The Role of Engineering Education in Solving Global Society Problems: A World Systems Approach

Professor Adedeji B. Badiru
Dean, Graduate School of Engineering & Management
U. S. Air Force Institute of Technology
Dayton, Ohio, USA

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The Global Importance of Engineering Education

“Education is the most powerful weapon which you can use to change the world.”
- Nelson Mandela

“Education misapplied is education missed.” – Adedeji Badiru
Societal Roles of Engineering Education: Meeting the Global Hierarchy of Needs

Reference: Maslow’s Hierarchy of Needs
(Abraham Maslow, 1943)

1. Physiological Needs
2. Safety Needs
3. Social Needs
4. Esteem Needs
5. Self-Actualization Needs
NAE’s 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
Societal problems revolve around the 14 Grand Challenges
Semantic Networking of the Grand Challenges
Application of Systems Engineering V-Model
Systems Engineering in the Nigerian Context

What is Systems Engineering?

Systems engineering involves a recognition, appreciation, and integration of all aspects of an organization or a facility.

A system is defined as a collection of interrelated elements working together in synergy to produce a composite output that is greater than the sum of the individual outputs of the components.

A systems view of a process facilitates a comprehensive inclusion of all the factors involved in the process.
What are the unique factors of interest or concern in the local Nigerian context?

(Audience inputs)
1. ???
2. ???
3. ???
   .
   .
   .
   .
   .
Nigerian Applications and Job Opportunities for Systems Engineering

Let us now emphasize the applications of systems engineering with respect to Job Opportunities in Nigeria:

• Diversity and Versatility
  ➢ Who?
  ➢ What?
  ➢ Where?
  ➢ When?
  ➢ How?
  ➢ Why?
**DEJI Model for Systems Engineering Implementations**

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<th>NAE's 14 Grand Challenges</th>
<th>Research Topics</th>
<th>Education Topics</th>
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<td>1. Make solar energy economical</td>
<td>Strategic Investments</td>
<td>Engineering Economics</td>
<td>Portfolio Management</td>
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<td>2. Provide energy from fusion</td>
<td>Design Safety</td>
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<td>3. Develop carbon sequestration methods</td>
<td>Natural Science Analytics</td>
<td>Storage Systems Design</td>
<td>Global Systems Interfaces</td>
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<td>4. Manage the nitrogen cycle</td>
<td>System Planning</td>
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<td>Environmental Science</td>
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<td>5. Provide access to clean water</td>
<td>Environmental Science</td>
<td>Water Resource Engineering</td>
<td>Water Management &amp; Remediation</td>
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<td>6. Restore and improve urban infrastructure</td>
<td>Resilience Engineering</td>
<td>Construction Management</td>
<td>Infrastructure Design</td>
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<td>7. Advance health informatics</td>
<td>Health Systems Engineering</td>
<td>Computer Science &amp; Bio Informatics</td>
<td>Health Informatics</td>
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<td>8. Engineer better medicines</td>
<td>Personalized Pharmaceuticals</td>
<td>Biomedical Engineering</td>
<td>Health Systems Engineering in Medicine</td>
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<td>9. Reverse-engineer the brain</td>
<td>Human Factors</td>
<td>Cognitive Psychology</td>
<td>Behavioral Science</td>
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<td>10. Prevent nuclear terror</td>
<td>Deterrent Strategies</td>
<td>Emergency Response</td>
<td>Social Responsibility and Negotiation</td>
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<td>11. Secure cyberspace</td>
<td>Information Resources Research</td>
<td>Enterprise Design and Management</td>
<td>Information Security</td>
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<tr>
<td>12. Enhance virtual reality</td>
<td>Software Engineering</td>
<td>Software Design and Programming</td>
<td>Game Design</td>
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<td>13. Advance personalized learning</td>
<td>Active Learner Systems</td>
<td>Blended Hybrid Learning</td>
<td>Distance Learning Systems</td>
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<td>14. Engineer the tools of scientific discovery</td>
<td>Product Design</td>
<td>Scientific Inquiry</td>
<td>Ergonomics</td>
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**Taxonomical Analysis of Engineering Education**

- Prof. Audeeji Badiru
Badiru’s 15 Grand Challenges for Global Engineering Education

➢ Adoption of a systems view of the world in educational delivery modes and methods in order to leverage unique learning opportunities around the world

➢ Pursuit of integration and symbiosis of global academic programs. Through global educational system integration, we can move toward a mutual-assured advancement of engineering education. We should think global, but educate locally to fit domestic needs. Language diversity, for example, can expand thought and understanding to facilitate global communication, cooperation, and coordination.

➢ Linking engineering education to the present and future needs of society rather than just a means to better employment

➢ Commitment to embrace all engineering disciplines in a collaborative one-focus alliance toward addressing societal challenges

➢ Engagement of non-engineering disciplines, such as management and the humanities, in addressing high-value societal problems collectively. There are now medical humanities programs. Consider engineering humanities programs to put a human face to engineering solutions.
Adoption and adaptation of e-education to facilitate blended learning modes, flexibility of learning, and diversity of thought in a fast-paced society. Of interest in this regard is the evolution of measurement scales for pedagogy and andragogy.

Leveraging of social media tools and techniques to facilitate serious and rigorous transmission of knowledge

Extension of formal engineering education to encompass continuing engineering education and sustainability of learning

Creation of hybrid method of teaching what is researched and researching what is taught

Inculcation of global sensitivity into engineering education programs
Inclusion of social responsibility in engineering education, research, and practice

Making engineering solutions more human-centric solutions. Use engineering to solve real human problems. Keep engineering education relevant to the needs of society.

Teaching of representational modeling in engineering education. Modeling can provide historical connectivity to recognize the present as an output of the past and a pathway for the future.

Teaching of “Of-the-Moment Creativity” to spur innovation for the current, prevailing, and attendant problem

Introduction of engineering solution “ilities” covering Feasibility, Sustainability, Viability, Desirability of engineering solution approaches
Networking representation of Badiru’s 15 Grand Challenges for Global Engineering Education
Application of the **DEJI** Model to Global Engineering Education Curriculum Design
### Desired Skills and Competencies for Future Engineers

#### Knowledge
- Engineering & Technology
- Production & Processing
- Computers & Electronics
- Engineering Design
- Building & Construction
- Basic Sciences

#### Skills
- Critical Thinking
- Active Learning
- Problem Solving
- Systems Selection
- Programming
- Troubleshooting

#### Abilities
- Deductive Reasoning
- Inductive Reasoning
- Sensitivity Analysis
- Analytical Modeling
- Quantitative & Qualitative Analysis
- **Project Management**

Engineering knowledge, skills, and abilities are applicable globally.
What does it take to be successful?
Ans: Project Management knowledge, skills, and abilities!

Whether you are:
1. Producing a physical product,
2. Providing a needed service, or
3. Pursuing a desired end result

“Project management is the process of managing, allocating, and timing resources to achieve a given goal in an efficient and expeditious manner.” – Adedeji Badiru

Project management must be applied to the education process itself, as well as projects executed by engineering graduates.
Recommendations

• Use engineering education as a pathway to a better world
• Use engineering education to create social opportunities
• Use engineering education to facilitate professional choices
• Leverage engineering education for global economic vitality

Thank you & Questions