



NATIONAL ACADEMY OF ENGINEERING

The Grand Challenges Scholars Program: 21st Century Engineering

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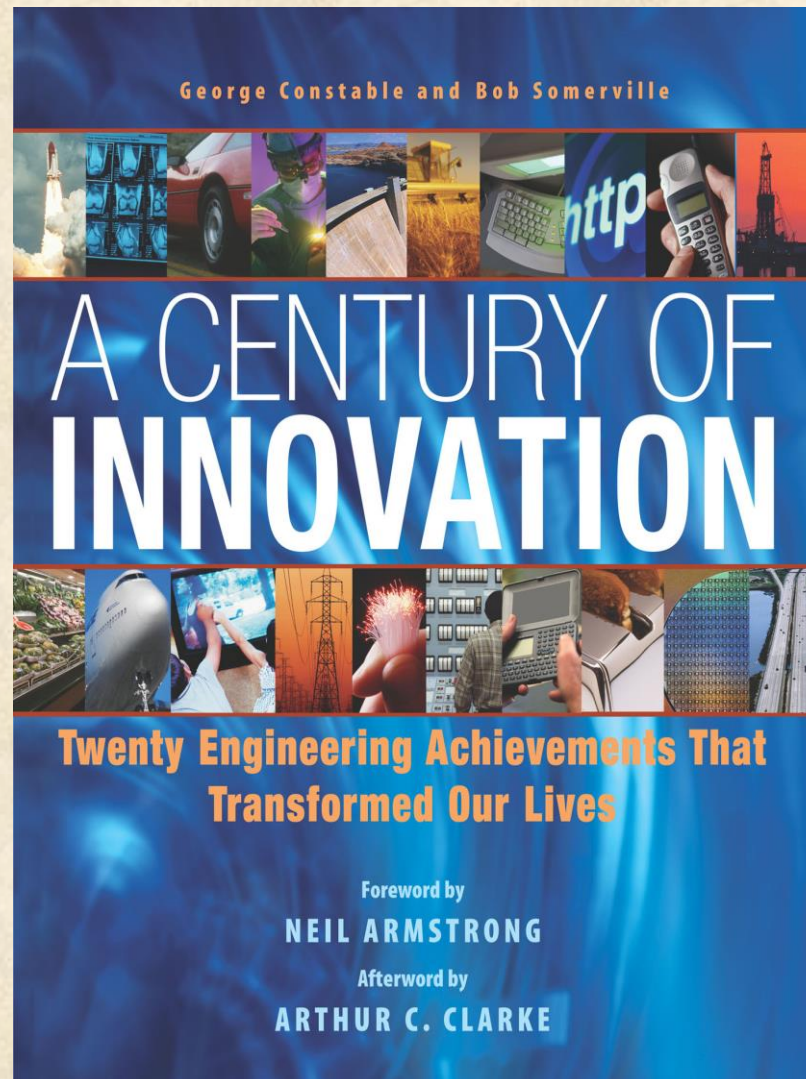
Former President, US National Academy of Engineering

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Alexandria, VA

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Engineering in the 20th Century



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20th Century Greatest Engineering Achievements

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/refrigeration
11. Interstate highways
12. Space flight
13. Internet
14. Imaging
15. Household appliances
16. Health technologies
17. Petrochemical technology
18. Laser and fiber optics
19. Nuclear technologies
20. High-performance materials



21st Century Engineering Achievements

What will **engineering achieve** in the 21st century?

Hmmm . . . not possible to predict, but a different question

What is a vision for **what engineering needs to achieve** in the 21st century?

This vision may have promise but **to do what?**

What is Engineering?

All engineering can be described using 4 words:

creation solutions people society

What is 20th Century Engineering?

Engineering described using 2 words:

creation solutions **people society**

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Grand Challenges : Vision for the Planet

Vision → Goals → Objectives

21st Century Engineering Vision

Vision: Continuation of life on the planet,
making our world more sustainable,
secure, healthy, and joyful

21st Century Engineering Vision

Vision: Continuation of life on the planet, making our world more sustainable, secure, healthy, and joyful

Goals: Grand Challenges for Engineering

Satisfying the goals (GC) will deliver the Vision

Goals: 14 Grand Challenges for Engineering

1. Make solar energy economical
2. Provide energy from fusion
3. Develop carbon sequestration methods
4. Manage the nitrogen cycle
5. Provide access to clean water
6. Restore and improve urban infrastructure
7. Advance health informatics
8. Engineer better medicines
9. Reverse-engineer the brain
10. Prevent nuclear terror
11. Secure cyberspace
12. Enhance virtual reality
13. Advance personalized learning
14. Engineer the tools of scientific discovery

20th Century Greatest Engineering Achievements

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21st Century Engineering Vision

Points to Note:

1. Planetary: Vision & Goals
2. Measures of life on the planet (4)
3. Nobody's in charge
4. No losers
5. About people, not about things

Grand Challenges : Vision for the Planet

Vision: Continuation of life on the planet,
making our world more sustainable,
secure, healthy, and joyful

Goals: 14 Grand Challenges for Engineering

Objectives: Solutions that deliver each Goal
(the hard part)

NAE Convening Role on GCSP

Approaches to **Objectives**:

Initiative Group: creates solutions - direct
(everywhere on the planet)

Talent Group: creates a workforce - indirect
(prepares youth for the GC)

NAE Convening Role on GCSP

Vision: Continuation of life on the planet, making our world more sustainable, secure, healthy, and joyful

Goals: 14 Grand Challenges for Engineering

Objectives: Initiative Group and Talent Group

IG: satisfies the GC over the planet

TG: prepares global workforce for GC

NAE Convening Role on GCSP

Vision: Continuation of life on the planet, making our world more sustainable, secure, healthy, and joyful

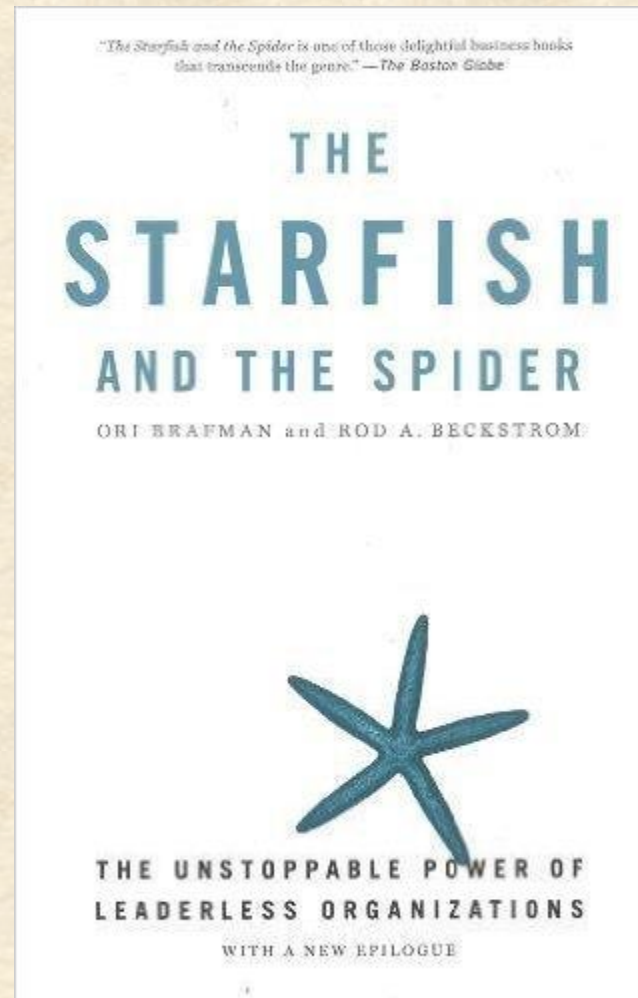
Goals: 14 Grand Challenges for Engineering

Talent Group: Prepares global workforce →
Grand Challenges Scholars Program

Grand Challenges Scholars Program

- **Program** and **experiences** supplement engineering education for global Grand Challenges-like problems → **Outcome based**
- University admits students to GCSP, prepares students, and determines their competency in five outcome areas:
- **5 student “competencies” of GCSP program:**
 - **Research/creative** – mentored solution/project experience on GC-like topic
 - **Multidisciplinarity** – understanding multidisciplinarity gained thru experience
 - **Business/entrepreneurship** – viable business model for implementation
 - **Multicultural** understanding – viable for implementation in intended culture
 - **Social consciousness** – serves people and society, through service learning

Grand Challenges Scholars Program



Grand Challenge Scholars Program – U.S.

As of 4/29/2019

71 University Programs approved / under review

24 Working with a Mentor

58 University Programs in preparation

200 National Goal - number of Programs

GCSP – International Programs

As of 4/29/2019

12 University Programs approved / under review

12 Working with a Mentor

39 University Programs in preparation

200 International Goal - number of Programs

Grand Challenge Scholars Program Countries

As of 4/29/2019

- Abu Dhabi
- Australia
- Brazil
- Canada
- China
- Columbia
- Hong Kong
- India
- Indonesia
- Ireland
- Israel
- Italy
- Kazakhstan
- Lebanon
- Malaysia
- Netherlands
- Puerto Rico
- Romania
- Russian Fed'ration
- Singapore
- South Korea
- Taiwan
- UAE
- United Kingdom
- United States
- Vietnam



**ENGINEERING IN AN
UNPREDICTABLE WORLD**

2019 Global Grand Challenges Summit

Inspired by the NAE Grand Challenges for Engineering (the 4th in a series)

The Summit sub-themes:

- Can we sustain a planet with 10-billion people by 2050?
- Will AI technologies change humanity for the better?

September 12-16, 2019

Student Competition and Collaboration Lab at County Hall in London.

September 16-18, 2019

Main Summit event at the Southbank Centre's Queen Elizabeth Hall; 900 innovators, entrepreneurs, and next generation engineers.



Points to Note

- i. GC is the 1st Vision for the planet in history

- ii. The Grand Challenges answer two important questions that the public does not understand:
 - **What is Engineering?**
 - **How does Engineering serve people and society?**

Points to Note

- iii. Global Vision mandates global solutions
 - Student interest is inspiring:
 - i. Vision and Goals – Grand Challenges
 - ii. Focus on people and society – social + tech issues
 - iii. Importance of culture to viability – solutions
 - iv. Working on complex systems – team work
 - v. Consideration of economic issues – sol'n viability
 - vi. Flexible global focus – only 1 competency is on GC

Points to Note

- iii. Global Vision mandates global solutions (continued)
 - Solutions depend on locale
 - Over **50%** GCSP students are females and minorities
 - Preparing workforce talent for global challenges
 - Not a normal feature of engineering education
 - National Academy of Engineering priority

- iv. **Grand Challenges Scholars Program** is about embracing a vision of engineering + preparing for it



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