Probing the Future: On the Role of Universities, Industry Entrepreneurs, and Professional Societies

(Based on a lecture by: Norberto Lerendegui IEEE Region 9 Director-Elect 2012-2013)

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Alice in Wonderland...

- “Would you tell me please, which way I ought to go from here?”
- “That depends a good deal on where you want to get to”, said the cat.
- “I don't much care where –”, said Alice.
- “Then it doesn't matter which way you go”, said the cat.

(Lewis Carroll, Alice in Wonderland, Chapter 6)
Introduction
Science and Engineering

- Engineering practice is "...the process of creating, developing, integrating, sharing and applying knowledge ...for the benefit of humanity and the profession"
  (from IEEE Mission Statement)

- The integration of academic-based theory as applied to the "real world"
Introduction
Science and Engineering

“Scientists investigate that which already is;
Engineers create that which has never been”

(Albert Einstein)
Introduction
Science and Engineering

- To remain relevant, engineering practice must be innovative
  - ...a challenge for the ability of either academia or industry on their own to adequately “teach Engineering”
  - Challenge further grows due to increased cost of life-long, continuing education

- Typical consequence:
  - In academic setting, theory is emphasized, with little association to applications
  - In an industry setting only the "practical" applications are considered
    - Those become a “cookbook” approach for all engineering issues
Innovation, Knowledge and Relevance

“Creativity and innovation concern the process of creating and applying new knowledge”
(David Gurteen)

“Innovation is not only about developing the latest technology ... Nowadays firms need to open their innovation process ... in order to ensure that they snap up the next bright idea relevant to the company”
(T. Bisgaard, C. Høgenhaven, “Creating new concepts, products and services with user driven innovation”)

“Knowledge is of no value unless you put it into practice”
(Anton Chekhov)
Innovation, Knowledge and Relevance

“The survival of a Society in the third millennium will depend on its ability to innovate”

(Knut Holt, Founder of ISPIM, International Society for Professional Innovation Management, 1985)
Engineering in Action

Engineering in Action → Transformation
Engineering in Action

“The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself
Therefore, all progress depends on the unreasonable man”

(George Bernard Shaw, Irish Dramatist & Socialist, 1856 - 1950)
The Promise of Engineering and Technology

- Doing things differently, better
- Improving quality of life
  - Energy, Water, Food, Health, Community
- Give hope for a better world, a better future
- This promise of the technology lives, succeeds or fails, through the fabric of our socio-economic system
Engineering in Action → Transformation

- Just imagine a world without...
  - Cars, ships, airplanes
  - Electrical Power
  - Plastics (5% of the petroleum products)
  - Radio and Television broadcasts
  - Computers and Internet
  - Cellular phones...
Engineering in Action → Transformation

- Our Earth is living, and challenges us daily...
  - Air quality
  - Food and water supply
  - Energy resources
  - Waste...
- We now live in a “global village” thanks to technology
- The great challenges of the Future are here!

“For tomorrow belongs to the people who prepare for it today”

(African Proverb quotes)
Engineering in Action → Transformation

- Man creates and solves problems

- Air pollution →
  - Reduce emissions (Tokyo Protocol)
  - Hybrid Vehicles
  - Sustainable Energy

- Water supply (10^9 people without safe drinking water...)
  - Reduce industrial chemical water pollution
  - Regulations
  - Local water purification

- Food supply (Unplanned population growth - Earth population of 8 x 10^9 habitantes in 2025) →
  - Overcoming the Paradigm of Malthus
    - “The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race” (Malthus T.R. 1798)
  - With direct sowing, hybrid seeds, irrigation control
Engineering in Action → Transformation

- Man creates and solves problems
  - Energy resources →
    - Sustainable energy resources
    - Wise consumption
    - Green facilities
    - Wise use of air-conditioning (consumption increased by 40% over 25 years)
    - Self-supporting building savings
  - Waste... (large scale pollution (plastics, PCBs) →
    - Separation and recycling of materials
    - New techniques for waste treatment
4 Human Mega-Aspirations

- **Health, Quality of life and food**
  - Diagnosis, Treatment, Bio-Technology

- **Housing and construction**
  - Sustainable construction
  - Rational use of energy
  - Waste management in Mega-metropolis

- **Energy and resources**
  - Production and efficient use of energy
  - Biogas as a source of energy
  - The Solar village

- **Mobility and communication**
  - Technologies for sustainable mobility
  - Automotive innovations

*Engineering is the practice of making good on the promise of technology*
“Need is the cause of most innovations, but the best come from desire”

(Guglielmo Marconi)
Scientific\Technological Education and Society

Government and Fiscal Policies

Education Policies

Scientific\Technological Education

R&D Outcomes
- Patents
- Technology Transfer
- Impact on Economic Growth
Scientific/Technological Innovation and Society

- INSTITUTIONAL and CULTURAL framework
- FINANCIAL system
- SCIENTIFIC and TECHNOLOGICAL system
Scientific/Technological Innovation and Society

But, what if...?

Where is social responsibility?

We live in one global village...

INNOVATION

INSTITUTIONAL and CULTURAL framework

FINANCIAL system

SCIENTIFIC and TECHNOLOGICAL system
The Great Challenge faced by Academia and Society

“We are preparing students for jobs that don’t yet exist… Using technologies that haven’t been invented… In order to solve problems we don’t even know are problems yet…”

(Karl Fisch, “Did You Know”)
Creating a Future

“Success is getting what you want
“Happiness is enjoying what has been achieved
“Coincidence is when the preparation meets opportunity”

(Lair Ribeiro, Cardiologist)
Creating a Future

The best way to predict the future is to invent it!

- **Academy** is focused on “ideal” conditions
  - A necessity in order to be effective in teaching the fundamentals of engineering
  - Emphasis is typically on methods to assure a successful design of products to provide various functions and features

- **Industry** is focused on supply products that meet customer expectations while operating in the “real” world
  - Requires knowledge and experience that can only be gained from industry
Creating a Future
Bridging the Gap...

- Bridging the gap between the knowledge in academia and applications in industry is critical to any successful Engineering practice
  - Academia can advance innovation with a responsible vision
  - Industry entrepreneurs develop new applications for the newly developed science and technology
- ...a challenge for the ability of either academia or industry on their own to adequately “teach Engineering”
Creating a Future
Understanding Each Other’s Needs

- How can academia understand industry needs
  - Invest time and effort to understand the environment that industrial work comprehends
    - “Getting out of the classroom”
    - Dialogue with experienced industry entrepreneurs
    - Participation in various industry groups (e.g., standards)
Obtain industry involvement in Science, Technology and Engineering (ST&E) education curriculum

- Encourage industry entrepreneurs to visit academic institutions and discuss the challenges they face in their daily work
- Invite industry entrepreneurs to serving on “design project” evaluation committees
  - Introducing industry to type of projects done by students
  - Can provide industry with students that have demonstrated skills and engineering abilities
Creating a Future Education

- A teacher teaches
- A good teacher educates
- An excellent teacher inspires
Creating a Future
Education - Universities' Role

- Find, preserve and disseminate the knowledge
- Research
  - Basic (meeting their own interests) - Research
  - Applied (addressing society needs) - Creation
- Direct participation in economic development - Innovation and Growth
- Challenges - lack of
  - Teachers and researches
  - Students
  - Funding
Universities must promote innovation, with responsibility for vision training:

- Know “what” (conceptual contents)
- Know “how to” (procedural content)
- know “what to be” (ethical and moral content)
Creating a Future
The Role of Scientific Societies vis-à-vis IEEE

- **Mission**: IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity.

- **Vision**: IEEE will be essential to the global technical community and to technical professionals everywhere, and be universally recognized for the contributions of technology and of technical professionals in improving global conditions.
Creating a Future
The Role of Scientific Societies vis-à-vis IEEE

- The IEEE fulfills its mission and vision as...
  - A professional society with membership > 400,000
  - Approximately (45%, approx. outside the US)
- Thorough:
  - Career enhancement of members
  - Organizational structure fit to respond to needs of IEEE members
  - Products and Services maintain IEEE as leader in timely generation and dissemination of electro-technology literature
  - Establishing a global human network with specific human quality and expertise
  - Maintaining knowledge through international symposia
  - Globalization, through collaborative and cooperative relationships with non-IEEE sister societies
Creating a Future
The Role of Scientific Societies vis-à-vis IEEE
IEEE and the 4 Human Mega-Aspirations

- **Health, Quality of life and food**
  - IEEE Society on Social Implications of technology (SSIT)
  - IEEE Product Safety Engineering Society (PSES)
  - IEEE Engineering in Medicine & Biology Society (EMBS)...

- **Housing and construction**
  - IEEE Power and Energy Society (PES)
  - IEEE Industrial Applications Society (IES)...

- **Energy and resources**
  - IEEE Power and Energy Society (PES)
  - IEEE Industrial Electronics Society (IES)

- **Mobility and communication**
  - IEEE Communications Society (ComSoc)
  - IEEE Electromagnetic Compatibility Society (EMCS)
  - IEEE Computer Society (CS),
  - and more...
Conclusions

- “The empires of the future are the empires of the mind” (Sir Winston Churchill, 1874 - 1965)
- Better to face the future than hide from it
  - Be the disrupter; not the disrupted
- Surfing a big wave is unpredictable
  - “…It is difficult to make predictions, especially about the future” (Niels Bohr)
- But... we do know that the key words for future evolution of science, technology and engineering are:
  - Know-how
  - Relevance
  - Synergy between Academia and Industry
  - Global outreach and professional expansion
Conclusions

- Universities hold the responsibility for fulfilling their vision and should promote education towards innovation (know what, know how and know what to be), forming individuals with a capacity for change.

- IEEE provides a comprehensive broad spectrum, global platform to discuss application of technology, encompassing the technological, scientific and ethical considerations on a global scale with the vision of making a better future.

- ... helping to form a successful global society, encompassing science, technology, business and government.
References

- Steffka, Mark, "Process And Benefits Of Industry / Academic Linkage in Electromagnetic Compatibility (EMC) Education"
- Lerendegui, Norberto, “Construyendo un Futuro: el rol de la Universidades, las Empresas y el Marco Científico” (“Building a future: the role of the universities, companies and the scientific framework”)
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