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LINKING ENGINEERING AND SOCIETY

Editor's Note

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Daniel Metlay

How Social Science Informs Engineering Practice

If one stepped back and viewed the state of technological development in the United States since the end of World War II (although the demarcation is hardly precise), it would appear dramatically different from that of earlier years. Technological capacity, driven by scientific research and engineering practice, has exploded in ways that could not have been predicted or anticipated in 1945. Consider the technology-driven revolutions in telecommunications, access to information, and agriculture that have significantly altered the lives of the last two generations.

Concurrently, the relationship between technology and society began to change fundamentally. Where once choices among technological alternatives were made by a narrow set of parties, either entrepreneurs or government officials, those decisions increasingly became subject to public scrutiny and influence. Where once the consequences of a technology were seen as largely localized, impacts came to be understood as more wide-ranging—geographically and temporally. Where once a particular technology could be assessed independently, its interaction with others now needed to be considered; for example, choices about new energy production technologies can affect transportation choices, housing patterns, and agricultural productivity.

By the mid-1970s, evidence had accumulated that, notwithstanding the general public's deep appreciation for technological development, strains of skepticism and discomfort were starting to emerge (LaPorte and Metlay, 1975a, 1975b). Controversies over the fluoridation of public water supplies, government support for building supersonic commercial aircraft, and the use of pesticides challenged how decisions were made about technological development and deployment, and prompted Langdon Winner's memorable question (Winner, 1980): Do artifacts have politics? Today there are few who would argue with the question's tacit affirmative answer.

As the relationship between technology and society grew more nuanced and multifaceted, social scientists became more intrigued by it. A relatively rich literature, and even new intellectual disciplines—such as risk analysis and the social study of science and technology—materialized. Drawing on three strands (among many) from that literature, this volume of *The Bridge* focuses on the question, "How can social science inform engineering practice?"

The first thread concerns increased complexity and whether it constrains the management of technological systems, with respect to either shaping relevant and appropriate public policies or governing the systems' operation. Daniel Sarewitz and I argue that certain societal problems, many of which are associated with advanced technologies, are so "messy" that standard and familiar decision strategies cannot adequately address them. Nick Pidgeon describes two perspectives for thinking about how organizations operate complex technical systems such as nuclear power plants and space shuttles. One view maintains that these organizations can be designed to be as reliable as needed, and the other, that "normal accidents" are inevitable.

The second thread looks at how the general public evaluates risky technologies. Roger Kasperson discusses the "social amplification of risk." He explains why events that seem to be of very minor importance to specialists can nonetheless evoke strong public reactions that have substantial consequences. Hank Jenkins-Smith and his colleagues explore public preferences for managing high-activity radioactive waste. This work may be helpful as national policymakers consider new initiatives in the wake of the Obama administration's decision to seek alternatives to the Yucca Mountain repository project.

The third thread uses the case-study methodology to investigate instances where the engineering and social dimensions were tightly coupled. Jameson Wetmore presents three examples when engineers and social scientists collaboratively worked on projects ranging from the regulation of nanosilver in antibacterial clothing to transmitting unspoken social cues to the blind to designing stoves for villagers in Ghana. He argues that without that collaboration the projects would not have succeeded. Ray Wassel summarizes a report by the National Academy of Engineering and the National Research Council that investigated the root causes of the Macondo well blowout. He touches on three issues: the interpretation of data associated with the cementing step; whether early warnings about the reliability of the blowout preventer were discounted; and why regulation by the Minerals Management Service was so lax.

Notwithstanding their varied approaches, all the articles, either explicitly or implicitly, address two key issues that are at the heart of the engineer's vocation: First, how are uncertainties resolved, perceived, communicated, and managed? Second, how are tradeoffs among salient values made? But, besides being of some intellectual interest, how might the two key issues inform engineering practice, which, after all, is the focus of this volume?

Some of the articles offer fairly straightforward prescriptions. In our analysis of messy problems Sarewitz and I argue that the current debate about climate change policies is misdirected and that misdirection is responsible for the public policy stalemate. Pidgeon reminds us that there may be constraints, imposed by the complexity of a technological system, that inherently limit an organization's ability to prevent accidents and upsets. These limits should be kept in mind when new systems are designed and implemented.

In the other articles, the recommendations are more implicit but do seem to follow rather directly from the analyses. Kasperson's explication of the social amplification of risk does more than reaffirm the maxim that "perceptions are reality." He cautions that engineers' calculations of risk are important, but by no means exhaustive, measures of how the general public actually responds to technological innovations. Finally, Wassel's description of what happened at the Macondo well leads one to ask, almost immediately, What if the deepwater oil exploration industry established an organization similar to the one created by the nuclear power industry (INPO) to monitor the performance of individual companies and disseminate best practices?

In sum, by exploring the management of uncertainty and the trading off of values from a multiplicity of perspectives, the articles cumulatively illustrate how social science can indeed inform engineering practice.

References

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