
AC 2011-1604: YOGI MEETS MOSES: ETHICS, PROGRESS AND THE GRAND CHALLENGES FOR ENGINEERING

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Yogi Meets Moses: Ethics, Progress and the Grand Challenges for Engineering

The future ain't what it used to be. -Yogi Berra¹

In the summer of 1964, while on vacation with my father, I attended the 1964 New York World's Fair, the creation of the city's master builder Robert Moses. (During the same trip I also saw my boyhood heroes, The New York Yankees, play at Yankee Stadium under the leadership of their new manager and former star, Yogi Berra.) The fair, whose various themes/mottos were "Peace Through Understanding," "Man's Achievements in an Expanding Universe" and "A Millennium of Progress," was a tribute to the world-changing potential of technology. Looking back, attending the fair was probably a significant factor in my decision to study engineering in college. Moses' vision of a world made better through technological progress, though not an original idea, has nonetheless endured through more than four decades of domestic and global struggles for human rights and environmental protection as well as numerous armed conflicts and alarming terrorist acts. Today Moses' vision is manifest in many forms including the "Grand Challenges for Engineering" (GCE) published by the National Academy of Engineering (NAE).² Over time, however, as my professional focus has changed from engineering to engineering ethics, I have become skeptical of such visions. The "future" has proven to be more complex than even Moses could have imagined; it is disappointing to find the leaders of the engineering profession still clinging to a vision of progress that doesn't account for this complexity and fails to make explicit the social and ethical responsibilities of engineers.

The overview essay for the GCE does not mention ethics (nor do all but one of the essays on the fourteen individual grand challenges). This in itself does not prove that the Grand Challenges are bereft of ethical substance. After all, most teachers of engineering ethics have reflected at one time or another on the barriers that the use of the "E-word" poses for capturing the attention of engineering students and their academic advisers. A close reading of the overview essay ("Introduction to the Grand Challenges for Engineering"), however, reveals an underlying philosophy that Leo Marx has referred to as the "technocratic" view of progress that is either, at best, indifferent to ethical considerations or, at worst, undermines engineering ethics.

In his well known essay "Does Improved Technology Mean Progress?,"³ Marx contrasted the Enlightenment concept of progress that saw improved technology as a means to achieving social progress with the technocratic view that sees improved technology as an end in itself: "Over time [the Enlightenment] conception was transformed, or partly supplanted, by the now familiar view that innovations in science-based technologies are in themselves a sufficient and reliable basis for progress."

The technocratic view is clearly on display in the work of Moses who was responsible for much of New York City's public works and infrastructure.⁴ Though originally a popular figure, as Moses' power grew, his projects continued to displace more and more people and seemed to take on a life of their own. As Marx noted, the Enlightenment view of progress was that technology should be a means to social progress—e.g., the realization of democratic values. To Moses, the epitome of the technocrat, however, technological progress became an end in itself rather than a means to an end. To him, democracy was an impediment to technological progress. He often

derided his critics as misinformed outsiders and frequently bull-dozed structures before those in his path had a chance to seek legal recourse. His technological achievements – Jones Beach, the Triborough and Verrazano-Narrows bridges to name but a few - are legion, but many of his projects had questionable social outcomes. While tenements were cleared as part of Moses' plans to build modern high rise buildings, viable, albeit poor, communities were destroyed in the process. And projects such as the Cross-Bronx Expressway destroyed vibrant, middle class communities.

The GCE introductory essay clearly adapts the technocratic view, sometimes explicitly, at other times more subtly. Early in the introduction, for example, the document sings the praises of technology and strongly implies that social progress has followed suit:

In the modern era, the Industrial Revolution brought engineering's influence to every niche of life, as machines supplemented and replaced human labor for countless tasks, improved systems for sanitation enhanced health, and the steam engine facilitated mining, powered trains and ships, and provided energy for factories.

In the century just ended, engineering recorded its grandest accomplishments. The widespread development and distribution of electricity and clean water, automobiles and airplanes, radio and television, spacecraft and lasers, antibiotics and medical imaging, and computers and the Internet are just some of the highlights from a century in which engineering revolutionized and improved virtually every aspect of human life.

This claim that technological progress naturally leads to social progress is hammered home in the document's concluding sentence which states:

Meeting all those challenges must make the world not only a more technologically advanced and connected place, but also a more sustainable, safe, healthy, and joyous — in other words, better — place.

To be sure, the document does highlight social indicators engineers can address, i.e., sustainability, health, vulnerability, and joy of living, but true to the technocratic view these benefits are seen as accompanying improved technology rather than being the ends of technological progress. Moreover, it is a rather limited range of indicators. What about justice? Peace? Education? Self-governance?

Curiously, the document also discusses a limited range of attributes ascribed to engineers in meeting the GCE:

Applying the rules of reason, the findings of science, the aesthetics of art, and the spark of creative imagination, engineers will continue the tradition of forging a better future.

Here is where the absence of ethics is most obvious in the GCE. Also, there are arguably other missing attributes such as humility, empathy, and interdisciplinary thinking. Also note in this last quote a return to the theme of technological progress automatically leading to a "better future."

Consistent with the technocratic view and with Moses' projects, the GCE introduction reminds us of the imperative that people must adapt to technological change (and not the other way around):

Public understanding of engineering and its underlying science will be important to support the calls for funding, as well as to enhance the prospect for successful adoption of new technologies. The ultimate users of engineering's products are people with individual and personal concerns, and in many cases, resistance to new ways of doing things will have to be overcome. Teachers must revamp their curricula and teaching styles to benefit from electronic methods of personalized learning. Doctors and hospital personnel will have to alter their methods to make use of health informatics systems and implement personalized medicine. New systems for drug regulation and approval will be needed when medicines are designed for small numbers of individuals rather than patient populations as a whole.

Not only must people adapt to technological imperatives but the GCE introduction suggests that, like the thousands evicted by Moses, people's goals and desires are obstacles and barriers to technological progress:

Part of the engineering task will be discovering which approaches work best at ensuring user cooperation with new technologies.

In sum, governmental and institutional, political and economic, and personal and social barriers will repeatedly arise to impede the pursuit of solutions to problems. As they have throughout history, engineers will have to integrate their methods and solutions with the goals and desires of all society's members.

To their credit the GCE authors acknowledge the existence of social/ethical issues in the application of engineering solutions when they note that "many of engineering's gifts to civilization are distributed unevenly." But their characterizations of such issues are oversimplified, false dichotomies of social divides (i.e., "wealth and poverty, health and sickness, food and hunger"). Such complex conditions are not binary on-off states but rather a continuum that exists both within nations and across the globe. Who goes hungry, for example, is as much a function of politics, culture, economics and ethics as it is of agricultural production. Though suggesting that "engineers must frame their work with the ultimate goal of universal accessibility in mind," no attention is given to how engineers might go about contributing to the solution of such complex problems (other than, à la Moses, pushing forward with technological progress).

It is beyond the scope of this essay to examine every one of the fourteen specific challenges identified in the GCE but a few remarks are in order. Here we find a mixed bag with economical solar energy and access to clean water side by side with such large scale technological fixes as nuclear fusion and carbon sequestration. Again we can take something from the book of Moses. The high rise projects constructed by Moses, though intended as technological fixes for poverty, lacked the community values of the neighborhoods they replaced. Thus, drug-abuse and crime

plagued many of them. And today the Cross Bronx Expressway, Moses' technological fix for streets jammed with traffic, is itself the most congested roadway bottleneck in the nation.⁵

As noted above, the GCE introduction points to the importance of "public understanding of engineering." Most such efforts to increase "public understanding," like the technocratic view, get it backwards. Rather than starting with the achievements of engineering, past, present, and future, marvelous though they may be, it would better serve both engineering and the public to clearly specify what the social and ethical commitments of engineering are and should be. From this vantage point the challenges of engineering would be no less difficult to achieve than those called for in the GCE, but far more likely to result in social progress.

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