Educating Engineering Workforce: Designing A Better Future

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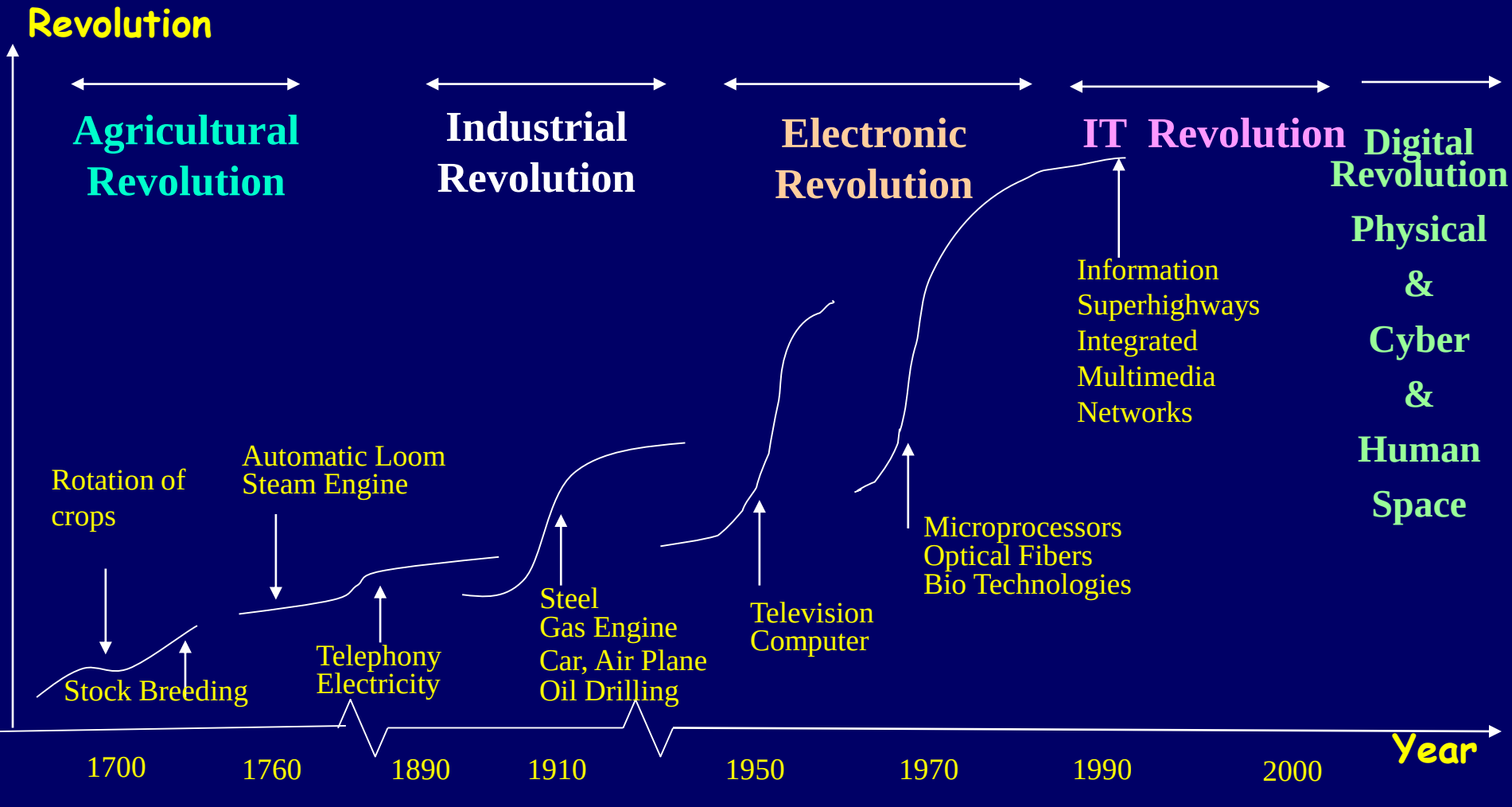
Overview

- 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



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

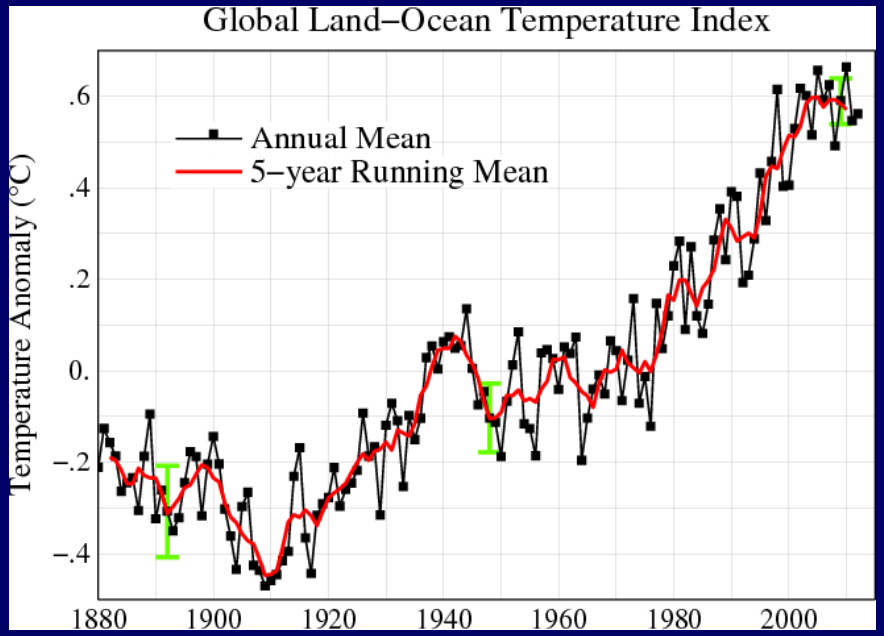
- In 2016; the richest 10% of adults accounted for 89% of the world global assets.
- In contrast, the bottom half of world adult population owned less than 1% of global wealth.
- Richest 1% of adults owned 46% of household wealth in 2016




Booming and Widening Trends 5/5

Earth Policy Institute 2010 Report – Global Warming

- 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



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.epochtimes.com/b5/10/1/5/dailypost.htm

Source: http://blogs.denverpost.com/captured/2011/10/14/worst-floods-in-a-half-century-in-thailand/5029/

Source: http://climatide.wgbh.org/2011/04/four- reasons-sea-level-is-rising-in-new-england/

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

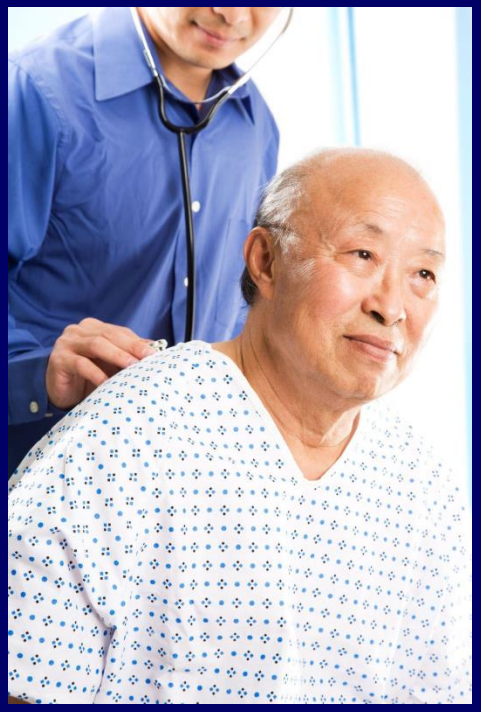
Source: http://world.people.com.cn/GB/157278/17009701.html

Source: http://news.nationalgeographic.com/news/2011/03/pictures/110315-nuclear-reactor-japan-tsunami-earthquake-world-photos-meltdown/#/japan-earthquake-tsunami-nuclear-unforgettable-pictures-wave_33291_600x450.jpg

Challenges 6/7

Health Care and Aging Population

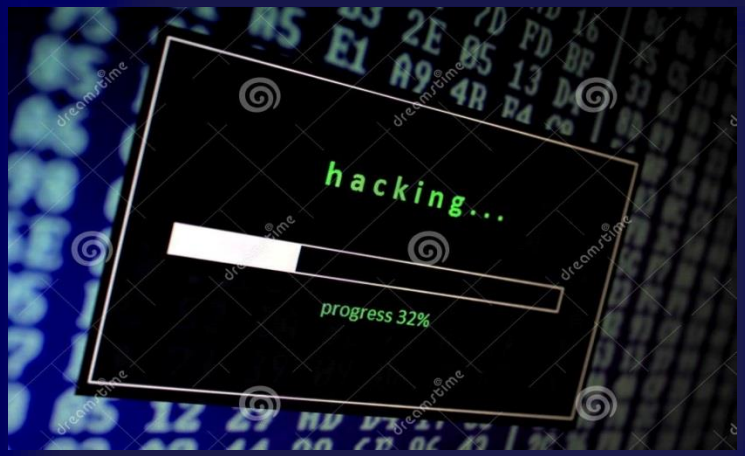
- More and More Expensive Health Care
- Low Birth Rate and Aging Population
- Uneven Distribution of Health Care Services
- Integration of Western and Traditional Medicine



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

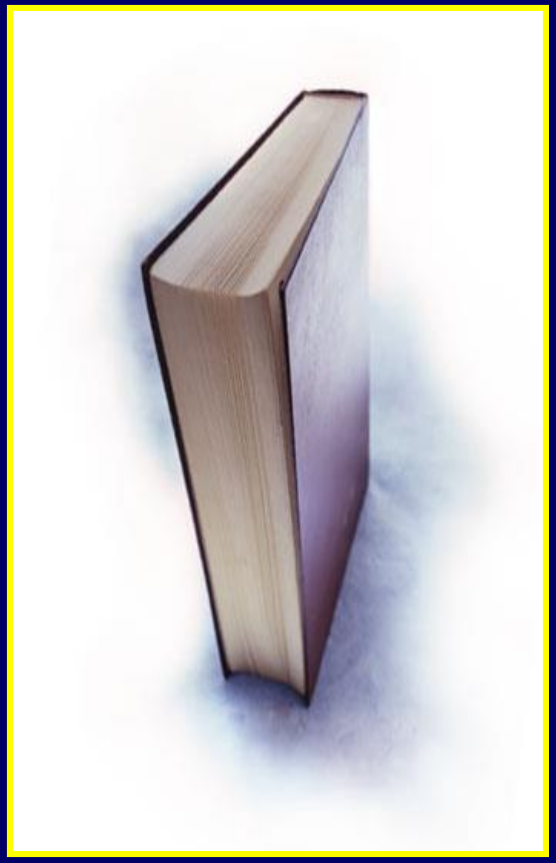
Study report “The Future of Jobs” in 2016 by World Economic Forum

Significant Highlights:

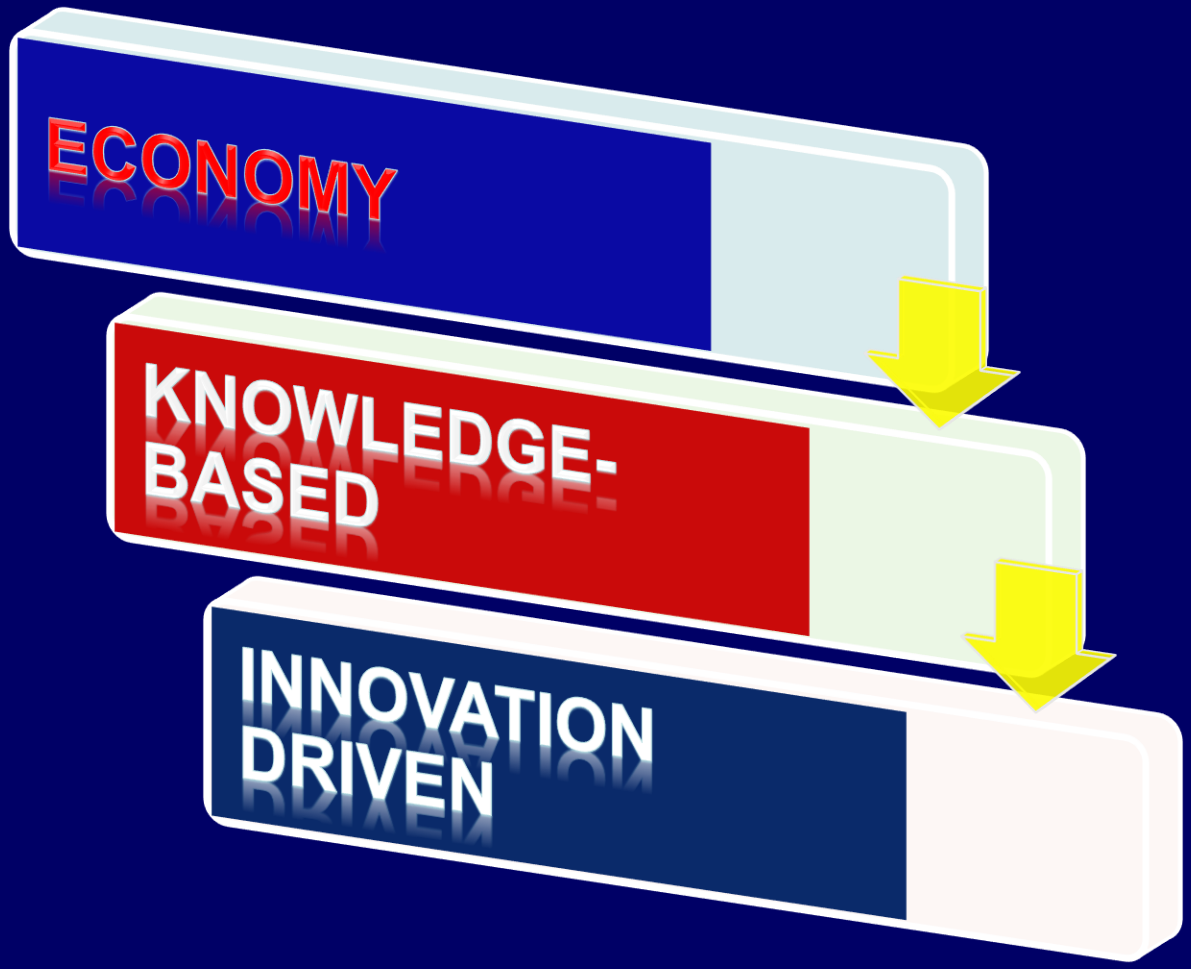
- **Digital Technologies, combined with other Socio-economic and Demographic Changes, will transform labour markets in the next five years, leading to a net loss of over 5 million jobs in 15 major developed and emerging economies.**
- **There will be new 2 million jobs created in digital industrial and 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

Engineering Personnel

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**

MISTAKES

DOCTORS

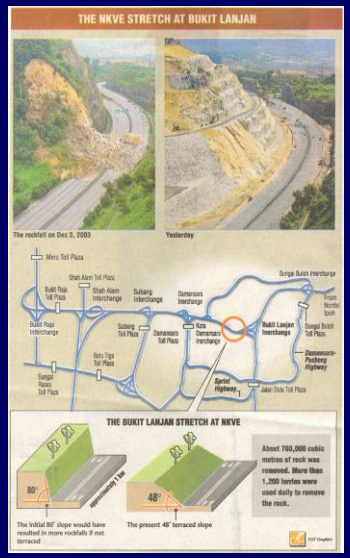
A doctor's mistake is left covered and buried…..thus unseen.

LAWYERS

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

BUT!!

ENGINEERS



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

Source: Francisco Marmolejo, Global Lead. Tertiary Education, The World Bank

Graduate Attributes of Engineering Workforce

Engineer	Engineering Technologist	Engineering Technician
Apply Knowledge of Maths, Science, Engineering Fundamentals and an Engineering Specialisation to the solution of ***COMPLEX*** engineering problems	Apply Knowledge of Maths, Science, Engineering Fundamentals and an Engineering Specialisation to ***DEFINED & APPLIED*** engineering procedures, processes, systems of methodologies	Apply Knowledge of Maths, Science, Engineering Fundamentals and an Engineering Specialisation to ***WIDELY PRACTICAL*** procedures and practices

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

OR

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

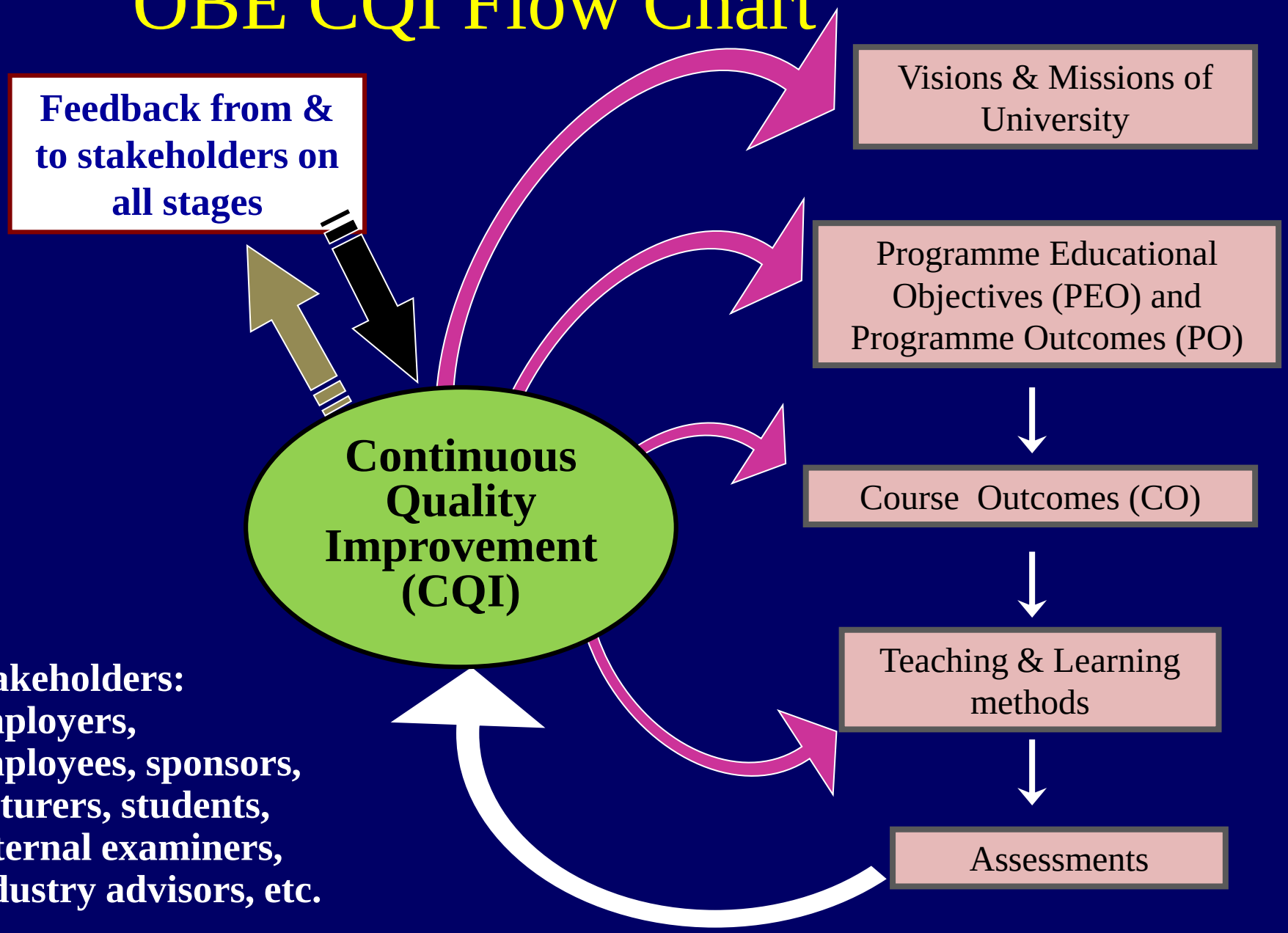
To evaluate the programme as a whole, not to introduce a parallel assessment system on top of the current grading/ marking system on individual students

Curriculum Review

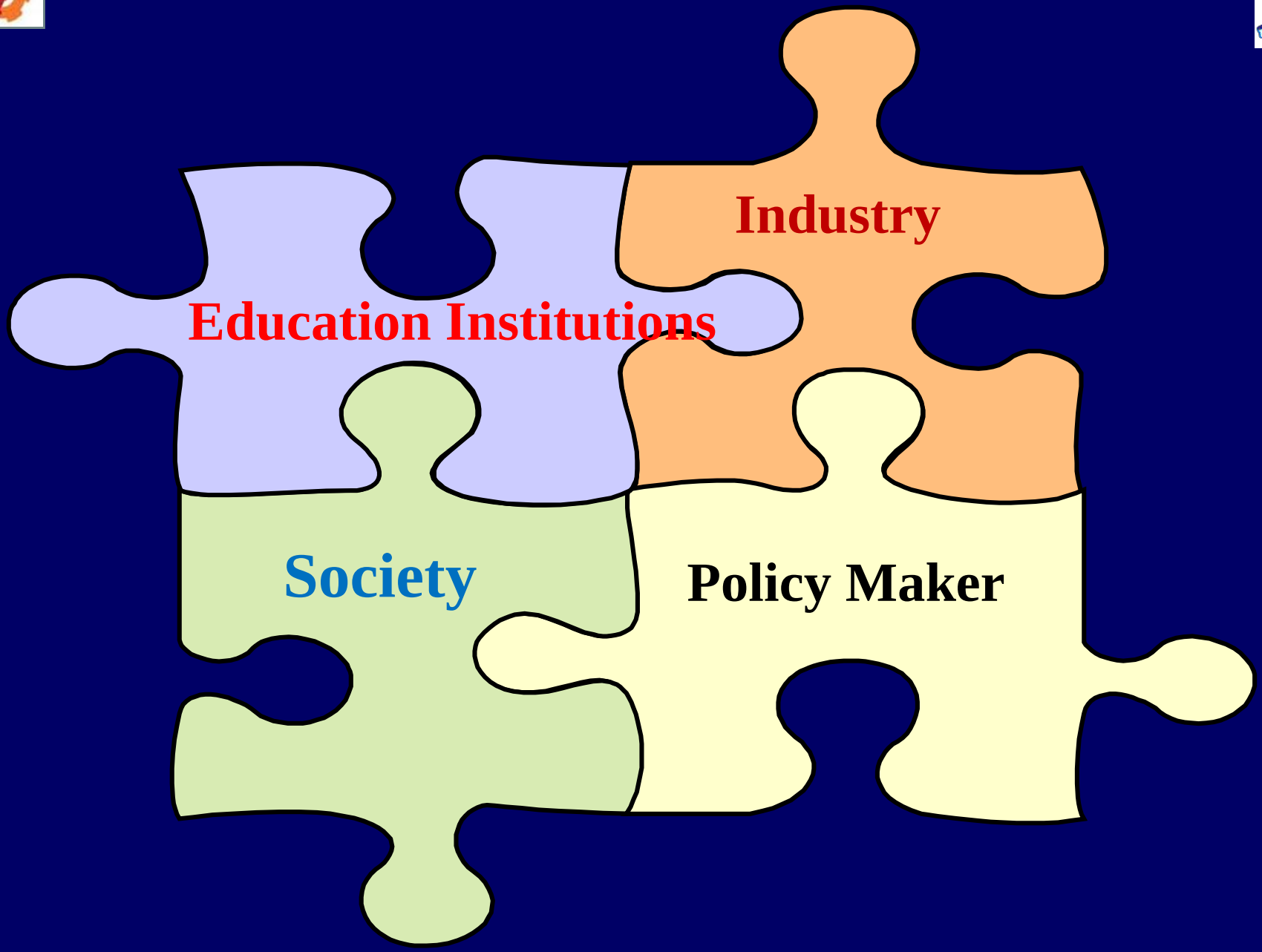
There must be a review of engineering curriculum to emphasise on:

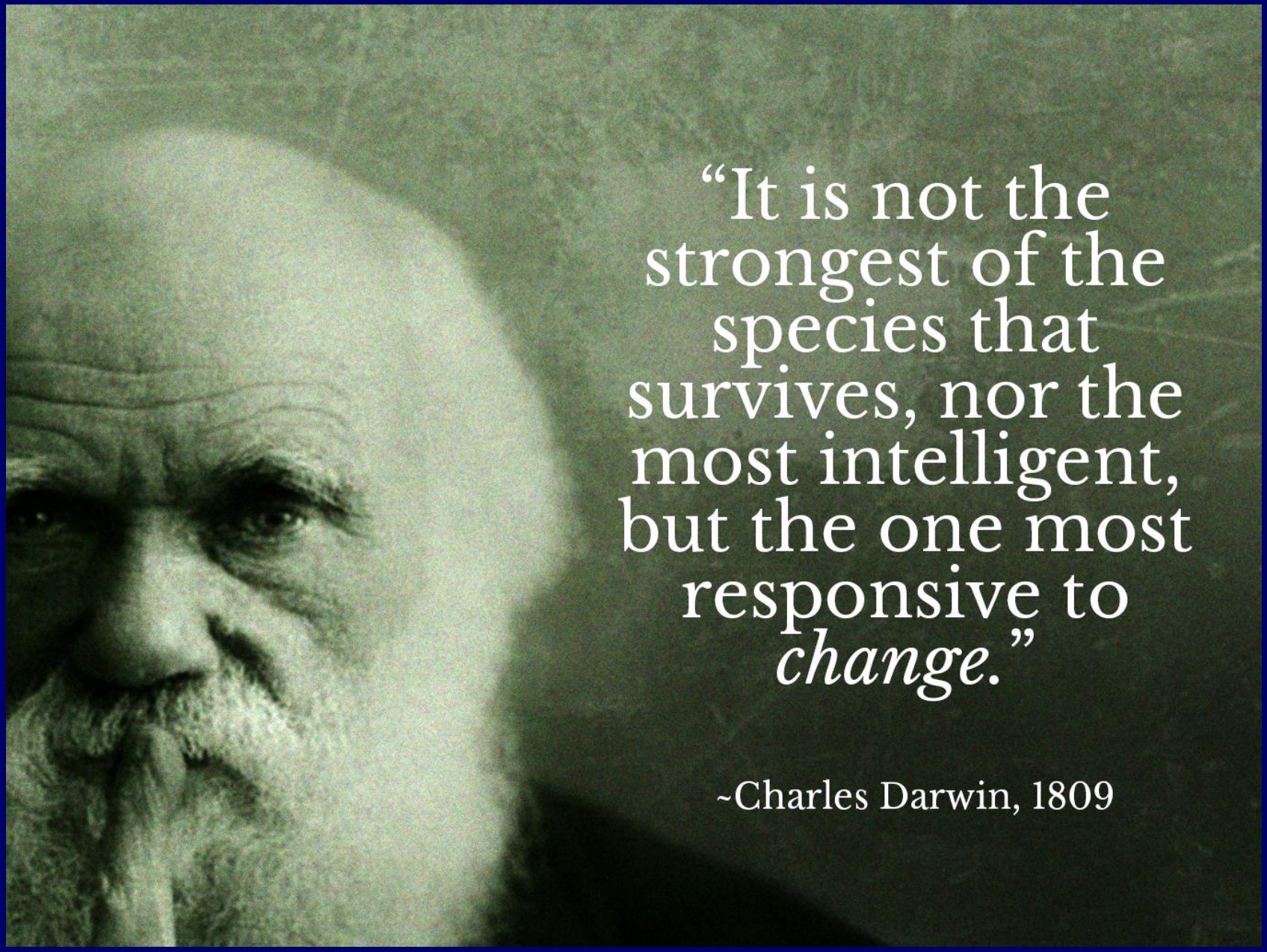
1. Sustainability and Environmental Friendliness
2. **Ethics and Professionalism**
3. Soft-skills (Communications/Language/Emotional Intelligence/Cultural Intelligence/Negotiation/Cognitive Flexibility)
4. **Life-Long Learning**
5. Project Management
6. **Finance, Economics and Accountancy**
7. Related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

OBE CQI Flow Chart



Stakeholders: employers, employees, sponsors, lecturers, students, external examiners, industry advisors, etc.


Industry
Education Institutions
Society
Policy Maker


"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

Belt and Road Initiative by China

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**

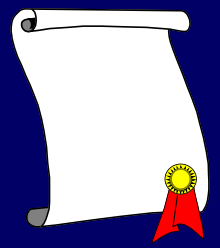
http://news.xinhuanet.com/english/2017-05/14/c_136282982.htm

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

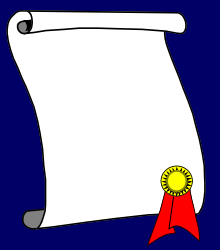
- **Integrity & Competence**
- **Integration & Communications**
- **Internationalisation & Cooperation**



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)

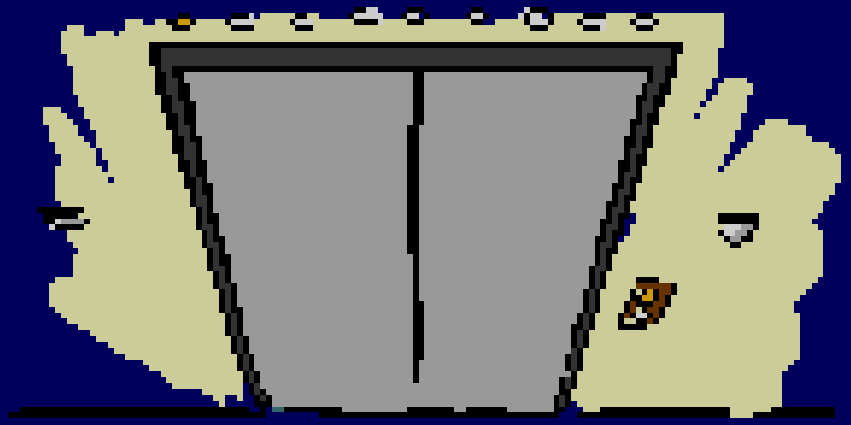
❖ APEC Engineers Register

❖ 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 一帶一路亞太區工程學會培訓中心

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
9. A platform for exchange of academics and engineering students

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

OR

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