PREPARING ENGINEERS FOR RAPIDLY CHANGING GLOBAL WORLD

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MY EXPERIENCE IN EDUCATION

1983-now  Lecturer of Aerospace Eng. Dept. ITB
2000-2003 Chairman of Aerospace Eng. Dept. ITB
2003-2010 Director of Education of ITB
2010-now  Head of Quality Assurance Unit ITB

OUTLINE OF THE PRESENTATION

GLOBALIZATION
RAPID GROWTH OF TECHNOLOGY
INFORMATION AGE TO INNOVATION AGE
CURRENT & FUTURE ATTRIBUTES OF ENGINEERS
PREPARING FOR INFORMATION ABUNDANCE
PREPARING YOUR MIND

GLOBALIZATION

The Ten Forces that Flattened the World
... & Leveled the Playing Field

1. 11/9/89
2. 8/9/95
3. Work Flow Software
4. Open-Sourcing
5. Outsourcing
6. Offshoring
7. Supply-Chaining
8. Insourcing
9. In-forming
10. The Steroids

The World is Flat

A Brief History of the Twenty-First Century

By Thomas L. Friedman

Friedman has won the Pulitzer Prize three times for his work at the New York Times, where he serves as the foreign affairs columnist.

Preparing Engineers for Rapidly Changing Global World

prep: Dr. Ir. Ichsan Setya Putra / Institut Teknologi Bandung
The current globalization features 4 unprecedented trends:

1. The movement of capital and other market instruments around the globe
2. The movement of human beings across borders, 100 million immigrants at any one time around the world
3. The movement of information through cyberspace
4. The movement of popular culture (clothing, food) across borders

Three Stages of Globalization

Globalization 1.0 – 1492 to 1800, focus was on countries & muscles

Globalization 2.0 – 1800 to 2000, focus was multinational companies

Globalization 3.0 – 2000 to …, focus on individuals & groups to collaborate & compete globally

Globalization = Competition

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 comes up, you better start running.

Globalization = Collaboration
The world has changed!
What does it mean for me??

“The Scream”, Edvard Munch, 1893

RAPID GROWTH OF TECHNOLOGY

We always underestimate the rate of technological change & overestimate the rate of social change.”

Gerard O’Neil
Princeton, 1981

Prevising Engineers for Rapidly Changing Global World
Prof. Dr. Ir. Ichsan S. Putra - Institut Teknologi Bandung

"640K ought to be enough for anybody.”

Microsoft Chairman
Bill Gates, 1981

We are living in exponential times
The amount of new technical information is doubling every 2 years

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Two thirds of the jobs that will be available in the world by 2020 haven’t been invented yet!

The changing nature of technology means that you’ll be in the job market, all the time, even if you’re happily employed.

Allison Overholt, Fast Company, March, 2006

We are currently preparing students for jobs that don’t exist...

Using technologies that haven’t been invented...

In order to solve problems we don’t even know are problems yet...

Educating students for an uncertain future is like “training for the Olympics” without knowing which sport you will compete in.

In the history of human civilization, there have been only three waves of Transformation:

1. Tribal hunting and gathering to agrarian society
2. Agrarian society to the industrial revolution
3. The industrial revolution to the information/knowledge age

Jorge Vanegas, Is the Capital Projects Industry observant...? Is it prepared...?
A single modern-day newspaper contains more information than an average person in the 17th Century was likely to come across in their entire lifetime.

Number of web pages in 1995: 1.3 million
Number of web pages in 2000: 1 billion
Number of web pages in 2005: 10 billion
Number of web pages in 2008: 1 trillion

By 2010, it is predicted to double every 72 hours!

The amount of technical information is doubling every two years.

By 2017, iPod will contain the Library of Congress.

It is estimated that all the technological knowledge that is known today will comprise only 1% of all the technological knowledge available by the year 2030!
The amount of information available digitally will continue to increase dramatically. 

The percent of digital information and services used by people will continue to increase dramatically.

**However…**

How Do I Prepare Myself in the World with such an Abundant of Information

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**We are now moving to the fourth wave:**

4. The information/knowledge age to the **Intelligence/Innovation Age!**

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但现在我们正在进入第四波：

4. 信息/知识时代到 智慧/创新时代！

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但我们的一些创新确实成功了。

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我们需要抓住机会并睁大眼睛...

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“婴儿伸手去拿苹果” Mary Cassatt, 1893
CURRENT & FUTURE ATTRIBUTES OF ENGINEERS

EC 2000 General Criteria

Criterion 3. Program Outcomes and Assessment

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a recognition of the need for, and an ability to engage in lifelong learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Needed Attributes:

- Analytical skills
- Creativity
- Ingenuity
- High ethical standards and strong sense of professionalism
- Leadership
- Lifelong learning

21st Century Skills

- Creativity & Innovation
- Problem Solving
- Critical Thinking
- Communication
- Collaboration
- Information Fluency
- Technological Literacy

PREPARING FOR INFORMATION ABUNDANCE
### Information Problem #1: Overload

- Information overload, information anxiety
- Just too much “stuff”; people can’t keep up.

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### Information Problem #2: Quality

- Researchers (Rand) checked out 6 health Web sites and 12 sites dedicated to specific diseases.
- How frequently Web sites are complete and accurate:

  - Breast cancer: 63%
  - Depression: 44%
  - Obesity: 37%
  - Childhood asthma: 33%

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### Information Problem #2: Quality

In a study of 500 sites used by Colorado high school students to do research, only 27% of the sites were judged to be reliable for academic research!

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### Search Google: Globalization and the role of engineering

- Found 3,970,000 possible sites through Google.
- If spent 2 minutes on each, would take over 132,000 hours (more than 15 years) to review.
- Assuming at least the 200 to review. Using these meaningfully could easily take 400 minutes or more than 6 hours.
- Assuming 5 websites to read for 1 hour each
- Total Potential time to spend: or almost 11 hours!!!

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### You Have to be Information Literate

Information literacy is a set of abilities requiring individuals to “recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.” (American Library Association)

http://www.youtube.com/watch?v=KIUhvFxQ8C4
While more young people have access to the Internet and other media than any generation in history, they do not necessarily possess the ethics, the intellectual skills, or the predisposition to critically analyze and evaluate their relationship with these technologies or the information they encounter. Good hand/eye co-ordination and the ability to multitask are not substitutes for critical thinking.

Dr. David Considine, media educator, Appalachian State University

1. Task Definition
   - Define the problem
   - Identify the Needed Information

2. Information Seeking Strategies
   - Determine possible sources
   - Select the Best Sources

3. Location & Access
   - Locate sources
   - Find information within sources

4. Use of Information
   - Engage
   - Extract information

5. Synthesis
   - Organize information from sources
   - Present the result

6. Evaluation
   - Judge the result
   - Judge the process

Melissa Dow: Teaching the Big 6: Promoting Student Information Literacy

1. The Disciplined Mind

Mastery of a major schools of thought (including science, mathematics, and history) and at least one professional craft.
2. The Synthesizing Mind

Ability to integrate ideas from different disciplines or spheres into a coherent whole and to communicate that integration to others.

3. The Creating Mind

Capacity to uncover and clarify new problems, questions, and phenomena.

Do you pay for function or do you pay for meaning?

Inventiveness is Your Right Brain Capacity

LEFT brain
Logical, linear, computer-like

RIGHT brain
Inventiveness, meaning, empathy, joyfulness

4. The Respecting Mind

Awareness of and appreciation for differences among human beings.
5. The Ethical Mind

Fulfillment of one’s responsibilities as a worker and a citizen.

CONCLUDING REMARKS

Successful Engineers in the Future:
- Possess not only cognitive power
- Creativity & innovation power
- Good attitude

Doing Good Work as Engineers:
- Engaging/Enjoying
- Excellent results
- Ethically pursue

THANK YOU VERY MUCH