Science, Engineering, Technology & Innovation Education for Economic Transformation

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Overview

❖ SETI Marvels
❖ Trends and Challenges Ahead
❖ Moving on: SETI Education
❖ Innovation: The Way Ahead
❖ Some Malaysian Experiences
❖ Concluding Remarks
Science, Engineering and Technology -
the Driving Force for Civilization ...
Waves of Technological Revolution

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

- **Industrial Revolution**
  - Automatic Loom
  - Steam Engine
  - Telephony
  - Electricity

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

- **IT Revolution**
  - Television
  - Computer
  - Microprocessors
  - Optical Fibers
  - Bio Technologies
  - Information Superhighways
  - Integrated Multimedia Networks

- **Life Science & Eco-System**
  - 1700
  - 1760
  - 1890
  - 1910
  - 1950
  - 1970
  - 1990
  - 2000
Buildings & Structure
TOP 20 ENGINEERING ACHIEVEMENTS IN THE 20TH CENTURY

Source: US National Academy of Engineering
The World without SETI
Booming and Widening Trends 1/4

• 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 2/4

- 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.
Booming and Widening Trends 3/4

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

- Richest 1% of adults owned 40% of global assets in 2000; the richest 10% of adults accounted for 85% of the world total.
- In contrast, the bottom half of the world adult population owned barely 1% of global wealth.
Social and Economic Challenges 1/4

- Inequality of wealth distribution – Gap is still widening
Social and Economic Challenges 2/4

- Clean water – is it readily and easily accessible to many??
Social and Economic Challenges 3/4

- Inequality in food distribution - food wastage and food sufficiency
Increasing Energy Consumption – Disparity among have and have-not
“To achieve this standard of living for its population England had to colonize the entire world. If India wants to achieve the same standard for its vast population, one has to imagine how many earths it would require to colonize.”

- Mahatma Gandhi
Trends in Globalised World:

- Faster Pace
- Borderless World & Opportunities
- Convergence
- Personalisation and Individualisation
- More informed and Higher Expectations – Seamless Mobility, Seamless Relationship
- Cost-Effectiveness
- Knowledge is Power
Trends in the Globalised World:

Past and Current
- Small Group of Experts
- Hardware
- Big Capital Investment
- Controlled Environment
- Local Markets

Future
- Human Centric
- Knowledge Creation
- Software
- Small Investment
- Open Market
- Free Market
Education – The Driver

- Source of Human Capital
- Uplifting of Poverty
- Catalyst of Change and Innovation
- Driver of Economic Growth
The US Experience

➢ In 2005: General perception – US competitiveness in global economy declined in comparison to China, India, Korea and Singapore

➢ US National Academies commissioned by US Congress to study the phenomenon and offer recommendations

➢ Study Report: “Rising Above the Gathering Storm”
Facts & Statistics in Higher Education & Research

Highlight 1

Percentage of Undergraduates in Natural Science or Engineering
Facts & Statistics in Higher Education & Research

Highlight 2

34% of natural science and 56% of engineering doctoral degrees were awarded to foreign-born students.

Highlight 3

In 2000: 38% of the U.S. workforce with PhD qualifications in the fields of science and technology were foreign-born.
Facts & Statistics in Higher Education & Research

Highlight 4

Number of Engineering, Computer Science & Information Technology Students in 2004

<table>
<thead>
<tr>
<th>Country</th>
<th>Duration of Degrees</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>4 years</td>
<td>350,000</td>
</tr>
<tr>
<td>U.S.</td>
<td>4 years</td>
<td>140,000</td>
</tr>
<tr>
<td>China</td>
<td>3 years</td>
<td>190,000</td>
</tr>
<tr>
<td>U.S.</td>
<td>2–3 years</td>
<td>85,000</td>
</tr>
</tbody>
</table>

- Over the past 3 years, China and India have doubled their number of graduates for the 3-year and 4-year degrees.
- U.S. has only doubled the number of graduates of computer science and information technology while the number of engineering graduates has remained stagnant.
Facts & Statistics in Higher Education & Research

Highlight 5

About 1/3 of U.S. students with initial intention to major in engineering eventually switched their majors before graduation

Highlight 6

More S&P 500 CEOs with engineering background than in any other field

Source: www.nap.edu
Interest in Science & Engineering is Declining (US)

% of S&E degrees awarded

Total no. of degrees awarded

Source: NSF, US.
US Secretary of Energy, Nobel Laureate Steven Chu:

“For America to stay competitive in global market, we must train and retain the world’s best engineers. Working together, private industry and the public sector can position the U.S. to continue to lead in science and innovation in the 21st century, creating good jobs and laying out the foundation for a robust economy.”
Innovation: The Way To Go

Human Capital – core of innovation and a productive high income economy

Human Development Index 2010

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Norway</td>
</tr>
<tr>
<td>2</td>
<td>Australia</td>
</tr>
<tr>
<td>3</td>
<td>New Zealand</td>
</tr>
<tr>
<td>57</td>
<td>Malaysia</td>
</tr>
<tr>
<td>89</td>
<td>China</td>
</tr>
</tbody>
</table>

Source: United Nations Human Development Reports 2010
Malaysia Responses to Challenges

- Human Capital Development
- Productivity
- Innovation and Creativity
- Conducive Environment and Policy
- International Bench-Marking
12 National Key Economic Areas

- Oil, Gas & Energy
- Greater Kuala Lumpur
- Agriculture
- Education
12 National Key Economic Areas (cont’)

- Palm Oil
- Communications, Content & Infrastructure
- Tourism
- Financial Services
12 National Key Economic Areas (cont’)

- Business Services
- Electronics & Electrical
- Wholesales & Retails
- Healthcare
Malaysia’s Target

Tertiary education enrolment (out of the total tertiary education-age population) has grown from 23% in 1999 to 30% in 2007

Target: 50% in 2020
### Integrated Human Capital and Talent Development Framework for Malaysia

<table>
<thead>
<tr>
<th>Ages</th>
<th>Themes</th>
</tr>
</thead>
</table>
| 0+   | • Ensuring every child succeeds  
      • Holding schools accountable for outcomes  
      • Investing in great leaders for schools  
      • Attracting and developing the best teachers |
| 4+   | • Mainstreaming and broadening TEVT  
      • Enhancing the competency of tertiary graduates |
| 5+/6+| • Accelerating labour reform  
      • Attracting and retaining top talent  
      • Upgrading existing talent pool |
| 17+  | • Revamping education system to significantly raise student outcomes |
| 20+  | • Raising skills to increase employability |

**SOURCE:** Economic Planning Unit
Mainstreaming Technical Educational and Vocational Training: Dual-Pathway to Employment

ACADEMIC PATHWAY

Primary and Lower Secondary

Secondary Academic Schools

Sixth Form

Matriculation

Universities

TECHNICAL PATHWAY

Secondary Technical Schools

Technical Stream

Vocational Stream

Skill Stream

Poly-technics

Community Colleges

TEVT² Institutions

Advanced TEVT² Institutions

EMPLOYMENT

1 TEVT Institutions include MARA Skills Institute, Industrial Training Institute and National Skills Institute for Youths
2 Advanced TEVT Institutions include German-Malaysian Institute, Japan-Malaysia Technical Institute and MARA Advanced Skills Institute

SOURCE: Economic Planning Unit, Ministry of Education and Ministry of Higher Education
Total Enrolment IPTA vs IPTS, 2002 to 2007

Source: Ministry of Higher Education, Malaysia
First Degrees Awarded in Malaysia

Source: MOHE
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
How to help to Train our Students to have inquisitive Minds?

How to give Exposure to the Students?

How to help to develop their Interests and Potentials?

What kind of Soft Skills and Hard Skills does one need?

Where is the Balance between “Ready-to-Market” and “Ready-to-Evolve” Training (Utilitarian versus Scholarly?)?

How to train a Person with Globalised Outlook?
SETI 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
SETI Knowledge Workers

- Highly Educated and Broad-based
- Life-Long Learning – Continual Professional Development
- Ability to Update – Just-in-time
- Flexible
- Creative and Innovative
- Communications and Human Networking
- Sociality and Humanitarianism
- Integrity and Morality
Engineering Graduates – Country Comparison

Statistics for 2009

- China – 1.9 million graduates  
  *Source: Ministry of Education of the People’s Republic of China*

- Malaysia – 15,043 graduates  
  *Source: Ministry of Higher Education, Malaysia*

- United States – 67,882 graduates  
  *Source: US Department of Education*
Statistics for Engineers

- **Malaysian Labor Force as at July 2011 is 12,741,200**
  
  *(Source: Principal Statistics of Labor Force, Malaysia, July 2011)*

- **As of November 2011, Professional Engineers stood at 10,704 while Graduate Engineers at 60,130**
  
  *(Source: Board of Engineers Malaysia)*

- **Approximately 54 engineers per 10,000 labor force in Malaysia**
Engineering Education

• Strengthening of the Fundamentals
• Development of Engineering Mind
• Knowledge Exploration
• Self-Development
• Social Network Linkage
• Surviving Constraint Challenges
Questions about Engineering Education?

• Tough
• Boring and too technical
• Squared face
• No time
• Simply too many problems
Who says engineers are ‘squared’ people?

Mr. Bean (Rowan Atkinson): graduate of Newcastle University and Oxford University, both in England; earned degrees in electrical engineering

http://www.rowanatkinson.org/biography.htm
Who Should Study Engineering?

- Only those who excel in **science** and **love to innovate** new gadgets/instruments for the benefit of mankind will succeed in Engineering education.

- Engineering is a **lifelong education** and engineers shall continue to keep abreast of the technology and contribute toward technology advancement.

- A **solid foundation of classical theories** is prerequisite to understanding of the state-of-the-art technologies.
Engineering Education Philosophy

- Morality & Professionalism
- Knowledge and Intellect
- Physical and Mental Health
- Sociality and Humanitarianism
- Aesthetics and Harmony
- Creativity and Innovation

Nurturing Competitive Human Resource
Innovation in UTAR’s Education:

- Exposure to Sun Tze Art of War, Law, Management and Accountancy

- UTAR Soft Skills Development Certificate System:

  7 core components:
  
  - Communication and Language Skills
  - Critical Thinking, Creative Thinking and Problem Solving
  - Emotional Intelligence and Teamwork Skills
  - Moral and Professional Ethics
  - Leadership Skills
  - Lifelong Learning and Information Management
  - Entrepreneurship
Innovation in UTAR’s Education:

- **Community Projects:**
  - *UTAR New Village Community Project*

- **Nurturing ‘Innovation’**
  - *Entrepreneurial Talk Series*
  
  Experience sharing by entrepreneurs of various industries and backgrounds

- **Flea Market**
  
  Trading of goods and items at reasonable prices
The UTAR Experience

**UTAR New Village Community Project:**

- Students are encouraged to carry out projects on new villages in Malaysia.
- It is a voluntary activity.
- The project can be carried out individually or in teams of 4-5 members.
Some Small Achievements

UTAR New Village Project

COMPLETED PROJECTS: 93
Uploaded: 57
Pending editing: 36

PROJECTS IN PROGRESS: 117
Baiku Yao Project

- Toilet and Sanitary Project in Jing Cheng Jiang District, Guangxi Province, China
- Collaboration between AAET and Disease Prevention & Control Centre of Jing Cheng Jiang District
- With AAET’s funding, 20 hygienic toilets were set up in 2010/2011
Examples of International Collaboration In SETI

- UTAR Global Research Network – International Collaborative Partners UTAR
- Cultural exchange: Mokpo National University, Inje University Korea
- Student Internship: French interns from Telecom Lille1 Ecole D’Ingenieurs, France
- Student educational tours to universities in China, Taiwan, US, etc
More International Collaborations in Education

- Staff Exchange – R&D and Appreciation Visit
- Student Cultural Exchange and Networking Programme
- Short Term Language and Communication Attachment Programme
- Community Projects
- Training Centre for Human Networking
Malaysia’s Initiatives on Innovation

National Innovation Council

Science, Technology and Innovation (STI):

• Driver for an innovation-led economy.

• With the focus on information and communications technology (ICT) development, biotechnology, industry and services sectors

- Malaysia Innovative Programme (MI2010)
- Year 2012 to be the Year of Science
Malaysia’s Initiatives on Innovation

Talent Corporation Malaysia (TalentCorp)

- Assumes a catalytic role in attracting, creating and motivating a world-class workforce
- Facilitator to both industry and private sector
- Programmes:
  - MyWorkLife
  - Malaysia My Second Home
  - Scholarship for Foreign Students
Learning of Science: Inquiry-based Science Education

• Training of Inquisitive and Creative Mind
• Increase Interest of Maths and Science in Primary and Secondary Schools
• La Main à la Pâte (LAMAP) of the French Academy of Sciences (www.lamap.fr)
• Handsbrain in China championed by Prof. Wei Yu (www.handsbrain.com)
Hands-Brain Experiments in Malaysia

**Objective:** To enable children to learn science through hands-on experiments on commonly encountered daily experience.

**Collaborative partners:** AAET and UTAR

**Outcome:** A booklet containing details (experiment objectives and steps, resources needed, observations to be made, concept and theory behind, info and link for further exploration, etc.) of about 30 experiments for pre-school and primary school children to be given free to schools in the South East Asia region.
Examples of Experiments

Primary 4
- Invisible Ink
- Green Pennies
- Layering
- Layered Liquids-Density

Primary 5
- Dancing Bubbles
- Burning Candle Over Water
- Bending Water With Comb

Primary 6
- Magic Solution
- How Friction Works?
- Rocket Balloon
Layering Experiment

• **Objective:** To study the density of different matters.

• **Materials required:**
  A glass/clear plastic cup, Water, Vegetable Oil, Honey

• **Procedures:**
  ✓ Fill in some water into the glass/clear plastic cup.
  ✓ Carefully pour the vegetable oil into the glass/clear plastic cup.
  ✓ Wait for a while and then carefully pour the honey into the glass/clear plastic cup again.
  ✓ Observe the liquid in the glass/clear plastic cup.
Creativity & Innovation Stories

- Airplane
- Apple tree & gravity
- Canned food
- Ceiling fan
- Chewing gum
- Disposable diapers
- Envelope
What IEM could DO more:

International Bench-Marking
Set Standards
Go Global – Human Networking
Back-to-Schools
Improve Image of Engineers
Speak Up – Be Trend Setters
Every morning in Africa, a gazelle wakes up.
It knows it must run faster than the fastest lion or it will be killed.

Every morning a lion wakes up.
It knows it must outrun the slowest gazelle or it will starve to death.

It doesn’t matter whether you are a lion or a gazelle.
When the sun rises, you better start “running”
THANK YOU
Terima Kasih
谢谢