IGIP - International Society for Engineering Education

IGIP Regional Conference 2010

“Engineering Education for Sustainable Development”

Beuth Hochschule für Technik Berlin
6-8 May 2010

“Engineering Education - the key to Sustainable Development”
Thursday 6 May, 14.30-15.00

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Basic and Engineering Sciences, UNESCO
IGIP Regional Conference 2010

Thank you for inviting me to speak at the IGIP Conference on:

“Engineering Education - the key to Sustainable Development”

Wilhelm von Humboldt (1767-1835)
Father of the “Humboldtian model” of engineering education, and the University of Berlin – the "Mother of all modern universities”

Christian Peter Wilhelm Beuth (1781-1853)
Father of Prussian industry
Namesake of the Beuth University of Technology Berlin - formerly the Technical University Berlin
Peter Beuth to Wilhelm von Humboldt …

... some themes of my presentation

Engineering needs promoting and engineering education needs transforming to attract young people and address sustainable development and climate change.

Yes - the Humboldtian model needs an update - perhaps IGIP and UNESCO can help.
Engineering drives development

Knowledge drives social, economic and cultural development

Knowledge relates particularly to engineering, science and technology (EST)

Knowledge application and innovation, at all levels, is essential for addressing the UN Millennium Development Goals (MDGs), especially:

- reduction of poverty and the eradication of extreme poverty,
- sustainable development, climate change mitigation, adaptation
  although this is often overlooked

Knowledge in EST is a major factor in social change/ transformation technology reflects political-economy of decision making

Technology and technological trajectories are shaped by society:
EST is an essential part of culture (eg Stone/Iron/Info Ages etc)
Serious issues and challenges facing the world

39% people do not have safe water – 2.6 billion human beings

35% people do not have improved sanitation - 2.3 billion

24% people do not have electricity - 1.6 billion

20% people live in poverty (<1$/day, 70% women) – 1.3 billion

15% people lack adequate housing/live in slums – over 1.0 billion

15% people lack any ICT connection – over 1.0 billion

13% people go hungry every day - 852 million

Life expectancy - poor countries: 52 years; rich countries: 78 years

These are engineering problems with engineering solutions!
UN Millennium Development Goals (MDGs): 2000 - 2015

8 MDGs, 18 quantifiable targets measured by 48 indicators

1. Eradication of extreme poverty and hunger
2. Achievement of universal primary education
3. Promotion of gender equality and empower women
4. Reduction of child mortality
5. Improvement of maternal health
6. Combating HIV/AIDS, malaria and other diseases
7. Ensuring environmental sustainability
8. Development of global partnership for development
   (including reference to knowledge, science and technology)
Knowledge and poverty reduction

Poverty is a reflection of the limited access of people to knowledge and resources with which to address basic needs, including:

- water supply, sanitation, housing, food production, energy, transport, communications, income generation, job creation

Knowledge in engineering and technology help poor people to reduce poverty and promote sustainable livelihood development.

Issues and challenges with knowledge relate to:
- access and application
- increasing knowledge divide between rich and poor countries

Knowledge divide – more serious than the digital/economic divides

Knowledge divides us, especially knowledge in EST
Engineering for sustainable development

Engineering is vital in addressing issues of sustainable development, link to Decade of Education for Sustainable Development (2005-14) - UNESCO is the coordinating UN agency for the Decade

Activities need to focus on environmental/ecological engineering:
- waste management, water supply and sanitation
- cleaner production and recycling
- energy efficiency, conservation and renewables


E-pub “Introduction to Sustainable Development for Engineering”

Development of activity on engineering and technology for climate change mitigation and adaptation
Engineering, innovation and climate change

The most specific and pressing need for engineering and innovation in sustainable development relates to climate change.

The Intergovernmental Panel on Climate Change emphasises climate change mitigation, adaptation, technology, finance and investment.

Key mitigation and adaptation issues relate to technologies in such areas as: energy supply, efficiency and conservation, transport, building construction, industry, agriculture and forestry.

The reduction of greenhouse gas emissions relates particularly to the need for:

- lower-emission technologies,
- more efficient available technologies
- R&D, demonstration and investment in new technologies, including carbon capture and storage technologies.
Engineering, poverty reduction, sustainable development and the MDGs

Engineering and innovation are vital in addressing the MDGs, especially poverty reduction and sustainable development, at two levels:

Macro-economic/infrastructure development

Micro-level direct applications

At the macro level, SET, innovation and enterprise supports economic, industrial and infrastructure development.
Engineering, innovation and development

Innovation and engineering applications:
Not just hi-tech
Includes introduction of technology that is new to the user and user-group
eg – new water pump for African farmers:
Intergovernmental Panel on Climate Change

IPCC Major findings:

- The planet has warmed
- Greenhouse gases continue to increase
- Climate models have greatly improved
- Most warming most likely due to greenhouse gases
- Greenhouse gases will continue to rise through 21\textsuperscript{st}C
- Warming will continue through the 21\textsuperscript{st}C

(Graeme Pearman, Australian Climate Group)
Small changes have a big impact:

Since 1979, more than 20% of the Polar Ice Cap has melted away.
Engineering, innovation and climate change

Small responses can also have a big impact ...

Specific options include:

- Improved end-use efficiency
- Higher efficiency combustion technologies
- New automotive technologies
- Decentralized power generation
- Affordable renewable technologies
- Capture and sequestration of CO2 from power plants

(Graeme Pearman, Australian Climate Group)
Overall challenges for engineering

Face the challenges of sustainable development, climate change

Economic crisis – infrastructure and engineering important

Promote engineering as problem-solving, part of the solution

Promote public/policy perception/understanding of engineering

Engineering capacity and capacity building:
  decline of entry of young people into engineering, esp women
  we need more engineers, greener engineers

Failure to meet challenges
  not enough engineers, brain drain, skills shortage
  impact on development, developing countries
Internal challenges for engineering

Need to make engineering education more interesting/relevant

To do this, we need to make university courses more interesting:

- Better learning/teaching pedagogy, curricula, materials
e.g., problem-based learning, just-in-time, hands-on
  (e.g., less differential equations in first year – Humboldtian model)

- Emphasis on problem-solving engineering and applications
to address major issues facing the world – e.g., poverty, SD

Solve two challenges at once:
- Face issues of sustainability, climate change
- Attract students to engineering
  - e.g., growth of Engineers Without Borders groups
Particular need to:

Assist developing countries in promoting innovation and associated support policies, capacity building, staff exchange, studentships and information exchange,

Develop strong partnerships with developing country counterparts, especially R&D cooperation with partner countries,

Help increase R&D capacities in developing countries with support funds and services,

Help disseminate R&D results from developing and developed countries, support innovation, technology transfer and associated policies and investments.
Science and engineering at UNESCO

The basic and engineering sciences, science and engineering education, were until the 1980s the main areas of activity in the Natural Sciences Sector of UNESCO.

The 1980s saw the rise of the environmental sciences - the ecological sciences, earth sciences, water sciences and ocean sciences, and associated intergovernmental programmes (IOC, MAB, IGCP, IHP, IBSP).

With the rise of the environmental sciences, interest in and funding of the basic and engineering sciences declined, despite their importance as the basic building blocks and applications of knowledge and despite the importance of engineering in addressing that MDGs and climate change.
Engineering Sciences Programme at UNESCO

Staff and budget of the engineering sciences at UNESCO:

1965-6 staff: 10; budget: $300k + $3.3M UNDP
1984-5 staff: 24; budget: $28.9M total
2008-9 staff: 2; budget: $600k + $1.0m extra-budgetary

Engineering Sciences and Technology Division merged into the Basic and Engineering Sciences Division in 2002, following the demise of the World Solar Programme and associated activities

Programme areas of activity:

networking, conferences, workshops, seminars, applications, information, publications, project activities
Engineering Sciences Programme at UNESCO

Capacity building in engineering and technology
- Engineering education, learning/teaching materials
- Cross-sectoral activities in technical capacity-building

Engineering and technology applications to address the Millennium Development Goals (MDGs), especially:
- Poverty reduction, sustainable development

Promoting international cooperation in engineering
- eg WFEO, FIDIC, CAETS, IGI P

Various extra-budgetary and related activities
- eg Daimler-UNESCO Mondialogo Engineering Award, Sida “Innovation for Development”

Produced in conjunction with:

World Federation of Engineering Organisations (WFEO)
Int Council of Academies of Engineering and Tech Sciences (CAETS)
International Federation of Consulting Engineers (FIDIC)

The three main international engineering organisations are all partners in the Report.

Eight sections/chapters, 250 pages, A4
115 contributions originally invited, over 120 contributions received

Soft launch at the World Engineers’ Convention in Brasilia, 2008
Printed version and hard launch in September 2010
Engineering Report: Contents

1. Introduction
2. Engineering and development
4. Status report, issues and challenges for engineering
5. Engineering around the world – regional and country overviews
6. Engineering applications: issues and challenges for development
7. Engineering capacity: issues and challenges for education and training
Extra-budgetary activities include:

Daimler-UNESCO Mondialogo Engineering Award

To promote international cooperation among young engineers to design project proposals that address the UN MDGs

First round 2004-5, Second round 2006-7
Over 2,000 student engineers took part
Third round 2008-9, record participation:
932 project ideas from 94 countries

€300,000 in prizes to support project

Very successful, award-winning activity
Lots interest in sustainable development
Other publications include:

**UNESCO Toolkits of learning/teaching materials:**

- Gender Indicators in Science, Engineering, and Technology
- Technology Business Incubation
- Small is Working

**Major forthcoming publications:**

UNESCO Report:

- “Engineering – Issues and Challenges for Development”
- “Social Factors and Innovation: Renewable Energy in the Pacific”
International cooperation in engineering


UN Millennium Project Task Force on STI

Other networking: EWB, ESW
Possible UNESCO–IGIP cooperation

**Capacity and capacity building**

Need for better information and research on engineering and engineering education

**Transformation of engineering education**

Cooperation on activity/project/problem-based learning, in conjunction with above information and research

**Promote engineering applications**

As part of the solution, problem-solving, for MDGs – poverty reduction and sustainable development, activity on engineering for climate change mitigation and adaptation
Peter Beuth to Wilhelm von Humboldt ...

Engineering education is a serious business, but it should be fun – as psychologist Joanne Oppenheim said, “when the fun goes out of play, so does the learning”

Yes - if you are having fun, you learn more easily, even in engineering – which can be fun!