National Academy of Engineering Grand Challenges Scholars Program

Ruth A. David

NAE Foreign Secretary

5th Arab-American Frontiers
of Science, Engineering & Medicine Symposium

November 3, 2017

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A bit of history….

- 2007: NAE convened international group of leading technological thinkers & asked them to identify the Grand Challenges for Engineering in the 21st century
- 2008: Report—*14 Grand Challenges for Engineering in the 21st Century*
  - 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
- 2009: NAE endorsed Grand Challenges Scholars Program
- 2017: 51 Universities have joined the GCSP movement, including
  - The Australian National University
  - City University of Hong Kong
  - National University of Singapore
  - Peking University
  - Taylor's University, Malaysia

And many more are in the planning pr

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The Vision….

- **Global Grand Challenges**
  - "Continuation of life on the planet, making our world more sustainable, secure, healthy and joyful."
- **Grand Challenge Scholars**
  - Prepare engineers to be world changers—equip them to tackle some of the most pressing issues facing society in the 21st century

The take-away: A necessary condition for achieving the vision of the Grand Challenges for Engineering is the successful global implementation of the Grand Challenges Scholars Program

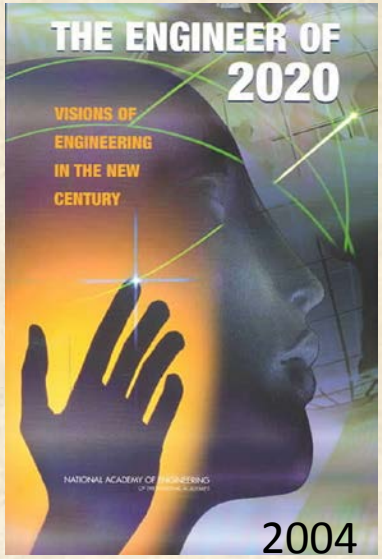
The Motivation…

- **Grand Challenge Scholars (GCS)**
  - Students have the capability to introduce the Grand Challenges movement into their local communities
  - Students in the Grand Challenges Scholars Program are highly committed to the Grand Challenges
  - Students have potential for leadership in the Grand Challenges movement as volunteers and professionals

The vision for Grand Challenges mandates that their solutions serve all communities–no viable alternative to fulfilling that mandate is apparent today

Precursor Work…

- **Attributes of the Engineer of 2020**
  - Strong analytical skills
  - Practical ingenuity
  - Creativity
  - Communication competencies (oral, written, and cultural)
  - Business, management, and leadership skills
  - High ethical standards and professionalism
  - Agility, resilience, flexibility



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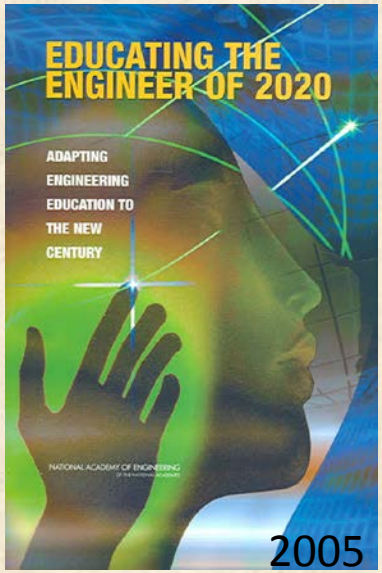

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Some Observations….

- Engineering Education prepares students for engineering within the homeland (globally).
- Grand Challenges for Engineering are global.
- The Grand Challenges Scholars Program (GCSP) provides a common bridge from <u>any</u> national program to a global one
  - An open, accessible, non-destructive addendum to any national program
  - Asks university to nurture 5 student competencies
  - *That's it.*

Each participating institution creates its own specific realization of how the competencies are built.

The GCSP Competencies….

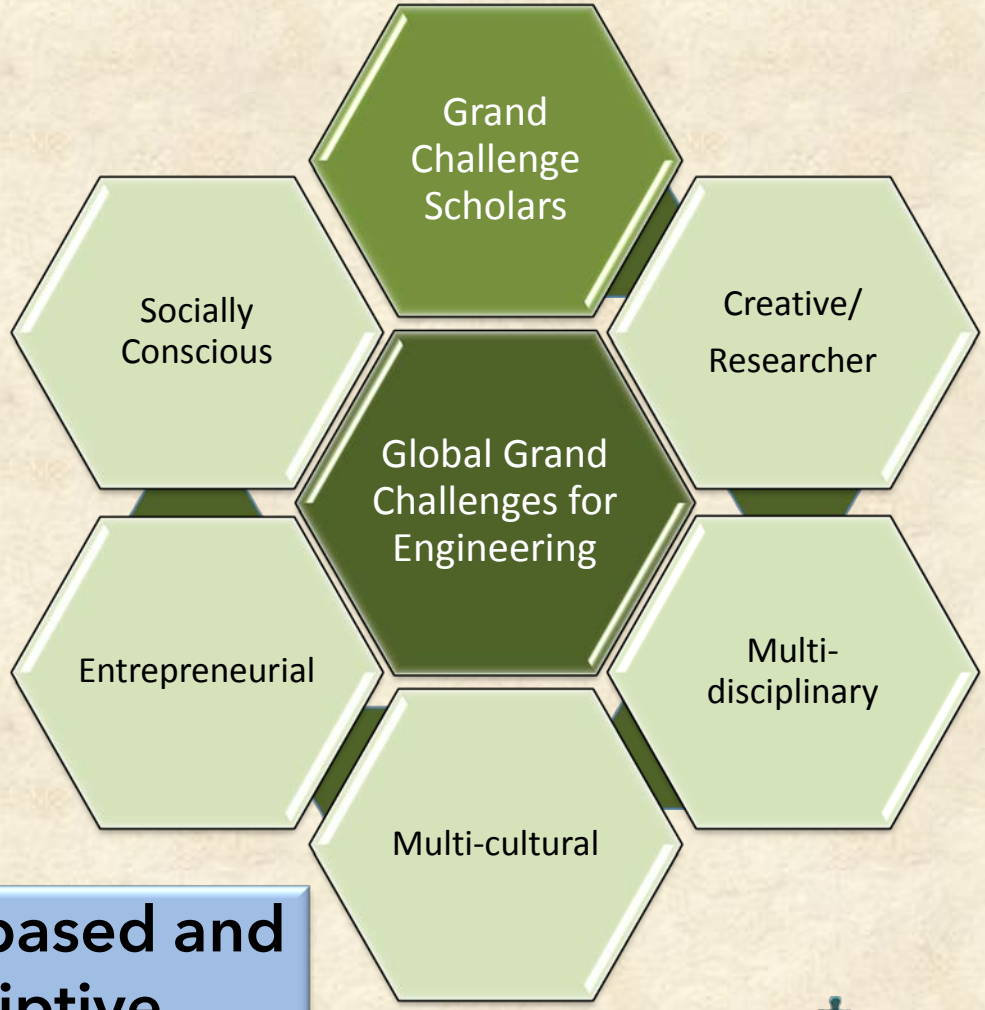
- **Research/Creative Competency:** Mentored research or project experience related to a Grand Challenge to enhance technical competence and creativity
- **Multidisciplinary Competency:** Understanding gained through experience of the multidisciplinary character of implementable and viable Grand Challenge solutions
- **Business/Entrepreneurship Competency:** Understanding gained through experience that viable business models are necessary for successful implementation of Grand Challenge solutions
- **Multicultural Competency:** Understanding gained through experience that serious consideration of cultural issues is mandatory for all viable Grand Challenge solutions
- **Social Consciousness Competency:** Deepen social consciousness and motivation to address societal problems, often gained through service learning, because serving people is the vision served by the Grand Challenges

Note that these competencies are not unique to engineers!

The GCSP…

- Programs are designed to ensure **coherence** and **connectivity** across the five competencies around a Grand Challenge theme chosen by the student

- Program elements are driven by the power of the idea of the 21st century engineer, with flexibility afforded to institutions for execution



The GCSP is outcomes-based and flexible–NOT prescriptive.

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NAE GRAND CHALLENGES SCHOLARS PROGRAM

Programmatic Synergies….

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CHALLENGES
SCHOLARS PROGRAM

Shared Purpose – SDG 3…

SUSTAINABLE DEVELOPMENT GOALS

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- Reverse Engineer the Brain
- Advance Health Informatics
- Engineer the Tools of Scientific Discovery

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Shared Purpose - SDG 4…

SUSTAINABLE DEVELOPMENT GOALS

4 QUALITY EDUCATION

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Advance Personalized Learning

Enhance Virtual Reality

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Shared Purpose - SDG 6…

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION

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- Provide Access to Clean Water
- Restore and Improve Urban Infrastructure
- Manage the Nitrogen Cycle

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Shared Purpose - SDG 7…

SUSTAINABLE DEVELOPMENT GOALS

7 AFFORDABLE AND CLEAN ENERGY

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- Make Solar Energy Economical
- Provide Energy from Fusion
- Develop Carbon Sequestration Methods

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Shared Purpose - SDG 11…

SUSTAINABLE DEVELOPMENT GOALS

11 SUSTAINABLE CITIES AND COMMUNITIES

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- Provide Access to Clean Water
- Restore and Improve Urban Infrastructure
- Make Solar Energy Economical

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Shared Purpose - SDG 13…

NAE GRAND CHALLENGES FOR ENGINEERING

- Make Solar Energy Economical
- Provide Energy from Fusion
- Develop Carbon Sequestration Methods

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GCSP Mobilization….

- Role of NAE: Inspire and Catalyze the Movement
  - Champion of the vision
  - Convener of the stakeholders
  - Community influencer
  - Change agent
- Goal: Build a global GCSP ecosystem
  - A distributed network of diverse, flexible and individualistic nodes, who will lead the charge in their own ways, but are in a symbiotic relationship and adapt and evolve over time
- Intent: Achieve critical mass to effect real change
  - Near term target is **200 U.S. GCSP**, which is more than half of the nation's engineering programs
  - Minimum target is **200 non-U.S. GCSP**

Join the GCSP Consortium…

- Points of contact
  - B. L. (Rama) Ramakrishna, Director of the GSCP Network (bramakrishna@nas.edu)
  - Ruth David, NAE Foreign Secretary (rdavid@nas.edu)
- To learn more
  - http://engineeringchallenges.org/GrandChallengeScholarsProgram/14741.aspx
- To become a member
  - Join the GCSP Community and LISTSERV to keep informed
  - Create a GCSP Operational Document (template & examples online)
  - Connect with a mentor for assistance
  - Submit your completed document

Final thoughts…

- Global Challenges require global solutions
- Global solutions require global talent
- Solutions for the Grand Challenges for Engineering require talent beyond engineering – and beyond engineers!

The REAL take-away: A necessary condition for achieving the vision of the Grand Challenges for Engineering is the successful global implementation of the Grand Challenges Scholars Program

by inspiring engineers and non-engineers alike to join the movement!

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