Fundamental Research in Engineering

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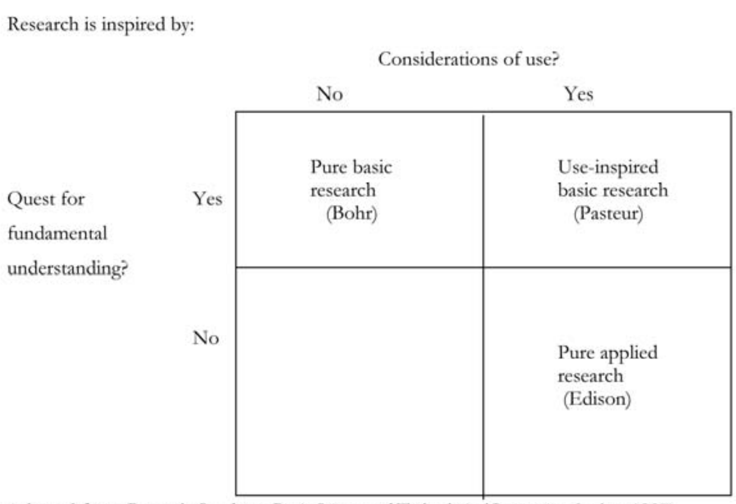
There is an essential role for federal support of fundamental research in engineering fields, which falls under the purview of "science policy" rather than "technology policy" (the latter being concerned with issues such as broadband deployment and the R&D tax credit).

While there is a "development" component to engineering, there is a very substantial "fundamental research" component as well. This research tends to be "use-inspired" fundamental research – "Pasteur's quadrant," the upper right in Stokes's diagram[2]:



(adapted from *Pasteur's Quadrant: Basic Science and Technological Innovation*, Stokes 1997).

In 2003, the National Academy of Engineering developed a book and a companion website describing twenty "Greatest Engineering Achievements of the 20th Century" (see http://www.greatachievements):

[1] For the most current version of this essay, as well as related essays, visit http://www.cra.org/ccc/initiatives
[2] Stokes, Donald. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Brookings Institution Press, 1997.

Electrification
Automobile
Airplane
Water Supply and Distribution
Electronics
Radio and Television
Agricultural Mechanization
Computers
Telephone
Air Conditioning and Refrigeration
Highways
Spacecraft
Internet
Imaging
Household Appliances
Health Technologies
Petroleum and Petrochemical Technologies
Laser and Fiber Optics
Nuclear Technologies
High-performance Materials

Greatest Engineering Achievements of the 20th Century

These achievements changed our lives. The fundamental research underlying most of them should be evident – research that led to the vacuum tube, the transistor, the integrated circuit, 60 years of progress in computer architecture, digital packet-switched communication, the TCP/IP network protocol suite, soft-tissue medical imaging, the laser, laser communication over fiber-optic cables, inertial guidance, mass production of penicillin, the gene sequencer, and so much more.

In 2008, NAE unveiled 14 “Grand Challenges for Engineering” for the 21st century (see http://www.engineeringchallenges.org/):

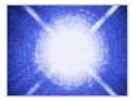
Make solar energy economical
Provide energy from fusion
Develop carbon sequestration methods
Manage the nitrogen cycle
Provide access to clean water
Restore and improve urban infrastructure
Advance health informatics
Engineer better medicines
Reverse-engineer the brain
Prevent nuclear terror
Secure cyberspace
Enhance virtual reality
Advance personalized learning
Engineer the tools of scientific discovery

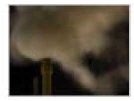
Grand Challenges for Engineering for the 21st Century

Meeting these challenges would have game-changing impact. And, again, the necessary fundamental research underlying most of them should be evident. (It is worth noting that the innovation required for at least half of them has a substantial or even a predominant computer science component – a matter for a separate note.)

GRAND CHALLENGES FOR ENGINEERING


Make solar energy economical


Provide energy from fusion


Develop carbon sequestration methods


Manage the nitrogen cycle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Advance health informatics


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Greatest Engineering Achievements OF THE 20TH CENTURY

◆ About ◆ Timeline ◆ The Book

Welcome!
How many of the 20th century's greatest engineering achievements will you use today? A car? Computer? Telephone? Explore our list of the top 20 achievements and learn how engineering shaped a century and changed the world.

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

Greatest Achievements