WHY TECHNOLOGIES ARE INHERENTLY NORMATIVE

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1 INTRODUCTION

The title of this chapter implies that technologies are inherently normative. Explaining and defending this claim requires, first of all, a plausible account of the notions of 'technology' and 'normativity'. For this purpose, Section 2 characterizes a (type of) technology as a '(type of) artifactual, functional system with a certain degree of stability and reproducibility', and it addresses the crucial question of how we may successfully realize such technologies. Next, Section 3 explains the notion of a norm as 'a socially embedded directive concerning what people should (or should not) say or do', and it examines several important aspects of how norms function in actual practices.

Section 4, then, introduces the distinction between contingently and inherently normative technologies and it provides a detailed discussion of the question of why technologies are inherently normative. After a general outline of the argument for this claim, Sections 4.1 through 4.4 address the central aspects of the inherent normativity of technologies on the basis of four different approaches, arranged in chronological order. These sections discuss the normativity of technology in the case of Langdon Winner's account of the political nature of artifacts, in my own analysis of the material/social control needed to realize stable and reproducible technologies, in the script theory of technological design advocated by Madeleine Akrich, and in the notion of use plans proposed by Wybo Houkes and Pieter Vermaas. The merits and problems of these approaches are assessed and their implications for the main question of this chapter examined. Section 4.5 uses the analyses and examples from the preceding sections to illustrate several important aspects of the role of normativity in technological practice. The fifth and final section summarizes the argument for the claim that technologies are inherently normative and it briefly explores the question of whether there are other ways in which technologies can be said to be inherently normative.

It will be clear that the focus of this chapter is on the philosophy of technology. However, since a central aim of the engineering or technological sciences is to contribute to the design and implementation of technologies, this chapter is essential to engineering or technological scientists as well. The basic point of relevance is that, if they aspire to anticipate the successful implementation of their designs,

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engineering and technological scientists need to be sharply aware of the inherent normativity of technologies.

2 TECHNOLOGY

Any systematic philosophical discussion of the normativity of technology should be based on a plausible account of the very idea of 'technology'. This is of course a huge subject, that has been treated in detail in a large number of studies (for extensive reviews, see Van der Pot [1994]; Mitcham [1994]; Mitcham and Schatzberg [this volume, Part I]). It will be clear that all those studies cannot be addressed here. What I will do in this section is to outline a theoretical account of technology that, I hope, is both plausible and suitable as a starting-point for an in-depth discussion on the subject of this chapter. In part, this account employs notions that are quite common in the philosophy of technology; in part, it builds on and develops several ideas taken from my own work.[1]

The resulting theory of technology has two interrelated parts. I start with a characterization of a (type of) technology as a *(type of) artifactual, functional system with a certain degree of stability and reproducibility*, and I explain the key notions of this characterization. In the second part, I examine the questions of how, where and when we may successfully realize and maintain such technologies, which will reveal a number of equally important, additional characteristics of technologies.

2.1 A first characterization of technologies

The distinct elements of this characterization of technologies can be, briefly and rather formally, described as follows. A *system* is any aggregate (or collective) of mutually interacting material entities within a certain region of space and time. Thus, a system possesses not only a spatial but also a temporal dimension, which allows us to see processes as systems. Although the notion of a system may also be used in more substantial ways,[2] this unassuming definition is appropriate in the present context. It may also be phrased by saying that technologies have a systemic character, because they result from bringing, and keeping, together two or more material entities. By definition, everything that is not included in the system is its environment. The *relevant part of the environment* comprises the conditions for the successful functioning of the technology in question. Thus defined, the notion of a system includes the qualification 'within a certain region of space and time'. This important qualification entails that, in thinking about actual technologies, we should always take into account their spatiotemporal location(s).

[1]See in particular [Radder, 1986; 1988/1984; 1996]. This section draws on, but includes some slight revisions of, the presentation in Radder [2008].

[2]Such strong notions often imply the idea of goal orientation (see, e.g., [Feenberg, 1999, pp. 117-119]).

An *artifactual* system is a system that is the result of human intervention in the material and social world. A minimal interpretation of the phrase 'is the result of' is that such artifactual systems would simply not exist without this intervention by human beings. In technological practice such interventions will usually be intentional, but this is not necessary on the minimal interpretation. An artifactual system is *functional* if its potential to play some role intended by one or more human agents can be realized by embedding the system in a suitable environment. Thus, the notion of functionality refers at once to the potentialities of a technological system, to the realizability of the system and the relevant parts of its environment, and to the intentions of one or more human agents (for example, policy makers, financiers, designers, manufacturers or users). Consequently, this notion does not presuppose a principled distinction between 'proper' functions (those intended by designers) and 'improper' functions (those intended by other people). The phrase 'can be realized' means that the technology in question can be actually realized in some region of space and time (perhaps still in the future). This requirement of the actual realizability of the function of a technology excludes realization conditions that are purely fictional or merely 'in principle' and it implies that 'being functional' is, in part, dependent on specific characteristics of the environment.

Furthermore, the system should possess a certain degree of *stability*. That is to say, it should be able to perform its function across a variety of situations and during a substantial period of time. Moreover, different systems of the same type should be able to exhibit the same function, that is, the system should be *reproducible*. Thus, the notion of reproducibility also shows the significance of distinguishing between technological systems as *tokens* and technological systems of the same *type* or of different *types*. As we will see, the notions of stability and reproducibility are crucial to an appropriate understanding of technologies. Yet, in philosophical theories of technology, they are often taken for granted or not taken into account at all.

By way of an example, consider a token of a washing machine. This particular device constitutes a system in the sense of an aggregate of mutually interacting parts. Thus, its sides contain the water while some of the heat of this water will warm up these sides. Given the minimal interpretation of the notion of system, where to draw the boundary between system and environment is a matter of pragmatic focus. That is to say, depending on our purposes we may define the technological system as more or less inclusive. Thus, apart from the washing machine, this system might include the plug socket or even the electric power station, the washing powder factory, and so on. Of course, these different definitions of the system will go together with different delineations of the corresponding environment.[3] The washing machine is obviously artifactual, since this machine would not exist without human intervention. Its most common function is to clean the

[3]Thus, the notions of a system and (the relevant part of) its environment include the idea of composition but point beyond the usual sense of that idea toward a more comprehensive kind of 'composition' that is necessary for the stable and reproducible functioning of a technology.

laundry of the people who own or use it, but it might also be primarily used as a table. The designers, manufacturers, owners and users expect that the device will not break down permanently after its first run, but that it will work in a stable manner for some period of time. How long exactly cannot be fixed in advance, because it depends on the quality of the build of the machine and on the specific environment in which it is supposed to function. Thus far, we have considered a particular washing machine, a token of this technology. Usually, many similar machines of the same type are being produced, and both producers and users expect that each of these washing machines of the same type works in the same, stable way. That is to say, they assume the reproducibility of the tokens of this technology.

How general is this account of technology? Does it cover each and every technology that we may think of? For instance, is every technology a system in the sense of an aggregate of mutually interacting parts? In principle, we can imagine limit cases of 'technologies' that are of one piece, that is, without parts. We should also realize, though, that it is often the case that technologies that look homogeneous at first sight are in fact the result of a process of artifactual composition. Thus, the coffee mug and spoon on my desk may look at first to be homogeneous, but the mug has been constructed out of a number of different synthetic materials and the spoon out of a number of different metals. Keeping the mug as a stable configuration requires a continuing interaction between its components, and the same applies to the spoon. Furthermore, is a technology always artifactual in the sense of being artfully made by some human being or beings? Again, there might be rare examples of 'technologies' which are not artifactual. Think of a stone that is picked up to be used as a weapon. Finally, from a purely logical point of view, one might question the necessity of including the notion of reproducibility in our characterization of technologies. Yet, although it is not logically necessary, in actual practice it is generally seen as desirable to have at least the possibility of producing more than one token of the same type of technology. To sum up, while functionality and stability are necessary features of any technology,[4] the features of system, artifact and reproducibility apply 'almost universally', and they certainly cover the interesting and important cases. Hence, the notions of system, artifact, functionality, stability and reproducibility are crucial to an appropriate understanding and assessment of real technologies.

2.2 How to realize and maintain technologies

So far, this characterization of technologies is probably quite plausible, but it is also quite limited. Hence, it should be significantly expanded by posing and answering the questions of how, where and when we may realize and maintain such (types of) artifactual, functional systems with a certain degree of stability and reproducibility. There are two basic problems that must be solved. First, as the

[4]Note that even throw-away devices are supposed to function stably during a brief period of time.

word 'artifactual' implies, well-functioning technologies need to be artfully made. Having them available in the first place requires active human intervention. Second, since the world may, and often does, change in substantial ways in the course of time, keeping a technological system stable and reproducible also requires active human intervention. Sometimes this intervention is small-scale and routine, more often it is elaborate and demands continuing attention. That is why technologies, if they are expected to keep functioning, cannot be left to themselves.

How to tackle these two basic problems? Firstly, we need the capability to, literally, put together a technological system that has the potential of performing the required function. This means that we need to have at our disposal the materials, resources, skills and knowledge that are required for designing, constructing and using the technological system in the first place. Secondly, since we want the technology to be stable and reproducible, we need to exercise such control so as to keep a once functioning system steadily functioning inside its intended spatial domain and during the required period of operation. A crucial feature of technologies is that this control should not merely be applied to the system in question but should extend to the relevant aspects of its environment. As we will see in more detail in Section 4, in this context 'to control' primarily means 'to be sure of and, if needed, to make sure' rather than 'to check explicitly'.
indent Let us go back to the washing machine to illustrate this sketch of how we may realize and maintain a certain (type of) technology. Clearly, putting together a washing machine requires a lot of knowledge about a variety of processes needed to realize the function. How to make the device waterproof and strong enough, how to heat the water, how to construct the spin-drier, how to program the entire washing cycle, and so on? In technological practice, sometimes we merely have know-how about realizing these processes, sometimes we possess more detailed, explicit knowledge of such processes. Of course, knowledge as such is not enough. We also need to have available to us the materials for constructing a functioning washing machine. This includes not just the parts of the device itself but also the water, the electric power and the washing powder. Furthermore, we need the resources (such as tools) and the skills to put the device together. Finally, in order to have a stable and reproducible washing machine, a number of further conditions should be met. First, the supply of clean water, safe electric power, effective washing powder, and the like, as well as the draining of dirty water needs to be guaranteed. Second, the users of the machine should have the required skills to operate it. This may merely require the capability to follow the instructions from the user manual. However, it may also include adjusting these instructions to local circumstances (for instance, harder or softer water areas) or even inventing new 'instructions' in order to cope with novel local problems. Third, a certain measure of stability and reproducibility can only be guaranteed if enough skilled maintenance and repair facilities are available.

We see that it is the requirement of stability and reproducibility in particular that demands a connection between our technological system and its wider environment. Because all kinds of psychological, social and cultural factors may influence the stability and reproducibility of a (type of) system, this environment is not just a physical environment. If some users become unemployed, cannot pay their electricity bill any more and are cut off by the utility company, their (token) washing machine will not function any more. Or, if a major and lasting stagnation of energy supplies arises because the resources have been exhausted and hence entire power stations have to shut down, most or all current types of washing machines will be rendered useless in terms of their cleaning function.

A further important connection between a technological system and its wider environment derives from the notion of function. In actual practice, 'to function' is not an all or nothing matter, but a matter of degree. A technology may function perfectly, well enough, just OK, badly and so on. But whether or not a technology functions perfectly, well enough, just OK or badly is also dependent on the characteristics and requirements of the user (and hence on the environment of the technology). A simple portable radio may function well when it provides background music for a not especially musical person, but the same artifact functions badly for a connoisseur who really intends to hear the details of a complex symphony. In addition, this example shows that how well a technology functions also depends upon the availability of alternatives, that is, better or worse existing options to realize the same function. In a situation in which a hi-fi stereo set is also available, the functioning of a portable radio will be assessed differently from a situation in which this radio is the best example of stated function there is.

2.3 Some philosophical implications

The theoretical and practical implications of this theory regarding the issue of why technologies are inherently normative will be discussed in Section 4. Here I will briefly mention some other philosophical implications. First, technological systems are, by definition, material. This excludes systems of nonmaterial entities (such as institutions), which are sometimes called 'social technologies'. More generally, I think that we should resist the tendency to call any goal-oriented procedure (such as, for instance, 'giving a command' or even 'interpreting a poem') a 'technology', for the simple reason that this would make almost anything a technology and thus it would undermine the usefulness of the very notion of technology.[5]

Next, the focus on artifactual systems also differentiates the theory from accounts of technology in terms of knowledge, that is, technology as the *logos* of *techne* (see [Layton, 1974; Mitcham, 1994, Chap. 8]). The theory of technology presented here explicitly acknowledges the significance of technological knowledge (both know-how and know-that), yet its primary focus is on the realization of artifactual, functional systems with a certain degree of stability and reproducibility.

Furthermore, the structural connections between system and environment, including the social environment, imply that there is no fundamental contrast between so-called 'stand-alone technologies' (say, a bicycle) and 'large-scale infras-

[5]In the same spirit, Koningsveld [2006, pp. 216-227] distinguishes nonmaterial from material practices and administrative or management sciences from technological sciences.

tructural systems' (say, the car transport system), in the sense that only the latter would be a 'socio-technical' system, while the former would be a 'nonsocial' artifact. Yet, the emphasis on the significance of the social conditions for the successful functioning of technologies does not mean that 'technology' and 'society' are inextricably interwoven in a 'seamless web'. In this respect, I follow the forceful critique of the alleged inextricability of this web in [Gingras, 1995]. The point of the proposed theory of technology is, after all, to make useful distinctions between particular material systems and the relevant parts of their material environment on the one hand, and their specific social conditions and effects on the other.

Finally, the focus on realization and its social conditions does not imply an anti-realist interpretation of the working of technologies, which is the usual view in social constructivist approaches to technology (e.g., [Bijker, 1995]). As in the case of experimental science, the potentialities that enable the stable and reproducible realization of a technology can be explained in a realist sense as being human-independent, that is, as not being constructed by human intervention and social practices (see [Radder, 1996, Chap. 4]).

As will become clearer in the course of the chapter, the proposed theory of technology aims to integrate, in Carl Mitcham's terms, elements from both the engineering and the humanities tradition in the philosophy of technology (see [Mitcham, 1994]). On the one hand, it explains what it means to design and make working technologies. On the other, it reflects on the kind of world that is implied by, and required for, having these technologies work.

3 NORMATIVITY

The second key notion that has to be explained, given the subject of this chapter, is the notion of normativity. Although the term normativity is often used in scholarly literature, its meaning is not very clear. As a kind of jargon term, it roughly denotes something like 'the subject of norms' or 'the role of norms' or, even more vaguely, 'issues having to do with norms'. For reasons of convenience, I will also use the term normativity in this, admittedly vague, sense. In addition, however, we need a more precise characterization of the more basic notion of 'norm' and the corresponding adjective 'normative'. In this section, I will first discuss, in a general way, the question of the nature and role of norms. The next section, then, will focus on technological normativity and address our main question of why technologies are inherently normative.

At the most basic level, a norm is *a socially embedded directive concerning what people should (or should not) say or do.* A somewhat weaker phrasing of the same idea is that norms pertain to those actions and assertions which are considered desirable (or undesirable). The actions and assertions to which norms may apply are taken to be publicly accessible. The social embedding entails that not following accepted norms may lead to some form of sanction(s).[6] The adjective 'normative' may then be defined as 'implying one or more norms'.[7] By definition, accepted norms presuppose (positive) value judgments of the (goals of the) actions we should perform and of the (meaning of the) assertions we should make. Thus, the norm that we should not tell lies clearly presupposes that 'speaking the truth' is considered to be a positive value. As to the reverse relationship, it is important to realize that in practice the same value may lead to rather different normative recommendations. Most people will endorse the value of scientific integrity but, without further specification, this does not tell us which norms this implies for the direction of scientific practice (for more about values, see Van de Poel's chapter in this volume, Part V).

3.1 Normativity in practice

In addition to these basic definitions, we need some further explanation of the nature of norms and the role they play in actual practice. First, from a theoretical perspective we may distinguish between different kinds of norms: epistemic norms ('good knowledge should be explanatory'); methodological norms ('medical research should use the double-blind approach'); technological norms ('a good device should be efficient'); social norms ('when introducing yourself, you should shake hands'); political norms ('all governments should be democratically controlled') and moral norms ('nobody should kill animals for no particular reason'). In practice, however, classifying norms into kinds may be less straightforward. Why is the requirement of double-blind research methodological and not epistemic? Is the norm of democracy purely political, or can it just as well be classified as social or moral? Moreover, in practice, different kinds of norm will often be intertwined. Medical scientists who follow the methodology of double-blind research at the same time act according to the social norms of their profession. Thus, distinguishing

[6] Although the theory of technology presented in this chapter differs from Jürgen Habermas' views in important respects, the primacy of publicly accessible actions and assertions and the inclusion of the notion of social embedding are in line with his approach to the issue of normativity. For instance, Habermas [1971, p. 92] states that norms 'define reciprocal expectations about behavior and ... must be understood and recognized by at least two acting subjects. Social norms are enforced through sanctions. Their meaning is objectified in ordinary language communication.' Some philosophers apply norms to private beliefs and desires, in addition to publicly expressed beliefs and desires. Because of its rationalistic or moralistic presuppositions, this extension of the normative from the public domain to the private realm is bound to be contestable.

[7] Thus, normative statements are statements about what one should (not) do or say. Another option is to call normative statements in the above sense 'prescriptive' and then include both prescriptive and evaluative statements in the class of normative statements. This is the approach chosen by Maarten Franssen in his contribution to this Handbook [Franssen, this volume, Part V]. Although I prefer to keep both a conceptual and an empirical distinction between norms and evaluations, terminologically both options are in principle possible. Since Franssen's approach assigns primacy to evaluative statements about artifacts (the prescriptive statements, it is claimed, follow on and follow from evaluative statements), the two chapters are in this respect complementary.

different kinds of norms may be useful from a theoretical perspective, but it will not always reflect the ways in which norms are being employed in practice.

A second qualification pertains to the scope of norms. Suppose we have the norm that 'people ought to do or say x'. Then the scope of this norm may vary for two reasons. The number of people that are, or can be expected to be, confronted with x may vary, or the number of times x occurs, or can be expected to occur, may vary.[8] Thus, a norm may have a large, moderate or small scope. 'One should respect the dignity of other people' is meant to apply to all human beings in all situations where they meet their fellow humans. In contrast, the scope of 'in situation s a social scientist should use statistical method m' may be quite limited, in particular when situation s does not arise very frequently. Corresponding to the variety of scope, the significance ascribed to a particular norm and the sanctions that may be applied to people who do not live up to it, may also differ substantially.

Third, norms may be explicit or implicit. In the above examples all norms were formulated explicitly. Often, however, we phrase things in a more implicit way. Thus, in certain contexts one might say: 'in The Netherlands we do shake hands when introducing ourselves' or 'your design is not very efficient'. Usually, in such contexts it will be clear enough that such phrases are meant to be normative. However, norms may also be implicit in a deeper sense. Important illustrations are the norms that are implicit in a prevailing vocabulary or in a standard practice. Thus, political debates may be framed in such a way that 'representative democracy' is the only legitimate notion of democracy. Or medical scientists may implicitly endorse the double-blind method in their practice as the one and only correct method for testing hypotheses. In both cases, a normative claim is operative, which also has the effect of excluding alternative claims or actions. An important critical task of philosophy has always been to unearth such deeper, implicit norms which are hidden in dominant vocabularies and routine practices.[9]

Fourth, it is obvious that norms are not always obeyed. This also happens in the case of norms that are widely accepted within a certain practice or culture. However, although norms may be contested, changed or abolished, they also possess a regulative character and are not immediately rejected in the face of norm-breaking behavior. What is more, the possibility (and probably even the actuality) of going against a norm seems to be one of its essential features. Furthermore, norms that are not followed do have empirical consequences. After all, the burglar prefers to work at night and in any case tries to hide or avoid all traces that might lead to his or her exposure. Hence, it would be wrong to conclude that norms that are not being followed do not exist or are inconsequential in practice, because they are not being followed.

Finally, even if norms are generally agreed upon, they do not determine what real people will say or do in real situations. This is true for (at least) two reasons.

[8]Described in this (empirical) way, the scope of a norm should not be confused with its validity.

[9]In this respect the term 'prescription' may be less appropriate, since it seems to be biased toward explicit normative practices.

The first is that a norm itself does not tell us if and when it applies. Consider the norm that when introducing oneself, one should shake hands. Whether or not this norm applies depends strongly on the context: on the size of the group, on the nature of the social interaction, on the country one happens to live in, and so on. A similar story holds for 'thou shalt not kill'. In cases of war and self-defense, can we speak of killing in the sense of the norm? The general argument is that establishing whether or not a norm applies requires a contextual judgment that takes into account all relevant aspects of the situation (see also Pritchard's chapter in this volume, Part V). A further reason why norms do not determine behavior is this: in practice, it is often the case that different norms are operative, which recommend actions or assertions that cannot be simultaneously done or made. Not lying would require always speaking the truth, but not offending people unnecessarily implies that speaking the truth is not always appropriate. Again, which norm will be followed in such cases is highly context dependent.

A general conclusion then, in particular from the last two points, is that norms do not determine each and every detail of what people in fact say and do. Nevertheless, accepted norms are clearly operative in the sense of guiding a practice or culture in a specific way, to a smaller or greater extent. Without these norms, the practice or culture would be different from what it in fact is.

4 WHY TECHNOLOGIES ARE INHERENTLY NORMATIVE

Having explained the basic features of technology and normativity I will now address their relationship. In view of their broad range and huge impact, technologies can be expected to be related to normative issues in myriad ways.[10] It is not the aim of this chapter to cover all these different normative issues. Instead, the focus is on the inherent normativity of technologies and the purpose of this section is to explain why all technologies are inherently normative. Given the account of technology, norms and normative claims in the previous sections, a technology is inherently normative if its realization implies one or more norms or normative claims about what to say or do. Technologies that are normative, but not inherently so, will be called contingently normative. Although I will occasionally point to the normativity of assertions, in what follows the focus will be on normative claims about what to do.

In abstract terms, the argument for the claim that technologies are inherently normative is relatively straightforward. In Section 2 we have seen that technologies can be characterized as artifactual, functional systems with a certain degree of stability and reproducibility, and we have discussed the issues at stake in the realization of such technologies. In addition, we have established the crucial role of the (material, psychological, social or cultural) environment in realizing technologies in a stable and reproducible manner. An important conclusion of this theoretical

[10]See, for example, the chapters by Franssen, Van de Poel, Mitcham and Briggle, all in this Volume, Part V.

analysis is that the successful design, manufacture, use and maintenance of a technology requires a specific intervention in and control of the material, psychological, social or cultural environment in which the technology is supposed to function.

More particularly, it follows that technologies are inherently normative, because their stable and reproducible realization in some region of space and time requires that the people in that region should behave in such a way as to enable, and not disturb, the intended functioning of the technology. As we have seen in Section 2, the relevant part of the environment comprises the conditions for the successful functioning of a technology. This implies that certain behaviors by all the people who are, or might be, present in that part of the environment are required, while other behaviors are forbidden. The point is that we cannot simply assume that those behaviors will be, and will remain to be, displayed. We have to reckon with the fact that the relevant part of the world, including the behaviors of human beings, is, or may be, changing at any moment. For this reason, a successful functioning of a technology requires a control of those behaviors.

The claim that technologies are inherently normative is in part theoretical, that is, derived from the theoretical characterization of technologies as artifactual, functional systems with a certain degree of stability and reproducibility. In part, the claim is empirical, because the inherent normativity of technologies is necessitated by the actual changeability of the behavior of human beings in the relevant part of the environment of the technological system.

Thus, the conditions for the successful realization of a technology ought to be satisfied. It is important to see that this 'ought' is really a normative ought, for two different reasons. First, as we have seen, norms presuppose values and the aim of following norms is to contribute to the achievement of these values. Hence realizing the conditions for technological success is normative because it contributes to the value of having a well-functioning technology available. Second, it may also be the case that realizing these conditions is seen as normatively undesirable, because it clashes with other, more weighty, social or moral values. I will come back to these issues in Section 4.2.

In addition to this explanation of the argument for the inherent normativity of technologies, it is crucial to see what is *not* implied in this argument. As can be expected in the case of an argument for the inherent normativity of technologies, the argument is of a general nature: it exploits a general characterization of what it means to have a functioning technology, it is based on a general empirical understanding of the complexity and variability of our material and social world, and its conclusion is a general normative requirement on the behavior of groups of people. However, whether or not a particular technology can, or will, be (wholly or partly) successfully realized is a contingent matter. The same applies to the issue of which specific behavior is judged to be normatively required for this technology. A similar point pertains to the question of who exercises the required control: it may be explicitly incorporated in the overall realization of the technology by the designers, or it may be a matter of self-control by its users, or it may exploit the control that has already been realized for some other reason, and so on. To sum up, in any particular case it is a contingent matter whether or not the people involved will follow the required norms, what the specific contents of these norms will be, and how the required behavior will be realized in practice. These practical issues are not fixed by the general argument and they have to be studied empirically by focusing on the relevant technological practices.

In the following parts of this section, I will focus the discussion on four more specific views that are directly relevant to the issue of the inherent normativity of technologies. This focus serves several purposes. First, it fleshes out and develops the rather abstract argumentation presented thus far: what does it mean, in concrete terms, to say that 'the people in the relevant part of the environment of a technological system should behave in such a way as to enable, and not disturb, the intended functioning of the technology'? In addition, it illustrates the different aspects of the role of norms, discussed in Section 3, for the case of technological practice. At the same time, this focus fits the idea of the Handbook by providing an exposition and discussion of four different approaches to the philosophy of technology and their relevance to the issues of technology and normativity. The four approaches, which have mostly been developed independently of each other, are arranged in chronological order. In each case, I will first introduce these approaches in their own terms. Next, I'll briefly discuss some of their merits and problems. And finally I will investigate what they imply for the question of the inherent normativity of technology.

4.1 Contingently and inherently political artifacts

The first view is Langdon Winner's. In a well-known paper, he sets out and defends the claim that technological artifacts have politics.[11] Later on in this section, I will explain the relationship between politics and normativity. But first I should introduce and discuss Winner's claim in detail.

At the start of his paper, Winner explains his basic point as follows.

> At issue is the claim that the machines, structures and systems of modern material culture can be accurately judged not only for their contributions to efficiency and productivity and their positive and negative environmental side effects, but also for the ways in which they can embody specific forms of power and authority. [Winner, 1986, p. 19]

He emphasizes that it is technological artifacts *in themselves*, and not merely their social or economic environments, that can have political properties [Winner, 1986, p. 20]. While everybody could agree on the latter, it is the former which is the critical point. Winner distinguishes two ways in which technological artifacts can be political. Technologies of the first type may be called *contingently political*, in contrast to the *inherently political* technologies. Because the phrasing of the

[11] See [Winner, 1986, Chap. 2]. This chapter, entitled 'Do Artifacts Have Politics?', was originally published in 1980.

claims and the distinction between the two types of political technologies is quite important, I quote the relevant passage in full.

> First are instances in which the invention, design, or arrangement of a specific technical device or system becomes a way of settling an issue in the affairs of a particular community. Seen in the proper light, examples of this kind are fairly straightforward and easily understood. Second are cases of what can be called 'inherently political technologies', man-made systems that appear to require or to be strongly compatible with particular kinds of political relationships. Arguments about cases of this kind are much more troublesome and closer to the heart of the matter. [Winner, 1986, p. 22]

The political nature of technologies of the *first type* is due to their consequences. Once realized, these technologies may have specific and enduring implications for the ways in which different groups of people live their lives. Here Winner introduces a further distinction. In some cases, the technologies may be intentionally designed with the political effects in mind. Winner emphasizes, however, that many of the most important cases of political technologies are rooted in an ongoing social process that is not the result of a conscious policy of individual people.

The most cited case is Winner's example of intentional political implications. He observes that many of the bridges over the New York parkways on Long Island are unusually low. These bridges were designed in the 1930s by Robert Moses, one of New York's most influential town planners and builders from the 1920s to the 1970s. Winner's explanation is that the bridges were intentionally built that low by Moses in order to exclude buses, which are too high to fit underneath the bridges, from these Long Island parkways. The political point is that these low bridges limited access by poor and black people—who did not own cars and usually traveled by public bus transport—to Jones beach, a favorite public park 'meant for' the white, upper and upper-middle classes. Thus, the 'innocent' concrete overpasses embodied a 'social class bias and racial prejudice in physical form' [Winner, 1986, pp. 22-23].

The mechanical tomato harvester exemplifies a case of a technology in which the political effects were not consciously planned by its designers. Nevertheless, this device — or better, an increasingly improved series of versions of it — entailed significant political consequences that seamlessly fit in a larger social pattern. Thus, in rural California, the large-scale introduction of mechanical tomato harvesters led to an increase in production and profits for a strongly decreased number of growers. At the same time, it brought about the bankruptcy of a large number of smaller growers and the loss of many jobs in the tomato industry.

Winner emphasizes that, in the cases discussed so far, the political consequences were contingent, that is to say, they were not dictated by the technological requirements of these (kinds of) artifacts as such. A different designer could have built a higher kind of bridge (a contingency in design); and in a situation without small growers and without a substantial tomato industry (a contingency in production conditions), the political effects of the introduction of mechanical tomato harvesters would have been different.

In the case of the *second type* of political technologies the situation is different. Here, the technological artifacts are claimed to be inherently political. Again, Winner distinguishes two versions of this type.

> One version claims that the adoption of a given technical system actually requires the creation and maintenance of a particular set of social conditions as the operating environment of the system. [...] A second, somewhat weaker, version of the argument holds that a given kind of technology is strongly compatible with, but does not strictly require, social and political relationships of a particular stripe. [Winner, 1986, p. 32]

The "requires" of the first version is a matter of judgments of practical necessity. The effective, efficient and safe operating of large sailing vessels, railways, nuclear power stations and the like, is generally judged to be dependent on a concomitant centralized and authoritarian social organization. Similarly, the 'strong compatibility' between a particular technology and a specific political environment is again a matter of practical judgment in a given social context. Thus, many people see solar energy as being much more easily compatible with democratic and local forms of social organization than other forms of energy production.

4.1.1 Some STS criticisms and their rebuttal

Both in philosophy of technology and in science and technology studies (briefly, STS) Winner's claim that artifacts have politics has often been discussed, sometimes approvingly and sometimes critically. In some cases, the link with Winner's argumentation is rather weak. Thus, Joseph Pitt criticizes Winner's views and claims that "tools and technical systems *are inherently ideologically neutral*" [2000, p. 72], but he does not address Winner's specific arguments for the inherently political nature of technological artifacts. Jane Summerton's article "Do Electrons Have Politics? Constructing User Identities in Swedish Electricity" [Summerton, 2004] does not discuss Winner's account either, in spite of what is being suggested by the title of her paper. In particular, this paper leaves unclear the sense in which the socially constructed user identities (the politics) are *required* by the specific configurations of electrons that run through the Swedish electricity cables and electrical devices (the artifacts). Some other STS authors, however, have addressed Winner's views more head-on, and have drawn a number of quite critical conclusions. In this subsection, I briefly describe and assess two sharp attacks on Winner's claim that artifacts have politics: one by Bernward Joerges and a closely related one by Steve Woolgar and Geoff Cooper. Taken together, these criticisms can be summarized in four claims, some pertaining to the examples discussed by Winner and some pertaining to his general line of argument. The focus of the critical comments is on Winner's account of Moses' bridges.

The *first* and principal point is that the low bridges did not at all prevent black and poor people from visiting the Long Island beaches. As a matter of fact, it is claimed, these beaches were accessible both via alternative car routes and, more importantly, through alternative public transport by bus and by train. Joerges concludes that the bridge story is "counterfactual" [1999a, p. 411] and "a bit of a scam" [1999b, p. 451]; and according to Woolgar and Cooper [1999, pp. 442-443], their 'counterevidence' has shown that "the example is simply wrong".[12] A *second* point of contention concerns the intentions Moses had in building his parkways and bridges. Did he intentionally design these parkways and bridges out of social class bias and racial prejudice? Joerges [1999a, p. 418] asserts that Moses "never pursued explicitly racist schemes" and he suggests alternative interpretations for the case at hand, which he claims to be more plausible.

The last two points are more general. The *third* point questions the notion of "the consequences of a technology". As the title of their paper indicates, Woolgar and Cooper strongly emphasize the ambivalence of technological artifacts. In particular, they claim that technologies do not have "definite consequences' about which a "definitive story" (such as Winner's) could be told. The ’extitfourth and final point is a critique of Winner's general claim that artifacts have politics. Thus, Joerges claims to have shown that "what Winner asserts about technical artifacts is doubtful for *any* technical artifact, not just for Moses' low bridges" [Joerges, 1999b, p. 450]. Similarly, Woolgar and Cooper state that, depending on which story is being told, "technology ... does and does not have politics" [Woolgar and Cooper, 1999, p. 443].

Let me now assess these criticisms on the basis of the account of Winner's views presented in the first part of this section. The core of the first point of criticism is that the low bridges did not prevent poor and black people from accessing the beaches, because of the availability of alternative ways to get there. This fact as such, however, is fully compatible with Winner's statements, as an accurate reading of the relevant passages shows. Thus, Winner claims that the low bridges *limit* access to the beaches or, in general, that technologies *influence* the form of life of the people involved [Winner, 1986, p. 23 and p. 28]. Given these claims, a sensible (primarily empirical) debate could focus on the degree of limitation and the kind of influence that, given the specific setting, comes with the technologies under discussion. Winner's critics, in contrast, base their attack on the misinterpretation that the bridges fully *prevented* access to the beaches, that one *had* to use the low bridges routes.[13] The point is important because — as Winner's careful phrasing shows — the world of technology is not a world of universal regularities.

The second point of criticism questions Winner's account of Moses' intentions.

[12]These authors then go on to discuss the question of how to explain what they call "the uncritical acceptance and potential endurance" of the low bridges story. Since my focus is on the substance of Winner's claims, I will not enter into this debate.

[13]See [Woolgar and Cooper, 1999, pp. 434-435] and [Joerges, 1999a, p. 417]. This kind of reasoning can be found more frequently in STS. From an all-or-nothing perspective, there is no space for nonlocal patterns, which are not universal but still pattern a variety of situations in normatively significant ways (see [Radder, 1996, Chaps. 5 and 8]).

Of course, it is not always easy to establish someone's intentions, certainly not in the case of historical figures. Yet, it is possible to make plausibility arguments. In this respect, my feeling is that the case needs further investigation. On the one hand, there is some evidence for Moses' racist intentions; on the other, Joerges' alternative interpretation of Moses as a promoter of the automobile society or even as an early ecologist [1999a, pp. 416-420] is worth exploring, although it is not (yet) plausible as it stands. But even if Joerges' interpretation should prove to be plausible on closer inspection, it is important to see that the scope of his criticism is rather limited. First, since their interpretations do not seem to be incompatible, Joerges and Winner may both be right. Second, and more importantly, Winner repeatedly emphasizes that, in the case of contingently political artifacts, the most significant and most frequently occurring political consequences are not the result of the intentions of one or a few individual designers.

The third point put forward, in particular by Woolgar and Cooper, is that technologies do not have definite consequences. In so far as this point is meant to follow Winner's usage of 'political consequences', and hence applies to contingently political technologies, it is fully compatible with Winner's view, and even stated explicitly by himself.

> In all the cases cited above [including the low bridges case] the technologies are relatively flexible in design and arrangement and variable in their effects. Although one can imagine a particular result produced in a particular setting, one can also easily imagine how a roughly similar device or system might have been built or situated with very much different political consequences. [Winner, 1986, p. 29]

Furthermore, at no point in Winner's text can one find even a suggestion that he sees his story as 'definitive'. In as far as Woolgar and Cooper's criticism is meant to apply to any technology, it leads us to the final point.

This final point is a general critique of the overall claim that technological artifacts have politics. Here, however, the perplexing fact is that none of the critics has addressed, let alone refuted, Winner's central claim. They have focused on what Winner designates as the less significant version of the less interesting type of his claims. That is to say, they have hardly mentioned the case of non-intended contingently political artifacts and they have completely ignored the strong cases of inherently political artifacts. Hence, their general criticisms are unsubstantiated.

4.1.2 The inherent normativity of political artifacts

The conclusion is that the STS criticisms of Winner's position are superficial and, for the most part, inconsequential. Hence, it makes sense to proceed and examine the connection between Langdon Winner's account of the political nature of artifacts and the issue of the inherent normativity of technologies. In which sense can political artifacts be said to be (inherently) normative? The answer is different for the two types of political technologies. In the case of the first version of inherently political technologies, the connection to normativity is straightforward. Given the choice for a particular technology (for instance, a large-scale railway system), the required social organization as the operating environment of the system (a centralized organizational structure) *should* also be created and maintained. In the case of the second version, the relation is less direct. 'Strong compatibility' between a type of artifact and some kind of socio-political arrangement does not strictly require the realization of this arrangement. In a weaker sense, one may say that such artifacts suggest or reinforce the arrangement.

The case of the contingently political artifacts is different. These artifacts do have particular political effects, but their normative consequences will depend on the specifics of the context. Hence, these technologies are clearly not inherently normative. The low New York bridges are contingently related to the norm that poor and black people should not be allowed on the beaches of Long Island. Similarly, the tomato harvester is contingently related to the norm that the economic value of increased and more efficient production should prevail over the social value of maintaining employment.

4.2 Closed systems and their normative implications

In section 2, I characterized a technology as an artifactual, functional system with a certain degree of stability and reproducibility. A working technology needs to possess some degree of stability and reproducibility. The aim of this section is to analyze this requirement in more detail and to explain its normative implications. As we have seen, keeping a technological system stable and reproducible requires control of both the system and the relevant aspects of its environment. The nature and implications of this control may be analyzed in more detail with the help of the notion of the 'closedness' of the technological system as an important *necessary* condition for achieving stability and reproducibility. Hence, the focus of this section is on the normative implications of technological closedness.[14] This leads to an approach that is akin in spirit but more detailed than (and distinct in content from) Winner's account.

Given the variability of our material and social world, stability and reproducibility do not come automatically, but require us to close the technological system through controlling the relevant interactions between this system and its environment.[15] In my chapter in Part I of this Handbook, I analyzed these interactions in order to illuminate the conceptual-theoretical and empirical relations between (experimental) science and technology. Here I exploit this analysis for the purpose of addressing the issue of the inherent normativity of technology. As we have seen, we may distinguish three basic types of interactions between the technological system and its environment: *required*, *forbidden* and *allowed* interactions. The required

[14]See [Radder, 1988/1984, Chap. 3] and [Radder, 1986]; a slightly revised version of the latter article has been published in [Radder, 1996, Chap. 6].

[15]The notion of *inter*action allows a comprehensive analysis of both the impacts of the environment on the system and the ways in which the system influences the environment. The present chapter, however, focuses primarily on the impacts of the environment on the system.

interactions need to be actively produced and maintained to enable the stability and reproducibility of the technology. Forbidden interactions are those interactions that would disturb the stable and reproducible working of the technology in question, and hence such interactions need to be removed or prevented from taking place. Finally, allowed interactions do, or may, occur but they do not have any (enabling or disturbing) influence on the stable and reproducible functioning of the technology. Thus, realizing and maintaining a working technology requires the power and control to bring about the required interactions and to eliminate or prevent the forbidden interactions.

We may summarize this account by defining a closed technological system as a system for which the required interactions have been realized and maintained, and for which the forbidden interactions have been removed or prevented. Since closedness is necessary for the stable and reproducible functioning of a technology (in a certain region of space and time), *if* we would like to have a working technology, we need to be able to close the technological system in that region.[16] Thus far, this is a theoretical analysis. In line with the general explanation in the introduction to this section, nothing so far is implied about the realizability of particular, closed technological systems, or about the 'we' who would like to see the technology realized and the 'us' who are required to exercise the relevant control. Moreover, what is needed to close a particular system will also depend on how we have specified the required functioning of the technology in the first place. Hence, analogous to the approach in Section 2, the theoretical analysis should be complemented by addressing the question of whether, and if so, how particular, closed technological systems may be realized in actual practice. I discuss this question with the help of two concrete examples.

Consider first the example of a contact lens. Contact lens technology constitutes a system but, as I explained in Section 2, how to delineate this system is a matter of analytic focus. We may focus on relatively small systems (the lens alone, lens and eye, lens and cleansing liquids and user procedures and the like) but we may also include much larger systems (factories for producing cleansing liquids, facilities for opticians for doing check-ups and the like). Concomitant social arrangements include health care provisions, insurance systems and so on.

Let us focus on the eye-contact lens system. To close this system we have to examine the interactions between this system and its environment. An important required interaction is the supply of sufficient moisture to the eye and lens. In part, this is done through our tear ducts, in part by applying artificial liquid. The

[16] In theory, one might think of the possibility of closing a system by transforming all forbidden interactions into allowed ones. In practice this is not possible, however, because of the fundamental complexity and variability of the material and social processes that take place in the environments in which a technology is supposed to function. That is to say, strictly fool-proof technologies do not exist. Of course, this does not exclude the possibility of transforming a particular technological system into a more stable one by changing *some* forbidden interactions into allowed ones. An interesting example is the recent research on 'self-healing materials'. In the case of reinforced concrete, for instance, the intrusion of water may be changed from a forbidden into an allowed interaction by adding certain bacteria to the concrete structures.

latter requires, at the very least, production facilities for these liquids and quite a bit of social regulation around it. In some cases, these days it may even require successfully passing the special detection devices at airports; if your cleansing liquid is confiscated, after some time your lens will not function anymore so long as no new liquid is available. An obvious forbidden interaction is the intrusion of dust and dirt into the lens and eye. This may be avoided by observing proper hygienic procedures, by wearing sun glasses in hot and windy weather, and so on. It implies that for small children, Alzheimer patients and workers in unclean circumstances the technology cannot be expected to work in a stable and reproducible manner. Finally, in the case of the eye-lens system, there is a host of allowed interactions. The sound of talking people and radios playing music induce allowed interactions. People smoking and wet weather are also allowed but only within certain limits.

What this example shows is that the realization and maintenance of the required interactions and the elimination or prevention of the forbidden interactions requires a substantial intervention in, and control of, the environment in which the technology is supposed to function. This intervention and control is at the same time material and social. In human affairs, the material realization of a working technology always involves a concomitant social realization of the relevant conditions needed for having the technology work in a stable and reproducible manner (see also Sørensen's chapter in this Volume, Part I). In the case of contact lenses, users are required to exercise self-discipline by following the relevant hygienic procedures, children are warned not to touch the cleansing liquids, a certificate is awarded to those opticians who have successfully passed the training courses and governmental offices oversee the environmental aspects of the cleansing liquid factories. The typical situation is indeed one in which a variety of actors (instead of one single actor) is involved in creating and maintaining the required intervention and control of the relevant aspects of the environment of the technological system.[17]

As we have seen in Section 2, the functioning of a technology may be a question of degree. A particular technology may function optimally, reasonably well, just OK, poorly or not at all. Of course, in the last case no control needs to be exercised. In the other cases, the higher the standards for the functioning of the technology are set, the stronger the normative constraints must be. Thus, in the case of the contact lens, poor hygiene might still lead to just OK functioning (at least for a limited time), but following appropriate cleansing procedures is really necessary for optimal functioning.

As a second illustration, consider the case of nuclear energy technology. Again, different arrangements may be chosen as our focal system. We may focus on the reactor, on the reactor plus other apparatus and operators present in a power plant, on the mining and transport of nuclear fuel, on the storage of radioactive nuclear waste, and so on. And again there are the concomitant social arrangements, such as the regulations for choosing suitable locations for the plants, the safety measures

[17] This compares with Michel Foucault's account of the decentered exercise of power (see, e.g., [Foucault 1982]).

for workers and people living in the neighborhood of the plants, treaties against the proliferation of nuclear technology, the Greenpeace donation system for critics of nuclear energy technology. Clearly, a comprehensive account of this technology would include a very large number of material and social arrangements.

By way of example, let us focus on the nuclear reactor itself as our technological system. For the purpose of closing this system, we need to control its interactions with its environment. In this case, the required interactions include securing a sufficient supply of nuclear fuel and, rather different but equally important, securing the employment of skilled, disciplined and reliable operators and technicians. As for the forbidden interactions, intrusion into the reactor buildings by terrorist saboteurs needs to be prevented. Finally, although the number of allowed interactions will be much smaller than in the case of the eye-contact lens system,[18] they are not fully absent. Presumably, playing music and the presence of a bit of dust and dirt in the reactor building do no harm, while smoking might be a borderline case in view of the risk of fire.

Closing the overall system of nuclear energy technology demands an effective control of the required and forbidden interactions during the entire period of operation for all the components of this technological system. Again, this control cannot be limited to the material arrangements, but it also pertains to the behavior of all the people who interact, or might interact, with the technological system. In particular in the case of the safe disposal of highly radioactive waste, this is an unresolved and, in view of the extremely long period during which effective control should be exercised, unsolvable problem.

The cases of contact lens and nuclear energy technology also show quite clearly that closedness is not sufficient for the working of a technology. The effective control of the relevant interactions with the environment is not enough to get a well-functioning technological system. In addition, this system needs to possess the appropriate potentialities which enable it to play its intended role when it is embedded in the right environment.

4.2.1 Some points of debate

How plausible is this account of closedness as a necessary condition for the stability and reproducibility of technologies? Brian Wynne claims that the approach is valuable but incomplete, and he suggests adding the following three points.

> (a) Closure of the system as the ideal pursued by ... technologists can never be complete, and is more problematic the more socially and physically extended is a technological system. ... (b) As science becomes increasingly an economic resource in industrial competition, the arbitrary properties of technologies as covert and authoritarian social experiments are amplified. This is because the rush to exploit scientific knowledge as commercial technology allows less time and social access

[18]See also Charles Perrow's [1984] analysis of nuclear energy as a complex and tightly coupled technological system.

> for wider system-problems and interferences to be anticipated. ... (c) Technologies can therefore be regarded as the arbitrary imposition of power, and their discourses, including scientific risk analytic discourses, as the ideological easement of the social experiment of power. [Wynne, 1988, pp. 163-164]

However, apart from some aspects of point (c), most of these 'additions' are already implied in the approach sketched thus far. Point (a) is taken into account by emphasizing the conditional nature of the theoretical analysis: *if* we would like to realize a technology, we should be able to close the technological systems in question. In practice, successfully closing technological systems is possible, but it is by no means guaranteed. Moreover, the larger the spatiotemporal extension of a technological system, the harder it will be to close it. Thus, whether or not closing a particular system may be expected to be feasible and desirable is a crucial empirical and normative issue, which cannot be settled on the basis of a theoretical analysis alone. In fact, making these specific distinctions and connections between theoretical, empirical and normative questions has been a characteristic and persistent feature of this approach to the philosophy of technology. Similarly, point (b) restates conclusions I drew from an analysis of the Dutch debate on the feasibility and desirability of nuclear energy during the 1980s [Radder, 1986, pp. 674-678].

Also, Wynne's last point can be fully endorsed in as far as it refers to the use of risk analysis in closing the system of nuclear energy production. Taken as a general claim we have to be more careful, though. The basic idea of the above analysis is that technologies can do something for us (to wit, function in a stable and reproducible way), if we are prepared to pay a price through complying with the necessary material and social control and discipline. However, the question of whether or not this control and discipline constitute an 'arbitrary imposition of power' cannot be answered on the basis of a theoretical analysis, since this also requires sustained empirical research and normative debate. In fact, one of the points of the above analysis is to stimulate more democratic debate on the pros and cons of specific technologies. It cannot be denied that practical decisions are often strongly influenced by prevailing power relationships. Yet, cases of a free and democratic acceptance of the required control and discipline occur as well. Under the present circumstances, I am forced to accept the price that comes with the realization of nuclear energy, but I am choosing to pay the price of wearing contact lenses.

On this point, there seems to be a significant contrast to Winner's approach. Winner [1986, p. 22] defines politics as 'the arrangements of power and authority in human associations as well as the activities that take place within those arrangements'. Both his linking of power and authority, and his examples of the exercise of power, strongly suggest that he sees politics as intrinsically repressive and coercive, especially regarding underprivileged social groups. In contrast, I prefer to define politics as (aiming at) the governance of society through shaping our material and social world in specific ways, and thus excluding the realization of alternative worlds [Radder, 1996, Chap. 7]. In modern societies this essentially includes the realization of specific technological systems. This governance may be performed through the authoritarian exercise of coercion and repression, but also through democratic deliberation and decision-making. What will happen in concrete circumstances is a practical, normative issue that cannot be decided by an a priori, theoretical definition of the notion of power.

A further question regarding the plausibility of the above analysis pertains to the appropriateness of the notion of closedness. Because closedness does not exclude the presence of required and allowed interactions, it should not be confused with full isolation. Instead, it may be usefully compared to the closedness of a door. The door of a room should not fully isolate it. Its required interactions with the environment may include letting in the appropriate people as well as enough fresh air. Its forbidden interactions may include letting through too much noise or unwanted people like burglars. Finally, its allowed interactions may include soft noises or conduction of small amounts of heat. In spite of this explanation, the term 'closedness' might still be seen to be confusing, in particular because of the important role of the required interactions.[19] For this reason, it may be advisable to drop this term entirely and focus on the idea of (attempts at) controlling the required and forbidden interactions rather than on the term 'closedness' as such. After all, it is the account of the interactions between technological system and environment that forms the core of the above analysis.

4.2.2 The inherent normativity of 'closed' systems

Finally, there is the question of the normativity of technologies, and especially of their being inherently normative. The analysis in this section implies that technologies are normative in the following sense: the requirement of stability and reproducibility demands that the people who are, or might be, involved in the realization of the technology in question *should* co-operate in realizing the required interactions and *should not* obstruct the prevention or elimination of the forbidden interactions. Especially in the case of comprehensive technological systems, this normativity is significant and the question of how the people involved can be made to follow the norms is of crucial importance. Moreover, if my theory of technology and the above analysis is right, technologies are inherently normative. This implication is not merely conceptual, because it is also based on the empirical fact of the variability of the material and social worlds in which the technologies are supposed to function. It is this variability that necessitates the intervention, control and discipline needed to obtain stable and reproducible technologies.

[19]See, e.g., [Ducheyne, 2005, pp. 324-326], who does admit that in practice systems are only relatively closed, but still defines a closed system as 'hermetically isolated and independent from its environment', and accordingly sees such an absolute isolation as the ideal. Similarly, the start of the above quotation suggests that something like this is also presupposed by Wynne.

Thus, in an ontological sense, technologies are inherently normative. Answering the epistemological question of *which specific* norms should be followed in order to realize and maintain a particular technology is a matter of practical inference. Suppose that x is the result of a certain technology, which may be achieved by exercising the control c. On the basis of the premises: 'one wants to accomplish x' and 'unless c is done, x will not be accomplished', one concludes that 'c should be done' (see also Kroes' chapter in this Volume, Part III]). Epistemically, the second premise is the crucial one. Depending on the degree of plausibility of this premise, the normative claim 'that c should be done' may be seen as really necessary, as strongly advisable, as maybe a good thing to do or as not at all obvious. Normatively, the first premise is at least as crucial. An important question is who is the 'one' that wants to accomplish x? Critical approaches to technology (e.g., [Feenberg, 1999]) insist that this question should be answered in a democratic manner. On the basis of the analyses in this section, we may add that the issues of *both the feasibility and the desirability* of realizing working technologies should play an essential role in democratic decision-making concerning the acceptability of these technologies [Radder, 2008].

4.3 The script of technological artifacts

Another approach that is directly relevant to the theme of this chapter focuses on the relation between the design and the use of technological artifacts. This is the so-called script approach, proposed by Madeleine Akrich. A script is a scenario that anticipates a specific kind of users and use of a particular technology. The claim is that designers of a particular artifact possess or develop a specific representation of the intended users and use. The script, then, is the result of 'inscribing' this representation in the physical design of the technology. Akrich develops this idea as follows.

> Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways.[20]

However, she immediately goes on to emphasize that this definition may fail and that the assumption may prove to be wrong. What will actually happen to a technological design is essentially contingent and, instead of a successful technological object, the designers may end up producing a chimera.

> To be sure, it may be that no actors will come forward to play the roles envisaged by the designer. Or users may define quite different roles of their own. ... Thus, if we are interested in technical objects and not in chimerae, we cannot be satisfied methodologically with the

[20] [Akrich, 1992, p. 208]. For some other discussions of the script approach, see [Latour, 1992; Oudshoorn and Pinch, 2003; Van Oost, 2003].

> designer's or user's point of view alone. We have to go back and forth continually between the designer and the user, between the designer's projected user and the real user, between *the world inscribed in the object* and *the world described by its displacement.* [Akrich, 1992, pp. 208-209]

Obviously, failure is more probable when the (physical or socio-cultural) distance between designers and users is large. This is the case, for instance, with processes of technology transfer between designers in developed countries and users in developing countries.

By way of example, Akrich discusses the attempted transfer of a photoelectric lighting kit from France to certain African countries. The kit consisted of a photoelectric panel to convert solar energy into electricity, a battery to store the electric energy, and a lamp to produce the light. In an attempt to make the kit 'foolproof', the designers had tried to exclude any interference (as a potential source of damage) by local users and local conditions. For this purpose, the design included direct current circuitry, connecting wires of fixed length, nonstandard plugs, and waterproof batteries. Hence, the script defined the users as unskilled, and prescribed them not to interfere in any way with the device. In fact, however, this script proved to be non-viable since it prevented a smooth adjustment to the local circumstances: repairs could not be done by local electricians, replacement of broken components was not possible and so on. The result was that local installation and maintenance technicians 'were confronted with considerable difficulties' and that users 'lost control over the installation'.[21]

The script approach has been taken up in other studies of technology and its basic idea has been applied to quite a few other cases. A quick example is the road bump. Its script prescribes that the users of the road, in particular car drivers, have to slow down on pain of inflicting substantial damage to their cars or to themselves. Ellen van Oost's study of the development of electric shavers by the Philips company since the end of the 1930s constitutes a more extended case. In the course of this period, a specific gender differentiation emerged between electric shavers for men and for women. Designers drew on stereotypical representations of the male and the female user, and inscribed these representations in the different designs of electric shavers. In doing so, they both reproduced and reinforced these gender stereotypes. Van Oost [2003, p. 206] summarizes her conclusions as follows:

> Masking the technology was a systematic element of the gender script of the Ladyshave. The methods used included using perfume to mask the smell of oil, linking the shaver to lipstick, transforming the shaver into a beauty set, and eliminating visible screws. The script of the Ladyshaves hides the technology for its users both in a symbolic way (by presenting itself as a beauty set) and in a physical way (by not

[21] [Akrich, 1992, p. 210]. Akrich's text leaves it unclear whether these difficulties were temporary or led to a more permanent failure of the technology.

having screws that would allow the device to be opened). The Ladyshave's design trajectory was based on a representation of female users as technofobic.

The design of men's shavers, in contrast, exhibited these devices as the latest high-tech products and suggested the technological competence of their users. Again, it is emphasized that the impact of these design scripts on the users should not be seen in a deterministic way, but rather as more or less compelling given the nature of the wider socio-cultural context.

4.3.1 The scope and limitations of the script approach[22]

In some respects, the script approach is similar to the views discussed in Sections 4.1 and 4.2. For instance, the case of the transfer of the photoelectric lighting kit could be easily reconstructed to fit Winner's analysis of inherently political artifacts or my analysis of the material/social conditions needed to realize stable and reproducible technologies. In some other respects, however, there are smaller and larger differences between these analyses and the script approach.

First, design and use constitute only a part of the realization of a technology as an artifactual, functional system with a certain degree of stability and reproducibility. Next to design there is production, and next to use there is social regulation, to mention just two further aspects of technologies. And although the notions of users and use may be employed in a relatively broad way, as is done by Akrich in her account of the transfer of the photoelectric lighting kit, quite often they are taken in a much narrower way, as in the case of the users of electric shavers discussed by Van Oost.

Furthermore, it is sometimes suggested and sometimes explicitly stated that the anticipated behavior of the users is required for the working of the artifacts (see, e.g., [Van Oost, 2003, p. 195]). However, it is not always clear what this 'working' involves. The case of the photoelectric lighting kit is relatively straightforward, in that this technology does not work if the lamp cannot be made to shine because of deficiencies in its context of use. In the case of the Ladyshave, however, the relation between the inscribed representation and the working of the shaver is much looser. Presumably, in this case, working primarily amounts to being economically successful in terms of sales.[23]

Finally, in line with the descriptivism of the STS approach, script analyses are limited to descriptions of actual technological practices. There is no (relatively independent) theoretical level at which it is possible to distance oneself from the actual course of technological developments. For this reason, there is no normative level that would enable a normative assessment of technologies. Normative assessments — for instance of the stereotyping of women as technofobic — are lacking

[22]For a more detailed assessment of this approach, see [Oudshoorn and Pinch, 2003, pp. 7-16].

[23]The same ambiguity regarding the notions of 'success' and 'working' can be found in social constructivist claims that the successful working of a technological artifact can be fully explained in social terms.

from the script approach. Furthermore, Akrich [1992, p. 222, my emphasis] holds that 'we are able to say that technical objects changed, stabilized, naturalized, or depoliticized social relations *only with the benefit of hindsight*'. Apparently, the world is assumed to be so radically contingent that no plausible claims at all can be made about the future. The implication is that any deliberate, future-oriented technology policy is pointless. Within the script approach, the forward-looking problem of how to shape future technologies cannot be sensibly posed.[24] In this respect, this approach strongly contrasts with the other accounts discussed in this section. Yes, we have no certainty about what will happen in the future. What this implies, however, is that deliberation concerning more desirable or less desirable futures is essentially fallible (but not pointless).

4.3.2 Scripts and (inherent) normativity

What about the inherent normativity of the inscribed representations of use and users? Do scripts of technological artifacts imply norms? In answering these questions we can make use of the preceding points of comment. As we have seen, some of the examples of the script approach, such as the photoelectric lighting kit, can be shown to exhibit an inherent connection between the particular technologies and specific norms that should be followed to have the technology work in a stable and reproducible way. Similarly, in the case of the technological system consisting of a road, a road bump, a car and a driver, stable and reproducible working requires that the driver respects the norm of driving slowly when approaching the bump. The script approach, however, does not include a general characterization of technologies. As is frequently the case in empirical approaches, it is assumed either that we already know what a technology is, or that a technology is what the actors that are being studied call a technology. For this reason, the general question of whether or not technologies are inherently normative cannot be answered on the basis of the script approach. Moreover, in quite a few cases 'working' is also defined in terms of economic success. In these cases, such as the design and use of the Ladyshave, the possible links between the functioning and the normativity of the artifact are clearly contingent.

4.4 Artifacts, use plans and functions

A second approach that focuses on the relationship between design and use is the use-plan approach advocated by Wybo Houkes and Pieter Vermaas. It is comparable to the script approach in its subject matter, but quite different in its philosophical method and style. The basic idea is that the design of a technological artifact essentially includes, or should include, a use plan. Design processes are seen as involving not only the description of a type of artifact, but also, or even primarily, the construction of an appropriate use plan.

[24]For a more detailed exposition of this argument, see [Radder, 1998a; 1998b].

> Central to our action-theoretical analysis is the notion of a use plan. Defining a plan somewhat loosely as a goal-directed series of considered actions, a use plan of object x is a series of such actions in which manipulations of x are included as contributions to realizing the given goal. [Houkes and Vermaas, 2004, p. 57]

In addition, use plans need to be communicated to prospective users. For this purpose, a variety of means are available: user manuals, explicit instructions or demonstrations, television ads, use cues added to the artifact, and so on. In constructing novel use plans, designers may draw on their own creativity, on the resources of socio-cultural traditions or on available scientific and technological knowledge.

In developing this account, two further distinctions are introduced: between standard and nonstandard use, and between rational and irrational use. Use plans based on socio-cultural traditions and scientific or engineering design practices are claimed to give rise to standard use. Nonstandard use may arise from (innovative or idiosyncratic) individual users. For example, the standard use of a screw driver employs it to fasten screws; using it to open a paint-can may be called innovative nonstandard use, while its employment to kill mosquitoes would be seen as idiosyncratic nonstandard use. Furthermore, rational, or proper, use is distinguished from irrational, or improper, use. Uses that are appropriate, effective and efficient are called 'rational'. Of the mentioned uses of a screw driver, the first two exemplify rational use (which implies that rational and standard use do not coincide), while the third is presumably a case of irrational use. In actual practice, the distinction between standard and nonstandard use is said to be a matter of degree, and the same seems to apply to the contrast between rational and irrational use. Moreover, in the course of time particular artifact uses may be classified differently. Standard or rational uses may become nonstandard or irrational and vice versa. Finally, Houkes and Vermaas emphasize the contrast of their action-theoretic philosophy of artifacts with artifact theories that focus on functions. In their view, it is not the function of an artifact which is the primary notion but its use plan and use.

> In short, our theory of function features use plans, justification, and communication as central concepts. Roughly speaking, an artifact function is any role played by an artifact in a use plan that is justified and communicated to prospective users. Hence, functions are plan-relative: it makes no sense to ascribe functions to an object that is not, metaphorically speaking, embedded in a use plan. [Houkes and Vermaas, 2004, p. 66]

The mentioned justification involves giving good reasons for the belief that the artifact is able to play the relevant role and for the belief that execution of the use plan contributes to realizing its goal. In the case of a professional designer, the justification of the use plan will mostly be based on scientific or technological knowledge; in the case of an innovative user, it will usually be based on his or her experiential knowledge.

4.4.1 Merits and problems of the use-plan approach[25]

The use-plan approach, as briefly summarized above, possesses several merits. The relational conception of technological functions is vastly superior to objectivistic accounts that try to explain functions exclusively on the basis of the features of the technological objects. This conception is compatible with the definition of functionality presented in Section 2. Furthermore, since the notion of a use plan is akin to the idea of a script, it shares the valuable features of the script approach. As we have seen, a script is a specific representation of prospective users that is inscribed in the technical content of an artifact. If we interpret the notion of 'technical content' in a broad way, a script may include not just the material use cues of the artifact itself but also user manuals and explicit instructions about, or demonstrations of, the use of the artifact (compare with [Houkes and Vermaas, 2003, p. 40]).

However, the similarity between the script and the use-plan approach also implies that the latter shares some of the limitations and problems of the former. For a start, the notions of use and users in the use-plan approach seem to be even narrower than those in the script approach. Both the examples and the general explanation strongly suggest that users are identified with individual consumers or end-users of simple and familiar artifacts. From this perspective, a factory worker who uses an artifact made in another factory as part of the production process for another artifact is excluded from consideration. Furthermore, the approach seems to be restricted to isolated artifacts and their immediate users. This point is illustrated by comparing the limited account of a use plan for a washing machine proposed by Houkes and Vermaas [2003, pp. 36-37] with the comprehensive analysis of this technology provided in Section 2 of this chapter. The general point is that the 'relevant aspects of the environment of a technology' include much more than just its immediate users.

Furthermore, the distinction between proper or rational use and improper or irrational use entails a certain a priori bias, since the requirement that a philosophy of technology should 'underwrite' the proper-improper distinction [Houkes and Vermaas, 2004, p. 53] tends to privilege the designers' or engineers' viewpoints. The problem is that terms like 'proper' or 'rational' and 'improper' or 'irrational' possess considerable pejorative connotations. But what is the point of denouncing somebody who kills mosquitoes with a screw driver as behaving improperly or irrationally? Or, to offer a real-life example, why should philosophers a priori condemn as improper or irrational any attempt at 'democratic rationalization',

[25]For further discussion of this approach, see Preston's chapter in this Volume, Part II.

such as the 'hacking' of the French Minitel system in the early 1980s?[26] In this respect, the script approach is more open-minded.

Related to this is the fact that the advocated notion of the rationality of a use plan is limited to its utility for an individual user. The implication is that a plan for designing and using gas chambers for mass killings is fully rational. Houkes and Vermaas [2004, p. 70, note 16] acknowledge such problems, but think they can be solved through supplementing their basic, designer-centered assumptions. It seems more plausible, however, that this 'supplement' will have to subvert their distinction between rational and irrational uses, because of the possibility that a use plan that is rational (respectively, irrational) according to the definitions of Houkes and Vermaas may be irrational (respectively, rational) according to a broader notion of appropriate use.[27]

4.4.2 Use plans and inherent normativity

The final question is again: are technologies, according to this use-plan approach, inherently normative and, if so, in what sense? Although the authors of this approach do not, as far as I know, provide an explicit definition, we may infer that 'a technology' is understood to be 'an artifact with a justified function and use plan'. Significantly, the justification pertains to the *beliefs* that the artifact can function in the relevant way, and that the envisaged use plan will facilitate the realization of this function. If this reading is correct, technologies are inherently normative because they imply that there should be good reasons for the beliefs in question. This is clearly a type of epistemic normativity. Indeed, as the authors emphasize [Houkes and Vermaas, 2004, pp. 66-67], their theory is primarily an (action-theoretic) theory of function *ascriptions.* It does not tell us what it means for an artifact to *have* a function. For this reason, the theory does not answer the question of whether technologies are inherently normative in an ontological sense, or so it would seem.

However, by relating use plans to the account of technology presented in Section 2, we may be able to say something more. After all, in order to have an actually functioning artifact, it is not enough to envisage some arbitrary use plan that will, in principle, facilitate the realization of this function. What is also crucial is that this use plan is feasible, that it can be actually realized in the relevant region of space and time in a stable and reproducible manner. Similarly to the script approach, in the use-plan approach technologies can be said to be inherently normative because they imply the norm that the (anticipated or actual) users should follow the use plans in the prescribed way in order to have the artifacts perform their intended function. But again, given the above-mentioned limitations to use and users, a variety of other inherent norms remain outside the scope of the use-plan approach.

[26] For this example, see [Feenberg, 1995, Chap. 7]; for the general notion of democratic rationalization, see [Feenberg, 1999, Chaps. 4–6].

[27] On these points, see the more inclusive discussion of use plans and responsibility in [Brumsen, 2003]. For a broader account of appropriate technology, see [Radder, 1996, Chap. 7].

4.5 Technological Normativity in Practice

In Section 3 we have seen that, when studying the role of norms in actual practice, a variety of aspects need to be taken into account. In this section, I briefly illustrate these qualifications of normativity in the case of technological practice. I use the examples given in the previous sections, but to avoid repetition, I will not again address the issue of the inherent or contingent normativity of these examples.

Different kinds of norms can be found easily in the mentioned examples. Consider the case of washing machines. Clearly, the design of these technologies needs to conform to technological norms (for instance, efficiency), social norms (such as safety), political norms (say, sustainability) and so on. It is also obvious that these distinctions are not always clear-cut. Is efficiency a technological or an economic requirement? Similarly, does sustainability count as a political or as a moral norm?

The scope of norms that are implied in, or contingently related to, technological practice may vary considerably. Assuming that the use-plan approach implies that people should not behave irrationally, one should not use a screw driver for killing mosquitoes. This is obviously a norm with a relatively small scope: although it applies to all human beings, the number of occasions for a potential application of this norm is limited. In contrast, the norm that women ought to have no interest in technology (exemplified through the design of the Ladyshave) clearly has a much larger scope.

Many technologies (for instance, a washing machine or a contact lens) include a user manual or other kinds of instructions for users. These instructions make explicit the norms concerning how people should behave in order to have the technologies work as intended by their designers, manufacturers or sellers. When norms are physically inscribed in the technological artifacts, they are clearly implicit and, perhaps, intentionally left implicit. Thus, the norm that Jones beach should not be accessible to the poor people of New York City was implicitly inscribed in the physical design of the bridges over the Long Island parkways. As we have seen, the question of whether or not this implicit normative inscription was made intentionally by Moses is answered differently by Winner and his critics.

Of course, also in technological practice, norms can and will be broken. In the case of nuclear energy, especially as regards the aspect of storing highly radio-active nuclear waste, this can be anticipated as being highly probable. In the example of the African uses of the photoelectric lighting kits, it proved to be the case with hindsight that the people involved did not behave as they should according to the script of the technology. In the case of contact lenses, a user might not be able to exercise the required hygiene on a particular day. Thus, depending on the case in hand, the consequences of not conforming to such norms may be disastrous (as in nuclear energy), a substantial problem (as with the lighting kits), or less consequential (for instance, when the occasional lack of hygiene causes a minor eye infection that can be cured by not wearing the contact lenses for one or two days).

For the sake of argument, let us suppose (with the proponents of the use-plan approach) that people should not act in irrational ways. Even so, some people might question the applicability of this norm to the case of killing mosquitoes with a screw driver. After all, they might judge that the norm of rationality does not apply to cases where the use of the artifact does not do any harm (even if this use looks inefficient or ineffective). Finally, the issue of trade-offs between opposing norms can be illustrated by the cases of contact lens and nuclear energy technologies. In the contact lens case, many people allow their aesthetic norms to overrule the norms that come with the required self-discipline and control. In contrast, in the case of nuclear energy, many people prefer to stick to norms of long-term safety over the norms of possible short-term economic gains.

5 CONCLUSION

Technologies are inherently normative. That is to say, the (actual or anticipated) realization of a technology in a certain region of space and time implies one or more norms about what the people who (might) interact with the technological system should, or should not, do. These people should behave in such a way that they enable, and do not disturb, the working of the technology in question. This argument draws both on the theoretical characterization of technologies provided in Section 2 and on the fact that the appropriate realization of the enabling and non-disturbing conditions for having the technology work as intended cannot be taken for granted. To flesh out this argument, Sections 4.1 through 4.4 provide detailed discussions of several important aspects of the inherent normativity of technologies, while Section 4.5 addresses some of the complexities of the issue of technological normativity in actual practice.

It is obvious that technologies can be contingently normative, or normatively relevant, in innumerable ways. This chapter has focused on the more specific question of the inherent normativity of technologies. An interesting further question is whether the argument provided at the beginning of Section 4 captures the only way in which technologies can be inherently normative. Of course, it is always difficult to claim to have a definitive answer to such a question. But what can be done is to exclude some of the other ways in which technologies may be alleged to be inherently normative. In concluding the chapter, I will briefly look at two other possible arguments for inherent normativity.

First, in addition to, and largely independently of, having functions, technologies may also carry symbolic meanings. Specific types of cars may count as social status symbols and certain designs may be seen as especially fashionable or aesthetically pleasing. Such symbolic meanings will entail certain normative claims, such as the social norm that 'as a top soccer player, I ought to drive a Porsche'. Clearly, symbolic meanings and associated norms play important roles in the case of many technological artifacts. It should be equally clear, though, that there are many technological products which do not possess a symbolic meaning. Thus, even if a particular type of car may carry symbolic meaning, this will most probably not apply to the types of bolts employed in its construction. Yet, these bolts are also artifactual, functional systems with a certain degree of stability and reproducibility, and hence are also technologies. More generally, quite a few, or probably most, technologies are simply taken for granted and used without any notice.[28] Hence, the norms derived from the symbolic meanings of technologies are context dependent and contingent: they are not inherent in the technologies themselves.[29]

A second claim about technology and normativity says that 'artifacts ought to perform their function'. This claim is explicitly meant to capture a type of inherent normativity of technological artifacts. However, as Maarten Franssen (in his chapter this Volume, Part V) shows, the ground of this alleged artifactual normativity cannot be found in the artifacts themselves. (Indeed, which sanction would be applied to a certain artifact if it would violate this norm?). Instead, these norms derive from a justified belief in the well-functioning of those artifacts. To make this point more concrete, consider this example. If I buy a dirt-cheap artifact at the flea market or if I get an artifact made by a friend (whom I know is not particularly handy), these artifacts may work but there is no expectation that these artifacts 'ought to work'. In these cases the saying applies that 'one should not look a gift horse in the mouth'. This shows that, in as far as normative expectations are present, they are based on some kind of (formal or informal) social contract or agreement, usually between the manufacturer or seller and the buyer of the artifact. Where such a contract or such an agreement is absent, there is no justified expectation and hence no 'artifactual normativity'.

Thus, neither symbolic meanings nor justified expectations entail that technologies are inherently normative. My discussion should not be taken to imply, however, that contingent norms are by definition less significant than inherent norms. Given a particular technology, its inherent norms may well be judged less important that some of the related contingent norms. More generally, whether inherent or contingent norms are seen to be more (or less) significant will be strongly dependent on the specific context of the technological systems and their material and social environment.

[28]In this respect, compare with Albert Borgmann's notion of the 'device character' of modern technology [Borgmann, 1984].

[29]In addition, overemphasizing symbolic meanings is questionable for two further reasons. First, it implies a one-sided focus on separate artifacts ('the car as a status symbol') and hence may lead to a neglect of the broader systems in which these artifacts are incorporated; second, it contributes to the persistence of the current myth that we live in a 'postindustrial society' in which material production has become unimportant. See also [Henwood *et al.*, 2001] and [Wajcman, 2004, pp. 121-122], who rightly criticize the claim that what counts in our 'digital world' is not material production but only information and communication.

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