Educating Engineering Workforce: Designing A Better Future

Ir. Prof. Academician Dato’ Dr. Chuah Hean Teik
President, ASEAN Academy of Engineering and Technology
Immediate Past President, Federation of Engineering Institutions of Asia and the Pacific (FEIAP)
Overview

- SETI Marvels
- Trends and Challenges Ahead
- Digital Revolution/4th Industrial Revolution
- Engineering Education – The Driver
- Skills Required for Future Graduates
- Attributes of Engineering Personnel
- Curriculum Review
- B&R Register for Engineering Personnel
- Concluding Remarks
Waves of Technological Revolution

**Revolution**

- **Agricultural Revolution**
  - Rotation of crops
  - Stock Breeding
  - 1700

- **Industrial Revolution**
  - Automatic Loom
  - Steam Engine
  - 1760

- **Electronic Revolution**
  - Telephony
  - Electricity
  - Steel
  - Gas Engine
  - Car, Air Plane
  - Oil Drilling
  - 1890

- **IT Revolution**
  - Television
  - Computer
  - Microprocessors
  - Optical Fibers
  - Bio Technologies
  - 1910

- **Digital Revolution**
  - Information
  - Superhighways
  - Integrated
  - Multimedia Networks
  - Physical
  - &
  - Cyber
  - &
  - Human
  - Space
  - 1950

- **Year**
  - 1970
  - 1990
  - 2000

- **Digital Revolution**
  - Physical
  - &
  - Cyber
  - &
  - Human
  - Space
  - 2000
Trends in Globalised World:

- Faster Pace
- Borderless World & Opportunities
- Convergence
- Personalisation and Individualisation
- More informed and Higher Expectations – Seamless Mobility, Seamless Relationship
- Cost-Effectiveness
- Technological Breakthrough: Knowledge is Power
Booming and Widening Trends 1/5

- The population boom: 7 billion and counting
- Could reach 9 billion by year 2050
- Global population as whole becomes more urban and less rural
Booming and Widening Trends 2/5

- In 2010, 50.5% or 3.5 billion people live in cities.
- Level of urbanisation is on the rise but with disparities – may reach 84% in 2050 in North America and 64% in Asia.
- In Malaysia by 2050 – 42 mil; 86% Urban Dwellers
Booming and Widening Trends 3/5

- Extreme inequality in wealth distribution
Booming and Widening Trends 4/5

- In 2016, the richest 10% of adults accounted for 89% of the world's global assets.
- In contrast, the bottom half of world adult population owned less than 1% of global wealth.
- Richest 1% of adults owned 46% of household wealth in 2016.
• 1880 – 1970 Global Average Temperature increased 0.03°C/decade
• Since 1970, increased 0.13°C/decade
• 2/3 of the increase of 0.8°C in last 40 years

Booming and Widening Trends 5/5

Earth Policy Institute 2010 Report – Global Warming

NASA_GISS_temp_graph
Challenges 1/7

- Inequality of wealth distribution – Gap is still widening
Challenges 2/7

- Clean water – is it readily and easily accessible to many??
Challenges 3/7

➢ Inequality in food distribution - food wastage and food sufficiency
Challenges 4/7

➢ Increasing Energy Consumption – Disparity among have and have-not
Challenges 5/7

Global Warming and Climate Change

- Flash Flood
- Landslide
- Rising Sea Water Level
- Other Natural Disasters


Source: http://www.businessnewsmalaysia.com/2011/05/fear-that-another-disaster-could-hit-the-slip-prone-region

Source: http://world.people.com.cn/GB/157278/17009701.html
Health Care and Aging Population

- More and More Expensive Health Care
- Low Birth Rate and Aging Population
- Uneven Distribution of Health Care Services
- Integration of Western and Traditional Medicine

In Malaysia by 2050, 23% aged above 60 years and above
Challenges 7/7

Security – Physical Space and Cyber Space
Initiatives by Various Countries for 4th Industrial Revolution

- Industry 4.0, Germany
- Reindustrialisation, USA
- New Industrial, France
- Rejuvenation Plan, Japan (Society 5.0 by 2050)
- China
  - “Internet Plus” Action Plan;
  - Big Industry Country 2015;
  - Made in China 2025;
  - Primary Industry Power 2025;
  - Medium Industry Power 2035;
  - Leading Industry Power 2045
- Manufacturing 4.0, Korea

Significant Highlights:

- Digital Technologies, combined with other Socio-economic and Demographic Changes, will transform labour markets in the next five years, leading to a net loss of over 5 million jobs in 15 major developed and emerging economies.
- There will be new 2 million jobs created in digital industrial and services sectors, and there will be 7 million job loss in the traditional industrial and services sectors.
- 65% of children entering primary school today will ultimately end up working in completely new job types that don’t yet exist.
Engineering Education – The Driver

- Source of Human Capital
- Uplifting of Poverty
- Catalyst of Change and Innovation
- Driver of Economic Growth
Engineering Workforce: Prime Mover of Nation Building
Engineering Education for Public Good

- What is good for the Development of the Country?
- What is good for the Industry in the Country?
- What is good for one country/region may not be suitable for another country/region in terms of human resource requirement.
- It is important that the Scientists, Engineers and Technologists must contribute towards economic growth of the country and be able to support the industry.

Be Trend Setters, Be Catalysts of Change
An Engineering Personnel is one with an analytical mind, who can think logically, and provides solutions based on fundamental principles of natural laws.
Engineering Education

- Strengthening of the Fundamentals
- Development of Analytical Mind
- Knowledge Exploration
- Self-Development
- Social Network Linkage
- Surviving Constraint Challenges
A doctor’s mistake is left covered and buried.....thus unseen.

A lawyer’s mistake is left suspended and bagged....again unseen.

An engineer’s mistake is left SEEN......to the WORLD!!
Engineering is a highly flexible profession. The profession plays many different roles …

- R&D
- Product
- Process & Product Development
- Consulting
- Field /Site Supervision
- Sales
- Education
- Entrepreneurs

Engineers are at both middle and top technical and management domains …

- R&D Manager
- Sales & support manager
- Chief technology officer (CTO)
- Business strategy & planning manager
- Chief executive officer (CEO)
TOP 10 Skills Required in 2020

- Complex Problem Solving
- Critical Thinking
- Creativity
- People Management
- Coordinating with Others
- Emotional Intelligence (& Cultural Intelligence)
- Judgement and Decision Making
- Service Orientation
- Negotiation
- Cognitive Flexibility

Source: Future of Jobs Report, World Economic Forum
Some Titles and Professions of the Future…

- Bio-systems Engineer
- Performance Technologist
- Visual Ergonomics
- Psycho-linguistic
- Cyber-librarians
- Bio-manufacturing
- Geo-environmentalist
- Information Architect
- Tissue Engineer
- Data Miner
- Genetic Engineer
- Knowledge Engineer
- Ethno-Epidemiologist-Musician

### Graduate Attributes of Engineering Workforce

<table>
<thead>
<tr>
<th>Engineer</th>
<th>Engineering Technologist</th>
<th>Engineering Technician</th>
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<td>Apply Knowledge of Maths, Science, Engineering Fundamentals and an Engineering Specialisation to the solution of <strong>COMPLEX</strong> engineering problems</td>
<td>Apply Knowledge of Maths, Science, Engineering Fundamentals and an Engineering Specialisation to <strong>DEFINED &amp; APPLIED</strong> engineering procedures, processes, systems of methodologies</td>
<td>Apply Knowledge of Maths, Science, Engineering Fundamentals and an Engineering Specialisation to <strong>WIDELY PRACTICAL</strong> procedures and practices</td>
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Points to Ponder

- How to help to Train our Students to have Inquisitive Minds for the 4IR?
- How to give Industrial Exposure to the Students?
- How to help to develop their Interests and Potentials?
- What kind of Soft Skills and Hard Skills does one need?
- What is the Balance between “Ready-to-Market” and “Ready-to-Evolve” Training (Utilitarian versus Scholarly?)?
- How to train a Person with Globalised Outlook?
Training of Ready-to-Evolve Graduates

• Solid Fundamental of Engineering Sciences in First 2 Years of the Programmes: Mathematics, Material Sciences, Electromagnetics, Thermodynamics, Dynamics and Kinetics etc.
• In First 2 years, while training students on basics, more engineering application examples be incorporated in lectures
• More elective options for students (flexible for Faculty to introduce, to review, to remove) in 3rd and 4th Year as and when technology changes
• Promote exchange of students regionally and internationally itself on credit transfer basis
• Skill-sets to be introduced in lectures/tutorials and SOFT-SKILL Certificate System
Outcome-based Education (OBE) Implementation

No Bean Counting: Focus on the forest, not just the tree

To evaluate the programme as a whole, not to introduce a parallel assessment system on top of the current grading/marking system on individual students
Curriculum Review

There must be a review of engineering curriculum to emphasise on:

1. Sustainability and Environmental Friendliness
2. Ethics and Professionalism
3. Soft-skills (Communications/Language/Emotional Intelligence/Cultural Intelligence/Negotiation/Cognitive Flexibility)
4. Life-Long Learning
5. Project Management
6. Finance, Economics and Accountancy
7. Related Laws (Land Law/Contract Law/By-laws)
OBE CQI Flow Chart

Feedback from & to stakeholders on all stages

Visions & Missions of University

Programme Educational Objectives (PEO) and Programme Outcomes (PO)

Course Outcomes (CO)

Teaching & Learning methods

Assessments

Continuous Quality Improvement (CQI)

Stakeholders: employers, employees, sponsors, lecturers, students, external examiners, industry advisors, etc.
“It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change.”

~Charles Darwin, 1809
Act Local and Go Global: Opportunities are Everywhere

- Be Optimistic: Public/Private; Degree/Diploma/Certificate; Professional/Semi-Professional
- World is Flat
- Look for Opportunities not only within the Country but also ASEAN, APEC and World-wide
- Smart Partnership and Human Networking
- Go into Areas where others have not explored fully – Blue Ocean Strategy
Unveiled by China President Xi Jinping in September and October 2013, consists of two main components namely the Silk Road Economic Belt and the 21st-century Maritime Silk Road that focus on the cooperation among countries Europe, Asia and Africa.
Belt and Road Initiative of China

OBOR routes run through the continents of Asia, Europe and Africa, connecting the vibrant East Asia economies at one end and developed European economies at the other.

The Silk Road Economic Belt focuses on bringing together China, Central Asia, Russia and Europe, linking China with the Persian Gulf and the Mediterranean Sea through Central Asia and the Indian Ocean. The Maritime Silk Road is designed to go from China's coast to Europe through the South China Sea and the Indian Ocean in one route, and from China's coast through the South China Sea to the South Pacific in the other.
Economic Belt of the 21st Century Silk Road
21st Century Maritime Silk Road
Belt and Road Initiative of China

At the Belt and Road Summit Forum 14-15 May 2017 in Beijing, China President Xi Jinping talked about the 5 Building Principles for Belt and Road:

• Road for Peace
• Road of Prosperity
• Road of Opening Up
• Road of Innovation
• Road of Connecting Different Civilizations

http://news.xinhuanet.com/english/2017-05/14/c_136282982.htm
Collaboration under B&R Initiative

• Provides opportunities for collaboration with China and economies along the Belt and Road

• International education is becoming increasingly important in order to nurture talents with international exposure and experience

• Areas of collaboration
  - Expanded student leaning experiences
  - Professional education cooperation
  - Cultural sharing and exposure
  - Research collaboration
Apply 3 IC’s

- Integrity & Competence
- Integration & Communications
- Internationalisation & Cooperation
International Cooperation

- Malaysia – 33 million
- AEC – 640 million Malaysia – 33 million
- Belt and Road Initiative:
  - 55% world GNP, 75% energy reserves, 70% population
- Capitalise on our Strength and Complement Each Others
- Global Market and Thus Human-Network
Global Mobility of Engineering Workforce

• Movement of Globally Engineering Personnel who are capable of Independent Practices
• Examples of Understanding/Agreements for Mobility of Engineering Workforce:
   ASEAN Chartered Professional Engineers Register
   International Professional Engineers Agreement (formerly EMF)
   APEC Engineers Register
   International Engineering Technologist Agreement
   Agreement for International Engineering Technicians
Regional/International Register for Engineering Personnel – Towards B&R Accord/Register

Your gateway to trade liberalisation and professional services
What We could DO Collectively:

• **International Bench-Marking**
• **Set Standards – FEIAP Guidelines for Engineer, Engineering Technologist and Engineering Technicians**
• **Sharing of Experiences**
• **Go Global – Human Networking**
• **Improve Image of Engineering Personnel**
• **Be Trend Setters – B&R Accord/Register**
OBOR-FEIAP Engineering Training Centre 一带一路亚太区工程学学会培训中心

Vision:

Harmonisation & Standards: Allow mutual recognition of the Engineering Education Programs (Engineer, Engineering Technologist and Technician programs) among Economies in the OBOR Initiative region and FEIAP

Facilitate and to promote Mobility of the Engineers, Engineering Technologists and Technicians among the economies in OBOR Initiative region and FEIAP

Train and Provide Continuous professional development to increase the number of competent Engineers, Engineering Technologists and Technicians who will help the economies to develop into developed nations.
# OBOR-FEIAP Engineering Training Centre

## Objectives:

1. To have an Engineering Training Centre in Xian, China to achieve the vision set.
2. To conduct Engineering Education Accreditation Training.
3. Promote of *Mutual Recognition of Engineering Education Programs*.
4. To promote students exchange program among the Universities.
5. To promote the mobility of engineering personnel.
6. To conduct Professional Development courses for *Infrastructure Dev. & Maintenance*.
7. To promote the networking of the engineering personnel.
8. To keep up to development of the world on the Engineering Education and Training.
Let’s not forget about the **Basic Duties and Responsibilities** of Education:

- Training of Wholesome Individuals with High Moral and Ethical Values, and Analytical Minds
- Training of Individuals who will have high Spirit and always keep abreast with Latest Technology
- Training of Individuals who look for opportunities globally
- Above all, human-human interaction & human-nature harmony must not be sacrificed
Tertiary Education

No Bean Counting:
Focus on the forest, not just the tree
Don’t Miss the Forest
Final Take-Away

• Your Degree could only earn you a Bronze Medal
  學歷能為你帶來銅牌
• Your Experience could earn you a Silver Medal
  經驗能為你帶來銀牌
• Your Human-Networking could earn you a Gold Medal
  人脈能為你帶來金牌
• BUT your right MINDSET would be your TRUMP
  但正確的思維是你的王牌
THANK YOU
For Listening