Chapter 23

STS and Ethics: Implications for Engineering Ethics[1]

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With some exceptions, STS scholars seem largely to avoid taking explicit normative stances. It is not uncommon to hear STS scholars trained in the social sciences claim that their job is to illuminate the social processes by which arguments achieve legitimacy rather than to use their understanding of those processes to establish the legitimacy of their own arguments or positions. This reluctance to take an explicit normative stance has been noted and critiqued by several STS scholars. Most prominently, Bijker (1993) argued that STS began on the path of critical studies, took a break from being proscriptive in order to build a firm base of knowledge, and now needs to get back to the original path. “Seen in this perspective, the science and technology studies of the 1980s are an academic detour to collect ammunition for the struggles with political, scientific, and technological authorities” (Bijker, 1993: 116). In the same year, Winner published his “Upon Opening the Black Box and Finding It Empty” in which he critiques STS theory on several grounds including “its lack of and, indeed, disdain for anything resembling an evaluative stance or any particular moral or political principles that might help people judge the possibilities that technologies present” (Winner, 1993: 371). Despite these promptings, STS scholarship of the last decade only rarely seems to involve explicit normative analysis.

This avoidance of normative analysis has manifested itself in many ways. First, it has had the obvious consequence that many STS scholars have shied away from making recommendations for change that might improve the institutions of science and engineering. Second, it has created an atmosphere in which it can be tempting to hide the normativity that is often implicit in STS analysis. And third, it has caused many scholars to be quite leery of exploring or even being associated with the field of ethics.

While the first two consequences certainly warrant further discussion, it is the final consequence that is the spark for this chapter. Our goal is to lower some of the barriers between the fields (and scholars) of ethics and STS. Despite the incongruence that is commonly assumed, the goals of STS and ethics are compatible in a number of ways. Even if STS scholars do not wish to take explicitly normative stances, they can still make important contributions to ethical inquiry. Scholarship in the field of ethics is not exclusively directed at generating and defending prescriptive conclusions; rather, a major thrust of the field is to engage in normative dialogue and to critically and reflexively explore and evaluate alternative actions and avenues for change. Using moral concepts and theories, ethics scholarship provides perspectives on the world that are useful in envisioning potential actions, appraising the possible consequences of these actions, and evaluating alternative social arrangements. In a similar manner, STS concepts and theories provide illuminating analyses of the social processes that constitute science and technology and the social institutions and arrangements of which science and technology are a part. Many of these analyses have ethical implications that are not commonly discerned; some also point to possibilities for new institutional arrangements, decision-making processes, and forms of intervention. In this way, STS concepts and theories have the potential to contribute to ethical perspectives and point the way to positive change.

Of course, the proof is in the pudding. The aim of this chapter is to illustrate how STS concepts and theories can be used to enrich normative analysis. To do this, we will focus on the fairly young field of engineering ethics. Scholarship in the field of engineering ethics critically examines the behavior of engineers and engineering institutions; identifies activities, practices, and policies that are morally problematic (or exemplary); and alerts engineers to a wide range of situations in which they might be caught up. Some engineering ethicists go so far as to make recommendations as to what engineers should do individually or collectively when faced with moral dilemmas.

STS has developed in parallel with engineering ethics over the past few decades. While there are few formal ties between the two fields, a number of scholars contribute to both. These scholars have begun the process of fleshing out the ways in which STS insights about the nature of technology, technological development, and technical expertise can inform engineering ethics. STS concepts, theories, and insights in these areas shed new light, we will argue, on engineering practice and open up new avenues for ethical analysis of engineering. In this chapter, we identify and develop further avenues in which STS can inform scholarship in engineering ethics and transform normative analysis of engineering.[2]

THE DEVELOPMENT OF ENGINEERING ETHICS

While we cannot provide a complete history of the field of engineering ethics, a quick overview of some of the important themes and trends provides a starting point for our discussion. Engineering professional societies first proposed codes of ethics in the nineteenth century, but it seems fair to say that the field of engineering ethics in the United States largely developed during the second half of the twentieth century in response to increasing concern about the dangers of technology.[3] A sequence of events starting with use of the atomic bomb in World War II, continuing with the Three Mile Island disaster, the Ford Pinto case, and the explosion at Bhopal, generated a significant concern in the media and the public about the effects of technology on human well-being. After decades of seemingly unmitigated praise, many Americans began to wonder if technology wasn't "biting back" and making us pay (in negative consequences) for the improvements it had provided.

Corporations and governments received a fair amount of blame for these events. For instance, the U.S. government was denounced for its promotion of DDT, and Ford Motor Company and Union Carbide were targets of substantial criticism as well as lawsuits for the fatalities linked to defects in their products and facilities. But a number of social critics, engineering professional associations, and the popular media also began to question the role of engineers in these catastrophes. They scrutinized the behavior of engineers and suggested that there were a number of problems, both in the way engineers behave and in their relationships to employers and clients. In this context, it seemed clear that more careful attention needed to be given to the ethical and professional responsibilities of engineers.

In response to this need, by the early 1980s, an academic field that has come to be known as "engineering ethics" had begun to form. It was built by scholars and practitioners from many different fields including philosophy, history, law, and engineering. Despite their varied backgrounds, however, most believed that concepts and theories from philosophical ethics could be useful in understanding the circumstances of engineers and assist them in making decisions in the face of difficult situations. This approach was inspired by the newly developing fields of medical ethics and bioethics.[4] Scholars building the field of engineering ethics contended that ethical theory and training in ethics would allow engineers to see the ethical aspects of their circumstances and help them identify the right choice and course of action with rigor and justification rather than with "gut" feeling or intuition. Like the other emerging fields of applied ethics, they saw a dose of ethical theory as a promising antidote for the temptations and pressures of the workplace. Thus, a significant part of the field of engineering ethics was dedicated to applying philosophical concepts and theories such as Kant's categorical imperative, utilitarianism, and ideas of rights and duties to issues faced by engineers.[5]

A major concern of the field was to identify the ethical issues, problems, and dilemmas that engineers commonly face in their careers. In large part because the traditional subjects of moral theory and moral analysis are institutional arrangements and social relationships, scholars looked to the organizational context of engineering and the social relationships that constitute engineering practice. Through this lens, the importance of the business context in which engineering is practiced was most salient. Scholars in the field typically portrayed the engineer as an ethical actor who had to make complicated decisions within the institutional arrangements of a corporation. The business environment was most commonly illustrated with case studies that focused on the description and analysis of disasters such as the Ford Pinto fuel tank explosions, the crashes (and near crashes) of DC-10 passenger jets, and the Bhopal chemical leak.[6] These case studies emphasized that individual engineers had to mediate their technical knowledge with institutional pressures, the demands of their employers, their professional codes of ethics, and the expectation that they protect the public. If an engineer mismanaged these demands, the results could be disastrous.

The idea that business is the context of engineering and that business generates or is wrapped up in most engineering ethics problems permeates much of the work of the time. Indeed, much of the literature of the 1980s and early 1990s can be seen as digesting the implications of engineering being practiced in the context of business interests. This emphasis can be seen in Kline's summary of the major issues that form the core of engineering ethics texts in the United States, which largely focuses on business-related interests including conflicts of interest, whistle-blowing, trade secrets, and accepting gifts (Kline, 2001–2: 16). Numerous case studies were developed that asked engineers to consider how they would act when confronted by a dilemma wherein a business interest came into conflict with the public good or some sort of professional norm.[7] To be sure, the field of engineering ethics was not and never has been monolithic but has been largely concerned with the social circumstances of engineers and the business decisions being made in the production of technologies. Scholars in the field have appropriately focused on disasters, unsafe products, and dangers to human health and well-being.

The field of engineering ethics has succeeded in illuminating an array of situations in which engineers often find themselves and provided concepts and frameworks with which to think through these situations. The literature in the field now includes two classic textbooks devoted to the topic that are updated every few years (Martin & Schinzinger, 2004; Harris et al., 2005), a handful of additional textbooks (Pinkus et al., 1998; Mitcham & Duval, 2000; Herkert, 2000; Schinzinger & Martin, 2000), and a number of somewhat more specialized single author books including Unger (1994), Whitbeck (1998), Davis (1998), and Martin (2000). The American Society for Engineering Education (ASEE) and the Association for Practical and Professional Ethics (APPE) regularly host sessions on topics of importance in the field at their annual meetings, and a special workshop on "Emerging Technologies and Ethical Issues in Engineering" was recently sponsored by the National Academy of Engineering (NAE, 2004). For the last decade, research in the area has been published in a journal devoted specifically to the field, *Science & Engineering Ethics*.

An important factor promoting and supporting the field was a change in the accreditation requirements for undergraduate engineering programs. In 2000, the U.S. Accreditation Board for Engineering and Technology (ABET) specified that to be accredited, institutions must demonstrate eleven outcomes, one of which states that their students must attain "an understanding of professional and ethical responsibility" (ABET, 2004). This has sparked the development of new programs and courses and, in turn, the development of new materials.

As the field has matured, the scope and topics that engineering ethics scholars and teachers address has also begun to expand. The relationship between engineering professionalism and business practices is still deemed to be of vital importance. But the field is beginning to think about the ethical implications of engineering through new lenses and in new places. Topics such as the public understanding of engineering and the value-laden character of design are increasingly being incorporated into the field.

As a number of scholars have already found (see Goujon & Dubreuil, 2001; van de Poel & Verbeek, 2006a), the observations, case studies, and theories developed in STS can play an important role in expanding the scope and insights of engineering ethics. STS opens up new ways to understand the processes of engineering and the effects its products have on the world. This chapter is written with an eye to promoting and escalating the turn to STS, as well as to encouraging STS scholars to take up the task of addressing ethical issues in engineering. A more robust infusion of STS concepts and theory could inform, enlighten, and transform the field of engineering ethics in significant ways.

To illustrate the links between STS and engineering ethics and the potential for cross-fertilization, we are going to focus on two core STS ideas. Engineering ethics scholars have begun to use these ideas in a variety of ways, and our aim is to demonstrate how they provide a basis for an STS-informed analysis of the responsibilities of engineers. The first of these ideas is the STS discussion around the relationship between technology and society—a discussion that examines the ideas of technological determinism and the social shaping of technology. The second idea is that of "sociotechnical systems"—that since social and technical aspects of the world are intimately interwoven and change in concert, sociotechnical systems should be the unit of analysis in technology and engineering studies. These two ideas provide a picture of engineering practice in which engineers are not isolated and not the only actors in technological development. This picture, in turn, provides the foundation for an account of the responsibilities of engineers.

THE RELATIONSHIP BETWEEN TECHNOLOGY AND SOCIETY

Much of STS scholarship is concerned with understanding the technology-society relationship and accounting for the forms, meanings, success, and effects of technologies. At the core of this concern is a debate about technological determinism. While multiple definitions and forms of technological determinism are described and then contested by STS scholars, technological determinism seems to involve two key tenets.[8] The first is the claim that technology develops independently from society. According to this claim, technological development either follows scientific discoveries—as inventors and engineers "apply" science in some straightforward, step-by-step manner—or it follows a logic of its own, with new invention deriving directly from previous inventions. Either way, technological development is understood to be an independent activity, separate from social forces. STS scholars have countered this idea with numerous theories and case studies, arguing and demonstrating that technological development is not isolated and that its character and direction are shaped by a variety of social factors and forces (Bijker et al., 1987).

A second major tenet of technological determinism is that technology (when taken up and used) "determines" the character of a society. The STS response to this tenet is complicated; while most scholars in the field agree that "determines" is too strong a term to describe how technology affects society, some concede that technology is, nevertheless, an important, and even powerful, force in shaping society, whereas others deny even this. In either case, there seems to be agreement that the important flaw of technological determinism is its failure to recognize that society shapes technology. Except for those few who believe solely in social determinism, there seems to be consensus around the claim that there is valence (influence, shaping) in both directions. Indeed, the claim that technology and society co-produce each other—that technology shapes and is shaped by society—seems to be a canon of STS theory (Jasanoff, 2004a). As Jasanoff puts it, technology "both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions—in short, in all the building blocks of what we term the *social*" (Jasanoff, 2004b: 3).

What are the implications of co-production for engineering ethics? Perhaps the best place to begin is with the rejection of the notion that technology develops in isolation and according to its own logic for this suggests that *the work of engineers* and especially the *decisions that engineers make* do not have an independent logic of their own and are not dictated by science or nature. This insight is of key importance for engineering ethics. A view of engineering as an isolated activity in which engineers are figuring out what nature will allow, tends to push much of the work of engineers out of the purview of engineering ethics. If what engineers do is determined by nature, there is no room for ethics, value judgments, or moral responsibility; engineers do only what is possible, i.e., what nature allows.

An STS-informed account of engineering practice, however, opens up this black box of engineering practice and contends that engineers have a good deal of latitude (power, influence, discretion) in what they create. They manipulate nature, but they can and do manipulate it in this or that way because they are pursuing and responding to various pressures, interests, and values. STS studies demonstrate that there is rarely (if ever) an objectively best design solution to a given problem. Rather, engineers choose from a range of possible solutions based on the fit of each solution with a broad set of criteria and values.[9] Engineering practice—from problem definition and the weighing of alternatives through to final design specifications—requires engineers to balance and trade-off technical feasibility, legal constraints, values such as privacy and accessibility, consumer appeal, fit with other technologies, and much more. This understanding of engineering practice suggests that nearly every decision an engineer makes is not simply a detached technical decision but has ethical and value content and implications. Acknowledging that engineers make value judgments when they make technical decisions suggests that the responsibilities of engineers are broad in scope. At a minimum, it means that engineers cannot deflect responsibility for what they do by hiding behind the shield of "the dictates of nature," at least, not to the extent that might be allowed under a determinist view.

Although STS accounts of the technology-society relationship show that engineers are doing much more than designing devices and although this points to engineers having responsibility for a broader domain, in other ways STS accounts seem to shift responsibility away from engineers. STS descriptions of technological development reveal the wide range of other individuals and groups who influence technological development before, alongside, and after engineers complete their work. This includes those with whom engineers interact at work—representatives of business such as managers, CEOs, and marketing departments—as well as lawmakers, regulators, consumer groups, judges, and others. These actors may have a direct impact on technology by banning or rejecting certain devices, setting standards for the design of particular technologies, funding specific areas of research, granting patents, and so on. In a less direct, but still powerful way, these actors may shape the perception and meaning of a technology through marketing, media, or demonstrations. For instance, STS accounts have been particularly helpful in pointing to the role of users in technological development. Scholars have shown how users can take up an artifact and find meanings and uses that never occurred to the engineers who designed it (Pinch & Bijker, 1987; Oudshoorn & Pinch, 2003) or effectively re-design technology through work-arounds (Pollock, 2005). From the perspective of engineering ethics, the role and influence of these other actors in technological development mean that engineers cannot be considered wholly responsible for technology and its effects. At least some responsibility falls to these other actors.

Engineers are important (perhaps even dominant) players in technological development, but the scope of their responsibility is limited. Their responsibilities are broader than what is suggested by the picture of isolated engineers following nature and they are broader than what is suggested by the view of engineers as designers of neutral devices that others can choose (or not) to use. Nevertheless, the other actors involved in technological development also have responsibilities with regard to the same technology.

Although these two insights about the responsibilities of engineers may appear contradictory in that one suggests that engineers have *more* power and the other *less*, they are not. Indeed, the complexity to which they point indicates the potential of STS to provide a new foundation for engineering ethics. The point is not to determine whether engineers have more or less responsibility but rather what kind of responsibilities are appropriate to their practice. The STS-informed account suggests that to be effective and responsible, engineers must recognize the values that influence their work, the ways their work influences values, and the other actors involved in this process. Recognizing these aspects of their work allows engineers to be better and more responsible engineers. That is, attention to the values at work in their endeavors and to the full array of other actors affecting and being affected by their endeavors can lead engineers to design more effectively and have more control over the effects of the technologies they develop. For example, when engineers recognize the effects of their work on marginalized groups, they can design to promote more equity or to avoid negative effects on particular groups.[10] Of course, recognition of the values they affect doesn't mean that engineers will automatically design for socially beneficial values. On the other hand, recognition of those being affected by their work and the values being shaped is a precursor to better design. Law (1987) uses the term "heterogeneous engineer" to capture the idea that successful engineers must master and manage many factors beyond the technical. Such a view of engineering provides a robust foundation for engineering ethics.

SOCIOTECHNICAL SYSTEMS

To further understand and conceptualize an STS-informed account of the responsibilities of engineers, let us now consider a second STS idea—"sociotechnical systems." Sociotechnical systems is the generic name we use to refer to the complex systems of social and technical components intertwined in mutually influencing relationships that STS scholars often take as their unit of analysis. The concept of sociotechnical system acknowledges that attempts to understand a device or a social practice (institution, relationship, etc.) as an independent entity is misleading. To treat either as a separate unit is to abstract it from reality. Focusing on an artifact alone can cause us to bracket and black-box (and push out of sight) all the social practices and social meanings that pragmatically make the artifact a "thing." Vice versa, focusing on a social practice tends to bracket and black-box aspects of the natural and artifactual world that shape the social arrangement or practice at issue.[11] A focus on sociotechnical systems, however, helps us see the ways in which artifacts, social practices, social relationships, systems of knowledge, institutions, and so on are bound together and interact with each other in complex ways. The concept of sociotechnical systems can be used to understand and analyze what it is that engineers help create and sustain—the products of engineering.

The notion can also be used to conceptualize and understand the work of engineers, that is, engineering can itself be understood to be a sociotechnical system. Engineers work with numerous actors (nonengineers as well as other engineers) in institutional contexts with a variety of formal and informal social practices; they use artifacts and manage relationships with all the other actors involved. The sociotechnical systems of which engineers are a part produce, maintain, and give meaning to technology. Insofar as the notion of sociotechnical systems helps us understand both the products and the work of engineers, it provides a foundation for engineering ethicists.

When it comes to understanding the products of engineering, the idea of sociotechnical systems works in parallel with STS accounts of the technology-society relationship. Rejecting technological determinism allows us to see that engineers are doing more than following the dictates of nature in isolation from interests, influences, and values and shows us that engineers are juggling natural phenomena, pressures from other actors, legal constraints, and interests and values of their own and others. A focus on sociotechnical systems points in much the same direction, showing that engineering practice is not isolated and that engineers are doing more than following the dictates of nature. Engineers are not simply building devices; they are building sociotechnical systems consisting of artifacts together with social practices, social arrangements, and relationships.

While the importance of artifacts should not be disregarded, especially when it comes to engineering, a significant portion of STS scholarship argues that a focus on material objects as the fruits of engineering is misleading. Engineers (and others who shape technology) don't simply produce devices and structures; they create sociotechnical systems. Airplanes, electric power plants, the Internet, refrigerators, and playpens *are* complexes of artifacts together with social arrangements, social practices, social relationships, meanings, and institutions. Because sociotechnical systems include social practices, relationships, and arrangements, and since ethics is generally understood to be about social interactions and arrangements, the connection between ethics and engineering comes clearly into view. In building (or contributing to the building of) sociotechnical systems, engineers are building society. Through the lens of sociotechnical systems, it is much easier to see the numerous ways in which engineering is a moral and political endeavor. Building sociotechnical systems means building arrangements of people, what people do, and the way they interact with one another. Engineers contribute to building the quality and character of lives, the distribution of benefits and burdens, what people can and can't do, the risks of everyday life, and so on.

Even if we think of engineers as attending primarily to the artifactual component of sociotechnical systems, the artifacts that engineers design function in relation to the other artifactual and human parts; that is, the artifacts that engineers design require, depend on, and influence social practices, social relationships, and social arrangements. STS scholars have noted that even inanimate objects can play a key role in shaping a sociotechnical system. They suggest that the design of artifacts function as a form of legislation or script for humans. Latour's (1992) discussion of his experience with seat belts and speed bumps and Akrich's (1992) case studies of artifacts from the developed world being introduced in developing countries point to the ways in which artifacts (designed by engineers) influence human behavior. Thus, even if it seems that engineers have primary responsibility for the artifactual component of sociotechnical systems, their work cannot be separated from the moral and political domain.[12] STS has shown that artifacts shape and even sometimes dictate social behavior. Through the lens of sociotechnical systems ethics and engineering are not distant domains; they are seamlessly intertwined.

Shifting from the products of engineers to the processes of engineering, engineers help to create sociotechnical systems by means of sociotechnical systems. Sociotechnical systems, such as the automobile, missile defense systems, and computers, are the result of processes that involve not only engineers but numerous actors, institutions, and organizations including policy makers, lawyers, marketing professionals, corporations, regulatory bodies, and ultimately users. Within the sociotechnical systems of development, production, and design, engineers must use their technical knowledge, manipulate artifacts, and communicate and coordinate with many other actors and groups including engineers and nonengineers.[13] Using the notion of sociotechnical system, engineers are framed as critical nodes in networks of people and things that influence and are influenced by one another.

When we flesh out the implications of this focus on sociotechnical systems for ethics, the picture of engineering practice that we get is similar to that which came to light in our analysis of the co-production thesis; that is, both analyses point to an expanded and a more narrow view of the responsibilities of engineers. When we understand engineers to be building sociotechnical systems, we see that their responsibilities go far beyond that of designing neutral devices that society can choose or not choose to use, and yet at the same time, we see that engineers' responsibilities must work in conjunction with the responsibilities of other actors who are involved in the development of sociotechnical systems. While seeming to dilute the responsibility of engineers, the fact that many other actors are involved in the process (in addition to engineers) does not justify engineers in saying, for example, "I design the technology, and others have to worry about whether to use it and how it affects society." If engineers are building sociotechnical systems, their designs and decisions must take into account the social practices, social arrangements, and social relationships as well as the artifacts that are part of the sociotechnical system. The fact that many other actors are involved in the process indicates not that engineers have a lessened responsibility but rather that they have a different sort of responsibility—a responsibility to communicate and coordinate with the other actors. To be sure, communicating and working with others has in the past been recognized as an important component of engineering but not as a responsibility.[14] Acknowledging both that engineers are building sociotechnical systems and working in sociotechnical systems goes a long way toward showing that communication and coordination are not just important skills for engineers to have but are crucial responsibilities.

When the work of engineers is understood to be part of a sociotechnical system, the traditional notion of engineering expertise is somewhat disrupted. While engineering expertise traditionally has been focused on the so-called technical aspects of their work (Porter, 1995), a focus on sociotechnical systems suggests that engineering endeavors involve much more than statistics, measurements, and equations. Successful engineering requires an understanding of the extant artifactual and social world in which devices and machines will have to fit. Engineering knowledge must fit together with other forms of knowledge. Engineering expertise is not simply in "the technical" but in integrating the "technical" with many other kinds of knowledge. Engineers are experts because they have the ability to design products that take into account and mesh with a complex world of people, relationships, institutions, and artifacts. When engineers keep in mind the values and politics that are promoted (or weakened) by their creations, the value and power of their expertise and status are more likely to do what they intend them to do.

Thus, in broad terms, viewing the products of engineering as sociotechnical systems shows that engineers have a responsibility to consider the character of the world they are building. Viewing engineering as a sociotechnical system points to engineers having responsibilities appropriate with regard to interacting in the system. Engineers should be understood to be nodes in a complex network in which it is crucial for each part to interact and communicate effectively with the other parts.

This brief discussion is only a beginning. We do not claim to have drawn out all the implications of using the notion of sociotechnical systems to understand the products and processes of engineering. Rather, we have tried to demonstrate the potential usefulness of the concept. Much more work needs to be done to realize the full potential of reconceptualizing the products and processes of engineering as sociotechnical systems.

CONCLUSION

The complexity of engineering practice has long been recognized by scholars in the field of engineering ethics. Indeed, the central issue of engineering ethics might, arguably, be said to be figuring out how engineers can and should manage this complexity responsibly. STS theory is helpful to engineering ethicists precisely because it provides ways to understand, conceptualize, and theorize this complexity. Framing the product and processes of engineering as sociotechnical systems makes visible the ways in which they are both combinations of technical and social components. The thrust of our analysis has been to show that as the complexities of engineering practice come into clearer focus by means of STS concepts and theories, so do the responsibilities of engineers. As the complexities of engineering practice are more sharply delineated, ideas for change to improve engineering practice also come into view.

Our chapter takes two STS ideas—that of the co-production of technology and society and that of sociotechnical systems—and shows that they have important implications for understanding the responsibilities of engineers. Although the analysis seems to point to a weaker account of the responsibilities of engineers insofar as it shows that many other actors are involved in the production of sociotechnical systems, it provides a picture of engineering practice in which engineers are seen to be doing more than designing neutral devices. Indeed, engineers are shown to be (with others) building the world in which we all live, a sociotechnical world. The analysis does more than merely deny the isolation of engineers; we use the STS co-production thesis and the notion of sociotechnical systems to develop a picture of the products and processes of engineering. Our analysis suggests the importance of engineers considering the ways in which their designs will influence values, politics, and relationships, while simultaneously recognizing, responding to, and helping shape the wide variety of actors that impact the design, use, and meaning of technology. We do not claim to have done all there is to be done with the connections between STS and ethics. More work is needed to realize the full potential of STS concepts and theories to contribute to the field of engineering ethics and to make the world a better place in which to live.

Endnotes

1. The research for this chapter was supported by the National Science Foundation Award No. 0220748.

2. We are not the first to attempt to do this. We have benefited enormously from the work of Lynch and Kline (Lynch & Kline, 2000; Kline, 2001–2), Brey (1997), Herkert (2004), van de Poel and Verbeek (2006a), and others.
3. For a historical account of the development of codes of conduct in the engineering professional associations, see Layton (1971), Pfatteicher (2003).
4. See Baum (1980).
5. For example, the anthology edited by Baum and Flores (1980) (arguably the first engineering ethics reader) includes chapters that make use of Rawls, Kant, and utilitarianism.
6. For example, the first two issues of the journal *Business & Professional Ethics,* which was created by Robert J. Baum in 1981, opened with articles on the Pinto and DC-10 cases (DeGeorge, 1981; Kipnis, 1981; French, 1982).
7. For example, the 1989 video, *Gilbane Gold*, produced by the National Institute for Engineering Ethics (NIEE, 1989) focused on this theme, posing the question whether the engineer depicted should blow the whistle on his employer. NIEE's more recent video, *Incident at Morales* (NIEE, 2003) also centers on this theme but has the additional element of arising in an international context.
8. For a more thorough account of technological determinism, see Bimber (1994) and more generally Smith and Marx (1994).
9. Whitbeck (1998) makes this point saliently and notes how engineering design problems and ethical problems are alike in this respect.
10. For an analysis of design with marginalized groups in mind, see Nieusma (2004).
11. Latour (1992) cautions sociologists to avoid this mistake.
12. A number of scholars at the Technical University at Delft have been analyzing technologies as a system to demonstrate the role that engineers play in promoting (or denying) certain values (van de Poel, 2001; van Gorp & van de Poel, 2001; Devon & van de Poel, 2004; van der Burg & van Gorp, 2005).
13. Vinck's account (2003) of a young engineer's discoveries during his first real-world job illustrates this nicely. Vinck explains that in order to design what at first appears to be a reasonably simple part from a technical perspective turns out to be enormously complex because it must be coordinated with the work being done by numerous other engineers. To be effective, the young engineer has to figure out how to get information from others, convince them to listen to his concerns, and ultimately redesign his small part several times to ensure that it will fit with other parts of the overall product.
14. See, for example, Herkert (1994), which emphasizes the importance of communicating with the public.

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