



The relationship between engineering work and "for humanity as a whole" varies dramatically as we move across the world...progress varies from place to place

—Downey 2014, *Engineering Countries and the Problem of Globalization*, [Youtube](#)

*What is an engineer?
What is engineering?
What is engineering fo*

Culture

Share set of values, ideas, concepts, knowledge, artifacts, customs, and rules of behavior shaping social group functions



What are dominant and non-dominant (often invisible) 'images' of engineering culture and role of engineer? Who gets to be an engineer?



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Engineering Culture(s)

Engineering culture and practice are not universal.



Perfection is possible
Serving people through government as elites

Nuclear energy becomes symbolic for France. Universal designs, orderly control over "nature", state + engineers = sustainable competitive advantage

Innovation for order-- not innovation for consumption, private gain, or innovation for itself



Engineering evolves from 18th-19th century apprenticeship culture. Respect for minutiae, craftsmanship, rising through ranks

Status comes through collective action (prof. societies) and building private industry

Innovation is unclear and not driven by engineering even when discussed



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Gary Downey's Research Project

*How do I credibly
build a history of
engineering as part of
larger social forces?*

U.S. Engineering Culture Evolved

- Pre Early 1800s looks like British apprenticeship situated around woodcraft (North America forests).
- Early to mid 1800s machining emerges and based production leading to precursors of industrialization
- Late 1880s into 20th century complexity of design grow and emphasize low cost, mass production innovation through “perfection” (French & German) Engineers shift from labor (British) to managerial capital class, and elite status
- 1920s to today Corporate Capitalism takes hold leading up to Multi-national capitalism. Professional management stay in U.S. with labor moving to cheaper areas and emerging markets.

*What is a smaller “scope”?
Who’s grand challenges?*

CHALLENGES

Introduction

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

Introduction to the Grand Challenges in Engineering

Throughout human history, engineering has driven the advance of civilization.

From the metallurgists who ended the Stone Age to the shipbuilders who united the world, we have witnessed many marvels of engineering prowess. As civilization grew, it was rewarded with more sophisticated tools for agriculture, technologies for producing textiles, and innovations in transportation. Inventions such as the mechanical clock and the printing press irrevocably changed the course of human history.

In the modern era, the Industrial Revolution brought engineering's influence to the masses. It replaced human labor for countless tasks, improved systems for sanitation enhanced life expectancy, and ships, and provided energy for factories.

In the century just ended, engineering recorded its grandest accomplishments: clean water, automobiles and airplanes, radio and television, spacecraft, and the Internet are just some of the highlights from a century in which engineering has transformed human life. Find out more about the [GREAT ENGINEERING ACHIEVEMENTS](#).

For all of these advances, though, the century ahead poses challenges as formidable as any in history. As our needs and desires expand, the problem of sustaining civilization's comfort and security looms more immediate. Old and new threats to personal and public health demand attention. Vulnerabilities to pandemic diseases, terrorist violence, and natural disasters demand prevention. And products and processes that enhance the joy of living remain a high priority since the taming of fire and the invention of the wheel.

RAMESH SRINIVASAN

BUSINESS NOV 7, 2019 11:27 AM

Opinion: The Global South Is Redefining Technology

Top-down, unsustainable Silicon Valley needs to learn from Africa, South Asia, and South America.

*What is a
smaller
“scope”?
Build Good
Engineers*

- Engineering Education accreditation forms also rise of corporate capitalism and shifting roles of
- Early engineering training was of mixed quality to concerns for supporting engineers during the Depression accreditation builds out of the engineering societies (learns from medical professionalization elite status)
- By WWII national interest in STEM explodes, accreditation seen as codifying “good” engineers for the success of the nation
- 1940s to 1980s emphasis is on technical skills and quantification of curriculum. Humanities and Social Sciences go from essential to “nice but not necessary”
- 2000 to present is reconsideration of how to build good engineers and engineering culture

ABET Logic

NAE Perspectives

- *More than 80 years ago, ABET was founded that new graduates had the skills needed to enter the profession. And, to this day, we constantly challenge ourselves to learn more about the changing needs of academia, industry and the world as a whole, and our criteria relevant, fresh and compelling.*
- *...we are sobered by two realities: first, that scattered interventions across engineering education over the past decade or so have not resulted in systemic change, only in isolated instances of success in individual programs on individual campuses; and second, that the disconnect between the system of engineering education and the practice of engineering appears to be accelerating. This is due to the explosion of knowledge, the growing complexity and interdependence of societal problems, the worldwide nature of those problems, and the need to operate in a global economy.*

NAE Report

NAE President

- *a vision that an engineering degree has the potential to become the most valuable degree for the twenty-first century;*
- *an undercurrent of awareness that current complexities are so great that tinkering at the edges—reforming one course, one program, or one department at a time, developing isolated instances of success here and there—is no longer a viable response if we are to build the kind of robust professional research and education now needed to strengthen the U.S. engineering community by 2020;*
- ***The intention to “do good” is not always realized in the artifacts, processes, and systems... As we look to the future, we should accept responsibility for incorporating the consideration of possible unintended consequences into their work and seek to minimize the possibility of their occurrence...***
- ***...engineers should seriously consider potential impacts of their invention on individuals, society, and nature. The connection between engineering and society should be tighter than it is. Could new technology cause harm to segments of the population and widen the gap between the haves and have-nots? Is there racial or ethnic bias in the algorithms we are developing for artificial intelligence and automated systems? Could a new product damage the environment or negatively affect the way humans interact?***

ABET
Today as a
proxy for
Engineering
Culture
Change?

1. an ability to identify, formulate, and solve complex problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and supportive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experiments, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Quiz Question 1

	1	2	3	4	5
Very confident	Above average confident	Somewhat confident	Above average confident	Very confident	Very confident
Above average confident	Somewhat confident	Not confident	Somewhat confident	Above average confident	Above average confident
Very confident	Somewhat confident	Somewhat confident	Somewhat confident	Very confident	Very confident
Above average confident	Very confident	Somewhat confident	Somewhat confident	Above average confident	Above average confident
Somewhat confident	Somewhat confident	Above average confident	Above average confident	Somewhat confident	Somewhat confident
Somewhat confident	Somewhat confident	Above average confident	Above average confident	Very confident	Above average confident
Somewhat confident	Somewhat confident	Above average confident	Somewhat confident	Very confident	Somewhat confident
Above average confident	Somewhat confident	Somewhat confident	Above average confident	Very confident	Very confident
Above average confident	Above average confident	Very confident	Above average confident	Above average confident	Above average confident
Above average confident	Somewhat confident	Above average confident	Somewhat confident	Very confident	Somewhat confident
Very confident	Above average confident	Very confident	Above average confident	Very confident	Above average confident
Somewhat confident	Not confident	Somewhat confident	Somewhat confident	Above average confident	Somewhat confident
Above average confident	Above average confident	Above average confident	Somewhat confident	Somewhat confident	Above average confident
Somewhat confident	Somewhat confident	Somewhat confident	Somewhat confident	Above average confident	Somewhat confident

Other forms of Evidence

- <http://www.engineeringchallenges.org/cha>
x



Other forms of Evidence

<http://www.engineeringchallenges.org/challenges.aspx>

I Change the World. I am

I am a technical group leader.

Shouleh works on bringing technology invented for NASA into saving lives. Advice to girls interested in technology: "Follow what you love. Always, always, ask questions and don't let anyone intimidate you."

Dr. Shouleh Nikzad | Pioneer Electrical Engineer

I enjoy the challenge.

Valencia enjoys thinking about what new technologies will transform our world and how she will contribute! Advice to girls interested in technology: "Identify problems that you are passionate about finding solutions to."

Valencia M. Inyaur | Electrical and Computer Science Engineer



I integrate engineering and medicine.

Pamela developed a device for using electrical charge to activate nerves in the hearing system, as part of a cochlear implant. Advice to girls interested in technology: "Be a positive agent for change in the world. Make a difference!"

Pamela Whitt | Electrical Engineer, Biomechanical Engineer

I achieved my goals.

"I was the first woman to graduate from the Columbia Univ. School of Engineering." She decided to study engineering in spite of people telling her that girls can't do it. Advice to girls interested in technology: "Set your goals, then achieve them!"

Glória Bahls | Electrical Engineer

Read more about women in engineering at www.ieee.org/women



IEEE Women in Engineering

IEEE WIE is the largest international organization dedicated to promoting women in engineering and science.

Write to us at women@ieee.org

Other forms of Evidence

Where is the text located?

What is the intended audience?

What are they attempting to share
with the audience?

What are different interpretations
if you are not the intended
audience?



Why not You, girl?

Engineers design everything from airplanes to cars to bridges and machinery.

They use what they learned in many classes, especially tech, engineering and math.

These jobs often pay very well and are considered very high status. They often have terrific benefits and bonuses.

Global

What is a global engineer?

Why do engineering societies, accreditors, and universities care if you understand global cultures and engineering practice?





Global Classroom

*What can we learn from other students
becoming engineers in the context of
Taiwan as boundary space between
Eastern and Western cultures*