research Chair in Philosophy of Technology at Simon Fraser University. He is the author of *Transforming Technology*, of *When Poetry Ruled the Streets, Questioning Technology, Alternative Modernity*, and of *Heidegger and Marcuse*, and is co-editor of *Technology and the Politics of Knowledge* and *The Essential Marcuse*. He has taught at Duke University, San Diego State University, the University of Paris, and the University of Tokyo. Correspondence to: Andrew Feenberg, Canada Research Chair in Philosophy of Technology, School of Communication, Simon Fraser University at Harbour Centre, ACT, Room 2598, 515 West Hastings Street, Vancouver, British Columbia, Canada V6B 5K3. Email: feenberg@sfu.ca

ISSN 0269–1728 (print)/ISSN 1464–5297 (online)
DOI: 10.1080/02691720701773247

this distinction at the heart of 20th-century social thought. Of course modern societies are not rational in a properly scientific sense of the term. But something about the structure of modernity resembles the rationality of the scientific disciplines, and much has been made of this resemblance in the ideologies that justify or criticize it. The question is, what is this something?

One self-congratulatory answer has it that we are more rational than our ancestors because we have achieved scientific knowledge of nature where they had only myths. There is some truth in this, but not much. Even in the advanced countries, the most bizarre beliefs persist and flourish. For example, a majority of Americans believe in angels but this does not prevent them from doing business in an efficient modern way we think of as rational. In any case, science itself is no longer analysed in terms of old positivistic models of pure rational method but is studied today as a social institution. What is more, people were capable of making discoveries and improving technology long before Galileo and Newton. Some sort of non-scientific rationality was involved in premodern technical progress. Finally, it should be kept in mind that rationality is not necessarily good or even successful. In its social employment, the concept describes a type of practice, not an end in itself or even a guarantee of effectiveness. Hitler's Germany exhibited a high degree of organizational rationality with consequences both morally evil and instrumentally disastrous.

For all these reasons, scholars no longer accept the old evolutionary notion, crudely formulated by Comte as a succession of religious, metaphysical, and scientific stages in the progress of civilization. Although this notion has become common-sense, it vastly overestimates the extent to which science, and especially technology, are independent of social influences. In reaction against this view, the very concepts of rationality and modernity have become taboo in much contemporary science and technology studies and postmodern critique. This makes for some inconvenient and misleading rhetorical strategies. We may never have been modern or rational in the Comtean sense of the term, but we have certainly been modern and rational in some other sense that remains to be specified adequately. The challenge is to arrive at a new understanding of these concepts that avoids the pitfalls of the evolutionary view.

The current mood affects the evaluation of the Weberian concept of rationalization, which is often dismissed as uncritically rationalistic. Yet this is to misunderstand Weber's contribution, which in no way depends on an idealized view of reason. Instead, what interested Weber was the increased importance of "calculation and control" in modern organizations such as government administrations and corporations. Weber pointed out that these organizations conform to principles or employ methods involving precision in measurement, accounting and technical insight. It is true that his concept of "disenchantment" suggests a reason purified of traditional social influences, but new ones emerge with the triumph of modernity. While his framework has evolutionary implications, they are not of the Comtean sort and do not detract from the real significance of his theory (Weber 1958).

In what follows I will develop an approach to rationalization that depends significantly on Weber. However, I am not a Weberian and I anticipate that too close

an identification with his position will burden my argument with many unwelcome associations. I therefore introduce the term "social rationality" to refer to phenomena Weber treated under the rubric "rationalization" and avoid that latter term wherever possible. What I retain from Weber is the emphasis on forms of thought and action that bear some resemblance to scientific principles and practices, and the role of modern organizations in generalizing those forms in society at large. Many other aspects of Weber's thought, such as his theses on the Protestant ethic or value-neutral research, are not relevant to my argument.

Social rationality, in the sense I give the term, depends on three main principles:

1. exchange of equivalents,
2. classification and application of rules, and
3. optimization of effort and calculation of results.

Each of these principles looks "rational" as we ordinarily understand the term. Calculation is an exchange of equivalents: the two sides of the equals sign are, precisely, equivalent. All scientific work proceeds by classifying objects and treating them uniformly under rules of some sort. And science measures its objects ever more carefully. Business, like technology, is based on optimizing strategies. Social life in our time thus appears to mirror scientific and technical procedures.

Note that the absence of *social* rationality in no way implies the presence of *individual* irrationality; namely, mere prejudice and emotionalism. That old fashioned view of premodern attitudes has long since been abandoned for a more nuanced appreciation of other cultures. Wherever there are human beings, one observes more or less rational *individual* behaviour and instrumentally effective *collective* behaviour. What is distinctive about social rationality is the role of coordination media such as the market (Principle 1) and formal organization and technology (Principles 2 and 3). Thus while all three principles of rationality are everywhere at work, in modern societies they are implemented by markets, bureaucratic organizations, and technologies on an unprecedented scale.[1] Let us consider this difference in more detail.

- With some exceptions, premoderns generally exchanged gifts or bartered goods and where markets existed they were fairly marginal (Mauss 1980). Under feudalism, taxation rather than exchange accounted for most of the movement of goods. By contrast, the modern economy is organized around the exchange of money for an equivalent value in goods or labour.
- Traditional societies apply classifications and rules handed down in a cultural tradition. Modern organizations such as corporations and government agencies construct the classifications and apply the rules. This makes for greater flexibility: the system can change overnight rather than evolving slowly as culture changes. It is designed consciously, not inherited from the past (Guillaume 1975, chap. 3).
- Some individuals in every society attempt to make their activities and techniques more efficient, but only in ours is this the primary work of organizations guided by technical or scientific disciplines and only in ours do we find constant progress in both efficiency and measurement. What makes this possible is the unusual degree to

which modern societies isolate entrepreneurs and innovators from the consequences of their actions for others and the social order (Latour 1993, 41–43).

In sum, a socially rational society is structured by markets, organizations and technologies around the three principles of rationality. In this it contrasts with regulation by systems of domination and subordination rather than equal exchange, informal cultural classifications and rules rather than formal ones, and traditional rules of thumb rather than carefully calculated optimizing strategies and techniques.

The Social Critique of Reason

As Habermas has pointed out, social rationality has both a technical dimension and a normative dimension. This is particularly clear in the case of the market. In obeying the principle of exchange, markets respect equality in both the mathematical and moral sense: "The institution of the market … promises that exchange relations will be and are just owing to equivalence … The principle of reciprocity is now the organizing principle of the sphere of production and reproduction itself" (Habermas 1970, 97). This particular form of "justice" is essential to the survival of capitalism in the word of inequality it creates. The critic who denounces the consequences of the system is silenced, ironically, by the appeal to justice of those who profit from it at the expense of their fellow human beings.

The fact that capitalism is rationally legitimated has important implications for the development of ideology in modern liberal societies. It sets a pattern in which all modern institutions emphasize the rational character of their activities. Science exemplifies the idea of rational community. Scientists agree because of the force of the stronger argument, not because some have more guns or money than others. Rationalized institutions too justify themselves by reference to reasons, although by no means such compelling ones as scientists adduce for their theories. Compelling or not, the mere fact that rational legitimation is considered necessary and useful exaggerates the role of reason in social life.

The appeal to reason is ambivalent. On the one hand, it justifies the system as fair, governed by unchangeable laws, and ruled by impartial experts. On the other hand, it suggests quite different principles of rationality such as reflective critique and uncoerced agreement. These principles can be traced back at least to the ancient Greeks and underlie the broader notions of rationality invoked by the early Frankfurt School, Habermas, and this paper as well. These notions of "communicative rationality", as Habermas calls them, are not based on formal similarities to scientific reasoning, but rather on the idea of self-knowledge and the pragmatic conditions of rational argumentation and understanding. But communicative rationality has never structured the central institutions of modern societies. Given its primarily ideological function in an unjust society, social rationality has failed to eliminate the element of conflict in social life. Indeed, rationality itself has become the object of critique.

Social criticism of rationality emerged at the end of the 18th century when the principles of rationality began to be applied systematically to human beings on a large

scale (Foucault 1991). Increasingly, the population appeared as a resource to be efficiently employed by organizations. Markets gradually took precedence over more personal forms of appropriation and exchange. Technology appeared as an independent force as it shed the traditional value systems and institutions that contextualized it in earlier times.

Since economic and technical criteria determine more and more aspects of social life, capacities and needs that lack economic and technical significance are ignored. The rulers of earlier societies were even more indifferent to their subjects, but innocently so, insignificantly, as outsiders with respect to the inner life of the small communities making up the social world. Now for the first time, a social order begins to be organized down to the last details while the claims of community are weakened by the increased mobility of the population. To the extent that the system fails to encompass all aspects of the lives it controls, the individuals become conscious of themselves as distinct from their social identity. The social and the individual stand opposed, or rather the functionalization of the social makes it possible to be an individual in a new sense opposed to all function.

Rationalization calls forth a romantic critique exemplified in the proud claim of Balzac's anti-hero Vautrin, "I belong to the opposition called life" (quoted in Picon 1956, 114). The image of life versus mechanism reappears constantly in the critique of social rationality, not just in relation to technology but also to markets and bureaucracies that appear metaphorically as social machines. But romanticism never succeeded in convincing any large number of people to give up the benefits of modernity despite the fact that capitalism, the economic system that generalized social rationality, turned out to be profoundly oppressive and unfair.

Another critique of social rationality stems from Marx. While many contemporary socialists agreed with Proudhon that "property is theft", and hence not an actual exchange of equivalents, Marx dismissed moralizing complaint and analysed the workings of the market in economic terms. He developed an immanent critique of the contemporary economic theory of exchange. According to this theory, goods were valued by their labour content and were traded for the most part in equivalents. The problem Marx confronted was how to explain the inequalities of capitalist society on the basis of this principle without recourse to implausible notions of merit or origin myths such as the social contract.

It is well known how Marx solved this problem with his theory of surplus value. He argued that, under the principle of equal exchange, the value of labour is measured by the cost of its reproduction just like any other commodity. But the productive power of labour is applied during a working day longer than needed to produce goods equivalent to that cost. The difference, surplus value, accrued to the capitalist and generated the observable inequalities without theft or cheating as many socialists supposed. Marx concluded that this exploitative arrangement is a contingent feature of industrial society, which could have been designed differently under different social conditions.

What can still interest us about this theory is not so much the questionable content as the form: the demonstration that rational principles of social organization can yield a biased outcome. Marx showed that capitalists play by the rules of equal exchange, but

he then went on to demystify their claim to fairness. He recognized the rationality of the system, thus affirming its coherence at least within certain historical limits, while also uncovering its bias, thus separating its technical and normative dimensions.

But even as western societies gradually absorbed elements of Marx's critique, similar mystifications arose to hide the bias of other rational systems. Technocratic ideology, reinforced by consumerism, depoliticized public issues and presented a smoothly rational face to a society dominated by wealth. These new mystifications are still effective.

Why is it so difficult to develop a critique of the rationality of modern institutions such as markets and technology? Our intuitive sense of bias is shaped by the Enlightenment struggle against a traditional social order based on myths. The critique of that social order identified what I call substantive bias—bias in social and psychological attitude. Substantive bias designates some members of society as inferior for all sorts of specious reasons such as lack of intelligence, self-discipline, "blood" or breeding, accent and dress, and so on. The Enlightenment questioned these pseudo-reasons as they applied to lower-class males. The false substantive claims of the dominant ideology were demystified and equality asserted on that basis. This approach set a pattern adopted in the critique of discrimination against women, slaves, the colonized, homosexuals, and potentially any other subordinate group.

Marx focused on what was left uncriticized by the Enlightenment, the monumental fact of economic inequality. Since markets are fair and the element of rational calculation that characterizes them is confounded with our notion of universal, neutral scientific knowledge, economic rationality escapes criticism of its biased consequences. Marx's methodological revolution consisted in circumventing this obstacle through a deeper analysis of the social dimension of this form of rationality. The most fundamental bias of the capitalist system is due not to irrational practices such as those of religion and feudalism, but to the particular way in which it implements the rational principle of equal exchange.

I have introduced the concept of "formal bias" to describe such prejudicial social arrangements. Formal bias prevails wherever the structure or context of rationalized systems or institutions favours a particular social group. Marx's economic theory offers a first example of the analysis of a formally biased social arrangement.

There are several different types of formal bias. Sometimes it refers to values embodied in the nature or design of a theoretical system or artefact, and sometimes to the values realized through contextualizations. I call the first case a constitutive bias, and the second an implementation bias. Here are some examples to clarify the distinction:

Constitutive bias

- Surveillance systems are biased by their very nature as they are especially apt at serving the needs of managers and police. With some barely imaginable exceptions, their effect is to enhance the power of a minority at the expense of a majority, the surveilled.

- Sidewalk design which blocks equal access for the handicapped also exhibits a constitutive bias.
- Machines designed to be the right height for children are biased to favour child labour. An argument can be made in a society using such machines that child labour is technically necessary and efficient. But of course we know that the same type of machines could be designed for adults without changing their nature.

Implementation bias

- A test that is fair in itself but has discriminatory impacts when used in a multilingual context exhibits implementation bias. In this case there is nothing wrong with the test that could not be corrected by simply translating it.
- Urban plans that concentrate toxic waste dumps near racial minorities are biased by the way in which the dumps relate to a context, not by the fact of their nature or design.
- The digital divide is another case where implementation has discriminatory consequences: it strengthens the rich at the expense of the poor, but only because the artefacts are distributed in a specific context of wealth and poverty, not because computers are inherently hostile to the poor. In fact, they can be a means of social advancement once the poor get hold of them.

Markets resemble artefacts in that they too can be structured by values in different ways. Legalizing the sale of human organs would change the nature of the market by altering its boundaries. An economic design decision is implied in the reliance on redlined maps in the mortgage business. An auction held at a time and place when legitimate buyers cannot attend would exhibit implementation bias.

Science represents a special case of constitutive bias. As Gerald Doppelt has argued, the constitution of an object of science depends on valuative decisions about epistemic methods (Doppelt 2008, forthcoming). For example, the idea that intelligence is defined by IQ tests bespeaks a choice of quantitative measurement over other ways of evaluating intelligence. Rational argument about epistemic values in this case is possible and necessary, and there can be good reasons to prefer some answers to others. Some epistemic choices simplify and distort, while others illuminate the phenomenon we call intelligence.

But it is usually not possible to argue to (at least provisionally) "correct" conclusions in technological and economic cases. The equivalent of the standard of truth in these practical domains is efficiency. But efficiency is itself relative to substantive values that may legitimately differ, whereas no legitimate alternative to the value of truth exists in science. Of course there are cases where rights can be adjudicated rationally and decide technical or economic controversies. The sidewalk case is an example. But there are also numerous cases where the clash over rights is not at all clear. In those cases we should not expect decisive arguments as is often possible in the case of scientific knowledge. Instead, decisions will have a clear political character.

Marxism and the Politics of Technology

Marx's critical method was not applied to technology in the years following the publication of *Capital*. Marx himself focused primarily on the first principle of social rationality, the exchange of equivalents. The market is a system or coordination medium and its movement has a lawful form. Nineteenth-century socialists were so fascinated by the idea of historical laws that they ignored Marx's critique of technology. But in *Capital* Marx hints at the class character of technology (Marx 1906 reprint I, part IV). The critique of the formal bias of markets is extended here less rigorously to the division of labour and mechanization. For example, Marx writes "It would be possible to write quite a history of inventions, since 1830, for the sole purpose of supplying capital with weapons against the revolts of the working class" (Marx 1906 reprint I, 476; Feenberg 2002, 47–48). He argues here that the form taken by technical progress under capitalism accords with the needs of enterprise rather than society as a whole. It was only in the 1970s that labour process theory recovered this aspect of Marx's thought and brought it up to date (Braverman 1974).

While Marx's contribution was largely ignored, Weber founded the field of organizational sociology on uncriticized capitalist assumptions. He was most interested in the second principle of rationality, classification and the application of rules as these procedures characterize bureaucratic and business organizations, but he lost the Marxian insight into the role of technology and class. Influential successors such as Parsons compounded his error. But Weber's contribution is important as the most successful early attempt to thematize the problem of social rationality as such (Weber 1958). Weber's "iron cage" of bureaucracy is echoed in Lukács's (1971) important early work *History and Class Consciousness.* There Lukács attempted to unify Marx's notion of the "fetishism of commodities" with Weber's rationalization theory in an innovative theory of reification (Lukács 1971).

As the word suggests, reification is the "thing-ification" of phenomena that are in essence human social relations. Reified society appears to its members as a vast mechanism to be operated or suffered but that cannot be fundamentally changed. Technical relations replace all other ways of interacting with human beings and the world. We are not far here from Heidegger's later critique of technology as a universal mode of thought and action in modernity. But unlike Heidegger, Lukács envisaged the possibility of de-reification. As a Marxist he argued that the human reality underlying the reified form of objectivity of the system can reassert itself and transform the society (Feenberg 2005, chap. 4).

Lukács provides the link between Marx and the Frankfurt School. Works such as *Dialectic of Enlightenment* (Adorno and Horkheimer 1972) and *One-Dimensional Man* (Marcuse 1964) are often dismissed as irrationalist and romantic when in fact they intend a rational critique of a new object. That object, omnipresent technology, is based on calculation and optimization, and shapes not just technical devices and social systems but also individual consciousness. Organizations, technologies, and culture are inextricably intertwined, each depending on the others for its design and indeed for its

very existence. According to the Frankfurt School, advanced industrial society is "totally administered" as a bureaucratic–technical system.

This extremely negative view of modernity results from a dystopian overemphasis on the limits of agency in socially rational systems. As a result, the Frankfurt School often serves as a left-wing version of Heidegger. But in Heidegger the social is completely absorbed into the technical sphere and no longer offers any basis for resistance. In his terminology, non-technical social forces, were they conceivable under modern conditions, would be merely ontic and subordinated to the ontological fundamentals revealed in the technical functionalization of the world. In contrast, the Frankfurt School proposed a dialectical conception in which the technical and the social are moments in a totality rather than situated in a hierarchy of more and less fundamental.

This is apparent in occasional comments by Adorno and lengthier analyses in Marcuse's work. In one surprising passage that seems to contradict the "critique of instrumental reason" in *Dialectic of Enlightenment*, Adorno writes:

> It is not technology which is calamitous, but its entanglement with societal conditions in which it is fettered. I would just remind you that considerations of the interests of profit and dominance have channelled technical development: by now it coincides fatally with the needs of control. Not by accident has the invention of means of destruction become the prototype of the new quality of technology. By contrast, those of its potentials which diverge from dominance, centralism and violence against nature, and which might well allow much of the damage done literally and figuratively by technology to be healed, have withered. (Adorno 2000, 161–162, footnote 15)

This passage is no more than a promissory note that Adorno never fulfilled, but Marcuse went much further in arguing that technology could be redesigned under different social conditions to serve rather than to dominate humanity and nature (Marcuse 1964, chap. 8).

Although the first generation of the Frankfurt School pursued a version of the Marxian approach under the new conditions of managerial capitalism and state socialism, its formulations are not entirely satisfactory. Ambiguities lend credence to charges of romantic irrationalism. Abandoning Lukács's daring critique and its echoes in the early Frankfurt School, Habermas and his followers avoid all discussion of technology and express open scepticism about workers' control and radical environmental reform. The Habermasians seem to concede that experts can resolve all technical questions properly and appropriately so long as they do not overstep the bounds of their authority and "colonize the lifeworld" (Habermas 1986, 45, 91, 187). With this concession to the autonomy of expertise, they have thrown the baby out with the bath water. And they have done so at just the moment when technology has become a major political issue.

Since World War II a new politics of technology has gradually refuted the old belief that technical controversies could be resolved through scientific consensus. Instead, we have seen the rapid proliferation of lawsuits, demonstrations, and political controversies over all sorts of technical issues. Students of Marx should not be surprised since these conflicts merely repeat in many new arenas the struggles he analysed in the 19th-century factory.

Today we no longer expect technical progress to resemble the old image of scientists bending over an experimental apparatus and nodding their heads in agreement. Indeed, we no longer believe that even scientists find agreement so simple. Our model of technical advance increasingly resembles ordinary politics. Diverse interests now contend for influence over the design of technologies just as they have always fought for influence over legislation. Each alternative design of medical technologies, transportation systems, the Internet, educational technology, and so on, has its advocates whose way of life or wealth depends on control of technical designs. They each argue more or less rationally for their point of view. Technological controversies appear on the front pages of the newspapers daily as we enter a new era of technical politics.

This is why I have reformulated the Frankfurt School's approach as the "rational critique of rationality" it was intended to be. Recent constructivist technology studies have been useful for this purpose. I employ the term "constructivism" loosely to refer to the theory of large-scale technical systems, social constructivism and actor network theory. They have in common an emphasis on the social contingency of technical development. They challenge the traditional view of the autonomy of technology and study it much as one might an institution or a law. The specifics of these methodologies are not relevant here, but this general approach can lend support to the Frankfurt School critique.

It is possible to combine insights drawn from the Frankfurt School with recent technology studies because technology studies itself resembles the Marxian critique of social rationality that inspired Adorno, Horkheimer, and Marcuse. Even though most of its practitioners are unaware or unappreciative of Marx's contribution, their own research unwittingly reproduces the very structure of his argument. The issues discussed in technology studies today are not confined to the factory as was Marx's critique. Technology has spilled over into every aspect of social life. Medicine, education, games, sports, entertainment, urban design, transportation are all highly technologized, and technology has widespread effects not just on human beings but also on nature. There are controversies and struggles in all these areas, as in the factories Marx studied, over how to organize a "rational" way of life. Technology studies is engaged in a critique of formal bias in so far as it recognizes the political significance of these controversies and struggles.

The generalization of insights from technology studies in the context of a critical theory of social rationality suggests the possibility of radical transformation through political action that is closed by the logic of dystopia. However, this hopeful approach requires a theory of social struggle over technological design which neither the Frankfurt School nor contemporary technology studies has developed. The critical theory of technology fills this gap.

Generalized Instrumentalization Theory

Critical Theory of Social Rationality

The instrumentalization theory is a critical version of rationalization theory that applies not just to technology but, with suitable modifications, to any socially rational

system or institution. Each of them realizes one or several of the three principles of social rationality under specific social, cultural and political conditions. A system such as the market involves operations of equivalence that have a rational character, but the framework within which these operations are performed is not itself an exchange of equivalents. Rather, it stems from the social and political conditions governing the market. Those conditions provide the decision rules that resolve underdetermined design choices. An example of such a choice is the boundary of the economy that determines just what can become a commodity and what is excluded from sale and purchase.

Similarly, classification of such things as crimes, diseases, or educational credentials may permit a bureaucracy to act coherently on what its members take to be a purely rational basis. Yet numerous rationally underdetermined problems must be solved in the construction of such systems. Often no decisive reason can be adduced to justify one solution over another. In fact, classification systems are the result of negotiations, conflicts, and the exclusion of alternatives that might have been brought forward by interested parties too weak to make their voice heard (Bowker and Star 2002, 44).

The critique of social rationality must therefore operate at two levels: the level of the basic rationalizing operations, and the level of the power relations or socio-cultural conditions that specify definite designs. I call these two levels the primary instrumentalization and the secondary instrumentalization. The relationship between them is not external: the device does not pre-exist the social determinations of its design. No pure market relation or natural kinds pre-exist the operations in which markets and classifications are configured. Society and its rational systems are not separate entities. The distinction between them is primarily analytic and methodologically useful, rather than a real distinction between things that exist independently of each other.[2]

The instrumentalization theory was initially applied to technical design. Consider an everyday object such as the refrigerator. Engineers work with basic components such as electric circuits and motors, insulation, gases of a special type, and so on, combined in complex ways to generate and store cold. Each of these components can be broken down into more basic ones until we arrive at the primitive decontextualized and simplified elements, the affordances with which all technology begins. There appears to be very little of a social character about these simplest elements although the ends they are intended to serve are socially contingent to some degree. The primary instrumentalization describes this aspect of technology.

But just for that reason, just because the technical elements are so thoroughly simplified and extracted from most contexts, they cannot completely determine how they are combined in the design of a concrete artefact. For example, consider the refrigerator again. The all important question of appropriate size is not settled technically but on purely social grounds in terms of the likely needs of a standard family. Even the consideration of family size is not fully determining. In places where shopping is done daily on foot, refrigerators tend to be smaller than where shopping is done weekly by automobile. The technical design of this artefact depends on the social design of society. This is the secondary instrumentalization. The refrigerator seamlessly combines these two registers of phenomena.

The refrigerator example may appear uncritical but the sociology of domestic technology has been explored by feminist scholars in terms of the impact of the nuclear family on invention and design.[3] The feminist argument depends on the fact that the narrowly conceived technical functions of domestic technologies, such as the speed or reliability with which they perform tasks, are essentially bound up with a specific lifeworld context. The refrigerator reduces the time spent shopping in a context in which household labour is still signified as largely feminine. Advertising images of happy homemakers confirm this cultural stereotype. The refrigerator is thus not just a labour-saving device but, more concretely, it is a substitute for female labour in the nuclear family. This shows up in features such as the streamlining of the device for incorporation into the space of women's domestic work (Nickles 2002).

It is easy to overlook the social background of a finished device. Its technical coherence seems a sufficient cause of its form, but this is an illusion. One has only to read such 19th-century utopias as Bellamy's (1960) *Looking Backward* to discover a possible alternative world in which "women's work" is socialized, and collective dining replaced the private production of meals. In such a world, refrigerators would no doubt be rather different.

To be sure, there would be important similarities between the engineering details of our household refrigerators and those of such a utopia just as today there are similarities between household and commercial refrigerators. This is what gives a sense to the idea of the technical as such. But formal engineering knowledge of these common features is not a device any more than a musical score is a symphony. The theory of formalization must be freed from the assumption that the object of formal description exists independent of society, exhaustively explaining the artefacts so described.

The customary conception of the "technical" abstracts from lifeworld contexts and so misrepresents both technology and society. What is true of refrigerators was just as true of the machines Marx analysed in *Capital*. He saw the factory not only as a locus of productive activity but also as a life environment for its workers, and a destructive one at that. All rational systems have this double aspect—as, on the one hand, a structure of operations based on one or several of the three principles of social rationality, and, on the other hand, as a complex lifeworld experienced by those they enrol (Feenberg 1992, 311). The secondary instrumentalizations arise in that lifeworld and structure socially rational systems. They may act either through specifications reflecting earlier social struggles, or as discursive expressions of contemporary users and participants aiming at changes in design. Thus considered historically, rational systems are not autonomous but are traversed through and through by the logic of the lifeworld they shape and that shapes them.

The Instrumentalizations[4]

The initial insight that opens up an object to incorporation into a rational system presupposes two conceptual operations: first the object must be decontextualized, split off from its original environment; and, second, it must be reduced or simplified to bring to prominence just those aspects that can be functionalized in terms of a goal.

These operations describe the original imaginative vision of the world in which affordances are identified that expose objects and persons to technization, commodification, and bureaucratic control. This vision plays out in actions that exhibit a decontextualizing and reductive aspect. For example, a tree in the forest is situated in a specific place and an ecological niche, but in becoming lumber it is removed and stripped of its complex connections to other living things and the earth. A person enters the purview of a bureaucracy as a "case", abstracted from the totality of a life process and simplified of extraneous elements. Goods become commodities through an interpretation that strips them bare of human connections and throws them into circulation. "In short, rationalization might be defined as the destruction or ignoring of information in order to facilitate its processing" (Beniger 1986, 15).

Passing from the level of the initial functional conceptualization to the actual making of a device or configuration of a market or bureaucracy brings in a host of new constraints and possibilities reflecting the existing technical and social environment. At every stage in the elaboration of a technical device or system, from the original creation of its elements to its final finished form, more and more underdetermined design decisions are made in response to social constraints. These constraints are of two main types.

Before it can be developed as a working artefact, the decontextualized object must be recontextualized. "Systematization", as I call this process, links the artefact or system to its technical and natural environment; for example, to the prevailing electrical voltage and weather conditions. In addition, the reductions it has undergone must be compensated by new valuative enactions drawn from the ethical and aesthetic registers of the society in which it is to function. Legal, moral, and aesthetic constraints intervene in the design and production process, determining an artefact capable of entering a specific social world.[5]

But it is important to keep in mind that the two instrumentalizations are analytically distinguished, at least to begin with. No matter how abstract the affordances identified at the primary level, they carry social content from the secondary level in the elementary contingencies of a particular approach to the materials. Similarly, secondary instrumentalizations such as design specifications presuppose the identification of the affordances to be assembled and concretized. This is an important point. Cutting down a tree to make lumber and building a house with it are not the primary and secondary instrumentalizations, respectively. Cutting down a tree "decontextualizes" it, but in line with various technical, legal and aesthetic considerations determining what kinds of trees can become lumber of what size and shape and are saleable as such. The act of cutting down the tree is thus not simply "primary" but involves both levels, as one would expect of an analytic distinction.

The theory is complicated, however, by the fact that technical devices and systems are built up from simple elements that have a wide variety of potentialities. The process in which these elements are combined consists of successive impositions of limitations on the materials. The secondary instrumentalizations play an increasingly important role as this process advances. The impact of the secondary instrumentalizations can be tracked as we follow an artefact from its earliest beginnings through the successive

stages of its development into a device able to circulate socially. The logging stage: the tree is cut down, but only the legal tree. The processing stage: it is transformed into lumber in accordance with the specifications of a particular construction system. The building stage: the house is built out of the lumber according to a building code and an architectural aesthetic. Even after its release, a technical device is still subject to further transformations through user initiative and government regulation: houses are remodelled. The lifeworld in which artefacts originate and to which they return has the power to shape and modify them. In this limited sense we can say they are socially constructed.

The two instrumentalizations characterize technical production in all societies but are only clearly distinguishable in modern times. This has led to the illusion that they are entirely separate entities enjoying external relations. In fact the distinction is primarily analytic even today, although large organizations often separate certain primarily social functions, such as packaging, from engineering operations. Thus the aesthetic function, an important secondary instrumentalization, may be separated out and assigned to a corporate "design division". Artists will then work in parallel with engineers. This partial institutional separation of the levels of instrumentalization encourages the belief that they are completely distinct. The existence of technical disciplines appears to confirm the common-sense notion that technology and society are separate entities, but these disciplines are actually full of traces of social choices that have been crystallized in standards and materials imposed originally by social actors in the past. A technological unconscious masks this history.

Nevertheless, radical versions of constructivism are wrong to insist that there is literally no distinction between the social and the technical. If that were true, there would be no technical disciplines and the makers and users of products would communicate more easily. It would be more accurate to say that modern technology is a particular expression of the social in artefacts and systems, mediated by the labour of differentiated technical disciplines. Ordinary social belief and behaviour is quite different, mixing the technical and non-technical promiscuously. Meanings guide improvisational action in everyday life, forming patterns that intersect with difficulty with engineered products, as Lucy Suchman argues persuasively (Suchman 2007).

A reconsideration of Marx's theory will help to clarify the relationship between these concepts and to generalize their application to the economy. Marx elucidated the consequences of replacing concrete human bonds of domination and subordination in production with formally equal market relations between commodities. This rationalization decontextualizes and simplifies natural and social elements for incorporation into a capitalist system of production and distribution. Things treated as raw materials are broken loose from their natural site and stripped down or processed to expose their one useful aspect in the context of production. In the production process they acquire new qualities suiting them to the human context for which they are destined in consumption. People are processed too. They are removed from the traditional domestic work context and relocated in factories. They cannot of course be stripped of their non-productive aspects like trees or minerals, but they can be obliged by the rules of the factory to expose only their productive qualities at work.

Marx thus proposed the basic outline of a theory of commodification. Paul Thompson has developed a more analytically precise version of such a theory. According to Thompson (2006), a good becomes a commodity when:

1. Alienability is enabled (the ability to separate one good from another, or from the person of a human being).
2. There is an increase in excludability (the cost of preventing others from use of the good or service).
3. There is an increase in rivalry, or the extent to which alternate uses of goods are incompatible.
4. Goods are standardized so that there is an increase in the degree to which one sample of a given commodity is treated as equivalent to any other sample.

Each of the commodification processes can be described under categories of the instrumentalization theory. Alienation and exclusion decontextualize objects, while rivalry and standardization simplify them. Once decontextualized and simplified, objects can be incorporated into a rational system, in this case the market, through appropriate systematizations; for example, by assigning a price and relocating the good to a place of sale. Enactions intervene in various ways; for example, as warranties and distribution point design.

So reconfigured, goods and labour circulate on markets, freed from the supposedly "irrational" encrustations on the economy of a traditional society in which religious and family obligations intrude on production. But as we have seen, the rationality of capitalism is biased by the fact that the capitalist alone is authorized to set the length of the working day. It is thus the economic equivalent of a formally biased technological design, resolving a technically underdetermined problem in accordance with the dominant social arrangements.

These rationalizing operations are performed by a detached, autonomous subject that is strategically positioned to make use of its objects' causal properties. As Bacon wrote, "Nature to be commanded must be obeyed" (Bacon 1939, 28). The actor's commanding stance has two seemingly contradictory prerequisites. On the one hand, the actor must be able to defer the consequences of action or reduce them in scope; and on the other, the actor must obey the independent logic of the system to accomplish an end. Technical examples of the first point are obvious. Hammering in a nail has a big impact on the nail but the energy that rebounds on the carpenter is of no consequences. Shooting a rabbit may be fatal for the rabbit but has a trivial impact on the hunter, and so on. This is the sense in which the actor can be considered autonomous. Economic examples of the second point are also obvious: to make money on my investments I do not attempt to change the world, but to occupy a market position where the crowd of later investors will find my property and bid up its value.

The capitalist exemplifies the autonomization of the subject in rational systems. The individual capitalist is of course not likely to be very different from other people, but in so far as he or she acts out of a new type of institutional base his or her practice has a remarkable characteristic: indifference to the social and natural environment within which optimization is pursued. The capitalist as subject thus lacks "humanity" in the

traditional sense. This is a detached subject free to a great extent from social control and positioned strategically to make a profit. On this condition it is able to achieve effective technical control of nature, labour and markets.

But this is not the end of the story. The detached actor finds itself engaged with its objects in a way that determines its identity, and called on to exercise initiative in manipulating them. As noted above, the hunter is not much affected physically by killing the rabbit, but is affected in his or her identity in so far as his or her actions designate him/her as a hunter—and as such the hunter takes the initiatives implied in the hunt. The capitalist may be indifferent to each investment and employee but he or she is a capitalist. The consumer is detached with respect to each commodity and yet an identity and corresponding activity is shaped by a pattern of consumption. What is deferred at the causal level returns at the level of meaning. This is the logic of finitude.

The activities associated with socially rational systems are complemented by cognitive and interpretive relations that also reflect the two levels of instrumentalization outlined above. In suggesting that cognitive relations are so structured, I do not wish to enter an epistemological debate over rationality, but remain at the phenomenological level. At that level, what is at stake is how subjects experience the world, not the nature of truth and reality. I also distinguish my approach from Habermas's at least to the extent of rejecting his sharp distinction of system and lifeworld. I do not believe that the differentiation of systems is anywhere near as complete as he appears to assume (Feenberg 1999a, chap. 7). The routine penetration of systems by lifeworldly meanings shows up in matters of system design and configuration that cannot be adequately addressed by systems theory and that receive only the most cursory attention in Habermas's theory of communicative action. Rather than a sharp distinction, a sliding scale of differentiation is indicated, going from the most semantically impoverished to the richest object relations.

The decontextualized and reduced experience of the initial encounter with affordances necessarily involves a perception of or reasoning about causality. The idea of piling log on log to build a wall is obviously dependent on causal thinking. But to build up a complex structure such as a house starting out from these simple beginnings, actors must integrate a much broader range of experience. That broader range is given as a world of meanings, a "lifeworld". In every society a house embodies a specific range of meanings assigned it by the culture, and this determines design.

The design of rational systems is no different from earlier craft techniques in this respect. It must integrate lifeworld and technical insight to be intelligible to members of the society. At the same time, institutionally differentiated technical work and formalized technical disciplines depend on maintaining a certain conceptual distance between functional abstractions and their lifeworld context. This operation is generally absent in premodern societies. It is accomplished by abstracting from valuative enactions to allow complex systematic connections to be elaborated in thought.

Table 1 presents a summary of all the relations involved in the instrumentalization theory as it has been presented above.

Table 1 Instrumentalization Theory

	Functionalization	Realization
Objectification	Decontextualization	Systematization
	Reduction	Enaction
Subjectivation	Autonomization	Identity
	Positioning	Initiative
Cognitive relation	Causality	Meaning
	Nature	Lifeworld

Adapted from Feenberg (1999a, 208).

Function and Lifeworld

The experts and managers who control socially rational systems and make technical artefacts, live, at least mentally, in a world of functions. The initial functionalization or primary instrumentalization is the basis of their operations. The lifeworld encompasses the everyday objects, activities and communicative engagements of the population at large. It is far more complex than the functional world of social rationality. Secondary instrumentalizations emerge in the lifeworld and impose a socially intelligible order on rational devices and systems. These devices and systems in turn disclose meanings that structure the lifeworld. The two instrumentalizations are thus inextricably imbricated in practice.

The generalization of this feature of the theory leads us back to its remote source in Marx's distinction between exchange value and use value. There is a gap between the concrete reality of goods and the laws of their economic circulation in a capitalist economy. The price under which things are exchanged governs their movement, often independent of use, rather than the immediate connection between the producer and an individual consumer as in former times. Similarly, functions float free from the wider context of the lifeworld and appear as the essence of artefacts that may in fact have many other relations to the human beings who live with them. The fetishism of function obscures these relations much as the fetishism of commodities masks the human reality of the economy (Feenberg 1999a, 210–213).

However, the analogy is not perfect. Marx's terminology is confusing. He seems to restrict the concrete reality of goods to use, obscuring the many other connections and contexts in which they appear in the lifeworld. As a result, Marx is accused of narrow utilitarianism, an interpretation welcomed by traditional Marxists and dismissed by others as complicit with the materialism of the very society he criticizes. Although Marx's (1973) *Grundrisse* discusses the wider implications of what he called use value, he did not develop a theory based on this insight.[6]

Moreover, the structure of Marx's political theory, with its projection of a radical disalienation of the economy, seems to promise an end to the distinction of exchange value and use value. Here the analogy with technology does indeed break down. Function is no illusion, nor is price despite Marx's hopes. Democratization of the codes

is the only possible disalienation in modern societies rather than a return to immediate forms of existence.

The distinction between function and meaning is also obscured in the recent philosophical literature. Searle, for example, constructs his social ontology around the apparently exhaustive contrast between the natural and the functional qualities of objects (Searle 1995). 'Function" refers to any intentional human interaction with a thing. A similar inflation of the concept of function afflicts the interesting contributions of Preston (1998) and Kroes and Meijers (2002). They recognize that the range of properties of technical objects is much wider than function in the narrow technical sense (Kroes and Meijers 2002, 36; Preston 1998, 246). Nevertheless, they apply the word "function" in various attenuated senses to all these properties. Of course everything that enters the social process is practically related to human beings, but calling all such relations "functions" is misleading, given their variety, and confusing, given the much stricter notion of function in technical fields. The significance of the distinction between function and meaning is clear in Cowan's sociology of consumption (Cowan 1987) and social histories of technology such as Schivelbusch's (1988) study of the industrialization of light in the 19th century. In common with other good sociologists and social historians, they highlight the hermeneutic complexity of technical change.

In technical fields a function is the designated purpose of a bundle of affordances orchestrated in a feature. When technical workers are told what function their work must serve, they look around for materials with affordances that can be combined and bent to this purpose. The secondary instrumentalization intervenes in the realization of the function in features. The affordances must be cast in a form acceptable to eventual users situated in a definite social context. Since technical workers usually share much of that context, many secondary instrumentalizations occur more or less unconsciously. Others are the result of using previously designed materials that embody the effects of earlier social interventions. Still others are dictated by laws and regulations or management decisions. Technical workers are of course aware that they are building a product for a specific user community, and to some degree they design in accordance with an amateur sociology of the user. Others in the organizations for which they work may be assigned this sociologizing task.

Marketers, for example, may decide that the purpose of a certain car is to entice dates, but no automotive engineer would consider that an engineering problem until it was translated into a feature such as a lowered hood. The lowered hood connotes racing car design, which in turn connotes a certain kind of daring driver, who in yet another turn may appeal to young women as the marketer or certain purchasers imagine them. The links between all these complex meanings and the engineering idea of function are too slender and contorted for the same term to be useful for both. It would be more accurate to say that function in technical disciplines is abstracted from "meaning", a more complex system of relations in the lifeworld. The race car image "means" the driver is a certain kind of presumably attractive person. It signifies the driver and only on that condition can it be used by him.[7] Function in the narrow sense is that aspect of meaning that is specified technically (or "translated") in features.[8]

Returning to our original example of the refrigerator, we see that it has two major functions: to keep food cold and to fit the interior decoration of the standard kitchen. The engineer is given the task of designing features corresponding to these functions. The meaning of the refrigerator is the whole set of relations, both practical and imaginative, entertained by family members toward this device. That meaning not only includes aspects of the refrigerator that have been translated into functions, but also other aspects that are not specifiable as functions; for example, rules concerning who has access to its content. (Not so long ago, children in most families were forbidden to open the refrigerator door.)

Yet other aspects of the refrigerator's meaning are not officially designated as functions. This includes a communicative usage that is not served by a feature: the door as a message board. Were this unplanned usage incorporated into the refrigerator as a function, presumably its messaging affordances would be improved through new design features such as a built-in whiteboard or, better yet, a screen and Internet connection. The refrigerator magnet would then appear as the first in an innovative line of kitchen communication devices.

Devices are situated in two radically different but essentially interlinked contexts: the technical context of development and production, and the lifeworld context of disclosure and use. A similar duality is apparent in the spheres of bureaucracy and the economy. Bureaucratic institutions are configured around systems of classification. These systems reflect the abstraction of what are called "cases" from the concrete flow of the lifeworld. A complex living human situation becomes a case when it is decontextualized and reduced just as a natural object is perceived in terms of affordances in the technical sphere. To pull cases together under a class governed by a rule corresponds roughly to the functionalization of affordances in technical work. And as with technology, bureaucracy loses much of the richness of the lifeworld with the result that tensions arise between it and its clients. We have seen how Paul Thompson's theory of commodification can be interpreted as a generalization of the instrumentalization theory to the economy.

The socially rational properties of the various systems expose them to mediation by each other. Bureaucratic rationality lends itself to technical mediation; for example, through computerization of clearly and distinctly labelled case files. Similarly, commodification is often supported by technical mediations—as in the currently contentious case of the digital watermarking of music and film, which ensures their "excludability". The overlapping of modes of rationalization in cases such as these creates an apparently seamless world of instrumentalities.

Technical Codes

The instrumentalization theory has been applied to the study of the regularities exhibited by technical designs over long periods. Standard ways of understanding individual devices and classes of devices emerge, called "black boxing" in constructivist studies of technology. Many of these standards reflect specific social demands shaping design. These social standards impose the technical code. Technical codes are durable, but they can be revised in response to changes in public opinion.

In this respect, technical codes are similar to law in a democratic state. Much democratic politics resembles an institutionalized version of the interactions between initial expert encoding and lifeworld recoding. The modern democratic state is essentially a vast administrative system that is more or less responsive to the lifeworld through the activity of citizens in the public sphere and of their elected representatives in an assembly that mirrors that sphere to some extent. Laws, like technical codes, establish stable regularities in social life. Laws depend in the first instance on the identification of classes of phenomena. Such classes are themselves abstracted from lifeworld contexts much as are affordances. Tensions and conflicts emerge where the abstraction leaves behind essential aspects of social life. These tensions may lead to protests and eventually to change, closing the democratic circle in which, as de Saint-Just explained, "the people is a submissive monarch and a free subject" (de Saint-Just 1963, 39).

The example of the refrigerator once again offers a simple technical illustration of this circularity. Its technical code determines such features as cubic feet of storage in function of the social principles governing the family. Other features have apparently no controversial social implications. But when it became clear that the standard refrigerant gas was destroying the ozone layer, environmentalists articulated public concern with skin cancer—and soon this concern led to government regulations, which were in turn translated into technical procedures implemented by engineers. The resulting designs were responsive to a new environmentally sensitive technical code. In other cases the technical code has an overtly political character, as in deskilling and mechanization of labour in the industrial revolution. Foucault's study of the Panopticon offers another example of the operation of a politically charged technical code (Foucault 1977). In these latter cases, contestation of the code is a permanent feature of the system.

Technical codes are sometimes explicitly formulated in specifications or regulations. But often they are implicit in culture, training, and design, and need to be extracted by sociological analysis. The researcher formulates the code as an ideal–typical norm governing design, but in reality there exist at least two very different instances of that ideal type: technical specifications formulated by experts on the one hand, and expressions of desires and complaints by lay users or victims on the other hand. It is the experts' job to make sure the specifications fulfil lay expectations; for example, that the new refrigerant does not continue to threaten the ozone layer. This requires a process of translation between a technical discourse and social, cultural, and political discourses. The new refrigerant's function is to protect the ozone layer, but more than that it "translates" lay concern into the language of technology as its technological equivalent. The translation process is ongoing and fraught with difficulty but nevertheless is largely effective. The technical code consists of this process that is made visible in the researcher's ideal–typical formulations.

The democratic implications of translation are easier to grasp now than in the past. As technology intrudes on more and more social settings, the resistant lifeworld generates ever more secondary instrumentalizations. In my earlier work I verified this dynamic in three domains, online education, human communication on computer networks, and experimental medicine.

- Online education was invented by teachers who engaged students in seminar-style discussions online. Later, computer companies and college administrators attempted to automate online education. They oriented the field toward the delivery of pre-packaged educational materials over the Internet. The final outcome of the contest between these different approaches is still in doubt, but online classes today often include both human communication and information delivery (Feenberg 2002, chap. 5).
- The French Minitel network, like the Internet, was introduced with the intent of enhancing the exchange of information, but both networks were pressed into service by users as communication systems. The Minitel was hacked to open it up to instant messaging, and email was introduced to the Internet by an early subscriber without permission from those managing the network (Feenberg 1995, chap. 7).
- Finally, AIDS patients perceived the early experiments in which they were involved as inhumanly restrictive. Because consistent cooperation could not be obtained under the prevailing protocols, patients were eventually able to force changes in experimental design. These changes added a focus on patient care for large numbers of patients to the scientific purpose of the experiments (Feenberg 1995, chap. 5).

In the first case, innovations introduced by lay actors were colonized by computer specialists and commercially oriented administrators. Limitations of the technology and resistance from users appear to have yielded a hybridized system. In the other two cases, a technocratic or scientific ethos presided over the construction of a new environment; and in each of these cases, lay actors brought to it a self-understanding very different from the designers' expectations. Out of the confrontation of users and technical systems emerged a distinctive hybrid that served a broader range of human needs than was originally envisaged. Such changes are democratic and progressive in character. They are essential to maintaining the openness to contestation of the technologized social world.

Conclusion

Modern societies are unique in the exorbitant role they assign social rationality in the constitution of their principal institutions. This has been a significant obstacle to the development of critical consciousness, from the earliest versions of free market ideology down to the present technocratic legitimation of advanced societies. The formal bias of socially rational artefacts and institutions is far more difficult to identify and criticize in a modern society than inherited mythic and traditional legitimations. A variety of strategies have been tried for this purpose, each growing out of a focus on one or another rationalized institution. The instrumentalization theory is based on critical strategies developed in relation to technology. Here an attempt is made to generalize it to other rationalized spheres.

This brief discussion of the instrumentalization theory can be summarized in the following seven propositions:

1. The theory is a critique of social rationality generally parallel to Marx's critique of market rationality.
2. The theory is based on analysis of the formal bias of socially rational systems and artefacts.
3. This bias is traced in design in the seamless combination of analytically distinguishable primary and secondary instrumentalizations.
4. Affordances are discovered at the level of the primary instrumentalization with minimal social constraints.
5. These affordances are combined in formally biased systems and devices embodying a wide range of social constraints described in the secondary instrumentalization.
6. Codes determine stable regularities in the design or configuration of socially rational systems and artefacts.
7. Tensions between design and lifeworld contexts give rise to new demands, which are eventually translated into new codes and designs.

I have sketched here a number of adaptations of the instrumentalization theory to other forms of social rationality, but clearly more work remains to be done. The terms of the instrumentalization theory and the notions of technical code and function must be reconstructed in the different contexts of bureaucracy and the market. A theory of formalization must be developed to explain the relation between technical disciplines and the lifeworld. Other socially rational systems such as games must be studied. And a grounded account of the difference between premodern and modern society must be elaborated that avoids both the rationalistic excesses of previous theories of modernization and the polemic rejection of Marxism and the sociological tradition characteristic of much science and technology studies. This is the agenda of a future research programme on social rationality.

Notes

[1] Other socially rational systems of lesser importance also exist. Among them, commercialized and technologized games are of special interest as rapidly growing phenomena with increasing effects on core institutions. See Grimes and Feenberg (2007).

[2] The case offers an interesting parallel to the relationship of sex and gender in Judith Butler's anti-essentialist gender theory (Butler 1990). Butler argues that sex does not precede and found gender because our understanding of sex, even in its pure anatomical concreteness, is already shaped by assumptions about gender. I think she would agree that the two are distinguishable in a meaningful way—otherwise there could be no science of sex—but they are not ontologically distinct. Like Latour's hybrids, the body, as a living actor, is ontologically fundamental rather than the two aspects of nature and culture abstracted from it in modern discourses. If there is a problem with this view, it lies in the tendency of its advocates to discount the internally coherent, rational form of the abstractions in which nature is constructed. Admitting this need not imply the realistic ontological claims anti-essentialism rejects.

[3] For an excellent review of feminist approaches see Wajcman (2004). Critical theory of technology can situate the sort of work done in feminist technology studies in the context of a general social critique of rationality. See Glazebrook (2006) and Feenberg (1999b).

[4] This brief description of the theory gives only a hint of developments described more fully in several of my books (Feenberg 1999a, 2002).

[5] I previously called these valuative enactions "mediations"; that term, however, risks confusion with the more general mediation of experience by technology. The choice of the new terminology was dictated by the desire to avoid reducing valuative dimensions of technology to attitudes of the subject. Values are enacted, embodied, in technologies, and as such script corresponding enactive relationships, not merely attitudes, on the part of subjects.

[6] "In fact, however, when the limited bourgeois form is stripped away, what is wealth other than the universality of individual needs, capacities, pleasures, productive forces, etc., created through universal exchange? The full development of human mastery over the forces of nature, those of so-called nature as well as of humanity's own nature? The absolute working-out of his creative potentialities, with no presupposition other than the previous historic development, which makes this totality of development, i.e., the development of all human powers as such the end in itself, not as measured on a predetermined yardstick? Where he does not reproduce himself in one specificity, but produces his totality? Strives not to remain something he has become, but is in the absolute movement of becoming?" (Marx 1973, 488). See also Sahlins (1976).

[7] Function is also abstracted from a wider range of causal relations, called "effects" in the instrumentalization theory, which includes unintended consequences.

[8] For the relation of the semiotic concepts of denotation and connotation to the hermeneutics of technology, see Baudrillard (1968).

References

Adorno, Theodor. 2000. *Introduction to sociology.* Translated by E. Jephcott. Cambridge: Polity.

Adorno, Theodor, and Max Horkheimer. 1972. *Dialectic of enlightenment.* Translated by J. Cummings. New York: Herder and Herder.

Bacon, Francis, 1939. Aphorisms concerning the interpretation of nature and the kingdom of man. In *The English philosophers from Bacon to Mill,* edited by E. A. Burtt. New York: Modern Library.

Baudrillard, Jean. 1968. *Le système des objets.* Paris: Gallimard.

Bellamy, Edward. 1960. *Looking backward: 2000–1887.* New York: Signet.

Beniger, James. 1986. *The control revolution: Technological and economic origins of the information society.* Cambridge, MA.: Harvard University Press.

Bowker, Geoffrey, and Susan Leigh Star. 2002. *Sorting things out: Classification and its consequences.* Cambridge, MA: MIT Press.

Braverman, Harry. 1974. *Labour and monopoly capital.* New York: Monthly Review.

Butler, Judith. 1990. *Gender trouble.* New York: Routledge.

Cowan, Ruth. 1987. The consumption junction: a proposal for research strategies in the sociology of technology. In *The social construction of technological systems: new directions in the sociology and history of technology,* edited by Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch. Cambridge, MA: MIT Press.

de Saint-Just, Louis Antoine. 1963. *L'Esprit de la revolution.* Paris: UGE.

Doppelt, Gerald. 2008. Values in Science. In *Routledge Companion to Philosophy of Science,* edited by M. Card, and S. Psillo. London: Routledge.

Feenberg, Andrew. 1992. Subversive rationalization: technology, power and democracy. *Inquiry* 35 (3–4): 301–22.

Feenberg, Andrew. 1995. *Alternative modernity: The technical turn in philosophy and social theory.* Los Angeles: University of California Press.

Feenberg, Andrew. 1999a. *Questioning technology.* New York: Routledge.

Feenberg, Andrew. 1999b. Sandra Harding's "Is science multicultural"? On bridging the gap between science and technology studies. *Science, Technology, and Human Values* 24 (4): 483–94.

Feenberg, Andrew. 2002. *Transforming technology.* New York: Oxford University Press.

Feenberg, Andrew. 2005. *Heidegger and Marcuse: The catastrophe and the redemption of history.* New York: Routledge.

Foucault, Michel. 1977. *Discipline and punish.* Translation by A. Sheridan. New York: Pantheon.

Foucault, Michel. 1991. *The Foucault effect: Studies in governmentality,* edited and translated by G. Burchell, C. Gordon, and C. Miller. Chicago, IL: University of Chicago Press.

Glazebrook, Trish. 2006. An ecofeminist response. In *Democratizing technology: Building on Andrew Feenberg's critical theory of technology,* edited by T. Veak. Albany, NY: SUNY Press.

Grimes, Sara, and Andrew Feenberg. 2007. Rationalizing play. Manuscript. ACT Lab, Simon Fraser University, Vancouver, BC, Canada.

Guillaume, Marc. 1975. *Le capital et son double.* Paris: Presses Universitaires de France.

Habermas, Jürgen. 1970. Technology and science as "ideology". In *Toward a rational society,* edited by J. Habermas. Translated by J. Shapiro. Boston, MA: Beacon Press.

Habermas, Jürgen. 1986. *Autonomy and solidarity: interviews,* edited by P. Dews. London: Verso.

Kroes, Peter, and Anthonie Meijers. 2002. Reply to critics. *Techné* 6 (2): 34–43.

Latour, Bruno. 1993. *We have never been modern.* Translated by C. Porter. Cambridge, MA: Harvard University Press.

Lukács, Georg. 1971. *History and class consciousness.* Translated by R. Livingstone. Cambridge, MA: MIT Press.

Marcuse, Herbert. 1964. *One-dimensional man.* Boston, MA: Beacon Press.

Marx, Karl. 1906, reprint. *Capital.* Translation by E. Aveling. New York: Modern Library.

Marx, Karl. 1973. *Grundrisse.* Translated by M. Niclaus. Baltimore, MD: Penguin.

Mauss, Marcel. 1980. Essai sur le don. In *Sociologie et anthropologie,* edited by M. Mauss. Paris: PUF.

Nickles, Shelley. 2002. "Preserving women:" refrigerator design as social process in the 1930s. *Technology and Culture* 43 (4): 693–727.

Picon, Gaetan. 1956. *Balzac par lui-meme.* Paris: Seuil.

Preston, Beth. 1998. Why is a wing like a spoon? A pluralist theory of functions. *The Journal of Philosophy* 95 (5): 215–54.

Sahlins, Marshall. 1976. *Culture and practical reason.* Chicago, IL: University of Chicago Press.

Schivelbusch, Wolfgang. 1988. *Disenchanted light.* Translated by A. Davies. Berkeley, CA: University of California Press.

Searle, John. 1995. *The construction of social reality.* Cambridge, MA: MIT Press.

Suchman, Lucy. 2007. *Human-machine reconfigurations.* Cambridge: Cambridge University Press.

Thompson, Paul. 2006. Commodification and secondary rationalization. In *Democratizing technology: Andrew Feenberg's critical theory of technology,* edited by T. Veak. Albany, NY: SUNY Press.

Wajcman, Judy. 2004. *Technofeminism.* Cambridge: Polity.

Weber, Max. 1958. *The protestant ethic and the spirit of capitalism.* Translated by T. Parsons. New York: Scribners.