UCC Engineers Without Borders (EWB) Seminar

On Mapping the Global Dimension within teaching and leaning

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University College Cork, 20th November 2014

GDEE http://gdee.eu

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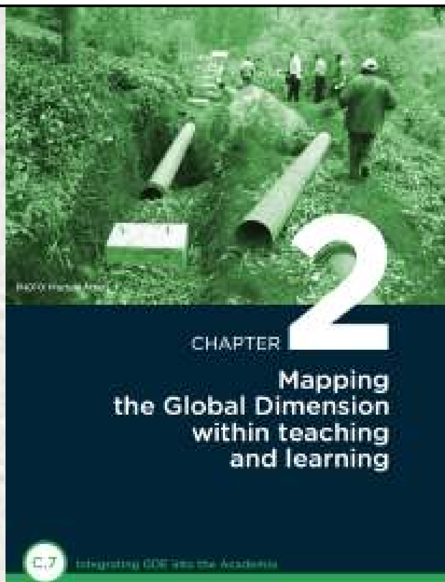

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Václav Havel
(1936-2011)

"I believe that every kind of centralisation is dangerous.
..it is quite possible that some of us will live in countries where the gross domestic product is growing by leaps and bounds, where everything is flourishing, the superstores are full of goods, the roads are teeming with lorries, energy is getting cheaper all the time, there is more and more construction, more and more industrial zones, bigger and bigger multiplexes, and more and more persuasive advertisements assail us from all sides – and yet everything is somehow dull, desolate, empty, soulless, ugly and, in spite of its pretense of diversity, infinitely uniform. And people are more and more nervous, disenchanted, lonely and sad."

V. Havel (Paris, 26 October 2004)

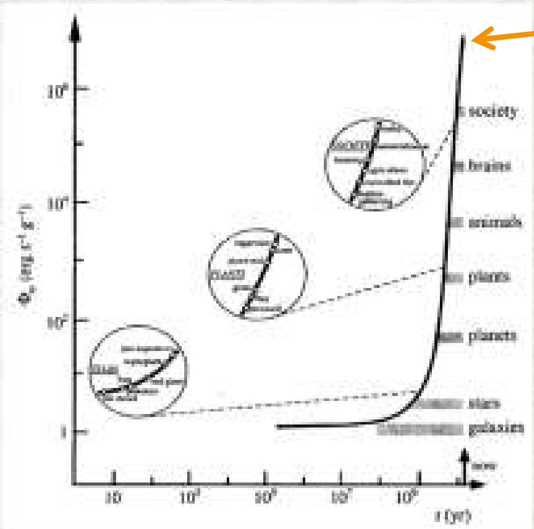
Contemporary global society confronting engineering graduates exhibits several interconnected meta-trends. These include unprecedented levels of:

- Anthropogenically induced **climate change**
- **Ecological destruction**
- Human induced **extinction event** (Halocene; 6th overall, but 1st by humans)
- **Human global population**
- Human **consumption** rates (energy, material, information)
- **Scientific knowledge** and capacity
- **Technological complexity** and encroachment on people's lives
- Human **connectedness** globally in an increasingly **globalized** world
- **Disconnect** between **humans themselves** and the **natural world**
- Plus: an **economic system** characterized by boom-bust cycles which both requires continual economic **growth** to maintain itself, and which tends to promote increasing levels of wealth concentration/economic **inequality**.

In addition, there are associated significant **health** and **social problems** globally e.g. elevated levels of unemployment, anxiety, isolation, violence, depression, obesity.

This is all clearly **UNSUSTAINABLE**.

'Big history': A story of increasing Complexity (⇧) and energy dissipation rate capacity (W/kg)



Now however, limits of growth (complexification) have been reached, within the finite planetary boundaries (material and energy) of the earth

Growth in complexity with time in terms of power density (Chaisson, 2005)

Complex systems cannot be managed and controlled deterministically but require pragmatic contingent interventions.

One possible intervention point is our education system.

For engineers and engineering educators, the education of engineers is an obvious starting point:

In the face of all this, ..*What can we do??*

"higher education needs to prepare engineers of the future with the skills and knowhow they will need to manage **rapid change, uncertainty and complexity**. Key here is the ability to tailor engineering solutions to the **local social, economic, political, cultural** and **environmental *context*** and to understand the impact of **local action** on the **wider world**."

Bourne & Neal (2008), The Global Engineer: Incorporating global skills within UK higher education of engineers. London. Engineers against Poverty.

Educating engineers to embrace complexity and context

This requires a radically transformative way not simply of 'doing' engineering but of fundamentally 'viewing' it.
The 'fit for purpose' Engineering graduate in this context must be educated to recognize (and consequently handle):

- The value of critical thinking
- The complex nature of the world in which we are living
- The increasingly vulnerability of economies/societies to global shocks
- An uncertain future with not necessarily easily identifiable solutions

Essentially this is Sharon Beder's 'New Engineer' (1998), exhibiting Edgar Morin's (2008) 'complexity thought'.

Byrne and Mullally

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Educating engineers to embrace complexity and context

Such an approach requires that engineers/engineering education adopt the following four perspectives (Bourne and Neal, 2008):

- A futures perspective

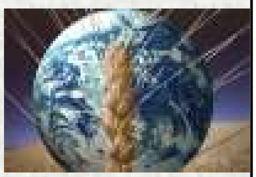
- A whole systems approach

- A business case

'It sort of makes you stop and think, doesn't it?'

- A critical perspective

Example of a Global Dimension change in perspective: Global food supply and demand



The Dominant Narrative:

- Global population growing; to reach 8-10bn by 2050
- Food production must increase by ca. 70% (FAO, 2009)
- To be achieved via a (techno-optimistic) projection of

the green revolution employing a number of productivist measures, including:

- Efficiency of production (e.g. "*yield improvements, adoption of improved production technologies, including improved seed varieties*", G8 New Alliance for Food Security, 2012)
- Technological initiatives (e.g. biotechnology/GM, agrochemicals, irrigation, synthetic fertilizers, etc.)
- Increased land use
- Liberalized international trade and economics of scale (moving from small subsistence family producers towards agricultural industrialization).

Example of a Global Dimension change in perspective: Global food supply and demand

A 'value free' conception of engineering education would uncritically adopt the values and ideology inherent in this dominant worldview.

However, A GD infused engineering education which requires critical thinking as well as a whole systems and futures perspective, would find this linear simple growth based 'solution' problematic on a number of levels.

A number of these shortcomings are highlighted in table 1 (p.12) of the chapter* (see next slides)

Global Dimension Perspective	Critique the dominant approach to global food problem: *"A third more mouths to feed [yet] food production will have to increase by 70%"* (FAO, 2009)
Critical perspective (recognising social consequences, complexity and uncertainty)	• Inequality is the main driver behind global hunger and food insecurity, not food production or population; there is ample food in the world to feed everybody, even with a larger population, problems of obesity and under nutrition mirror each other globally. • Fails to address problem of (hugely resource intensive) meat production as well as animal welfare issues around intensive agriculture; assumes increased per capita consumption of meat, whereas a reduction would help mitigate problems. • Increased uncertainty and reduced resilience as a result of a globalised productivist model of food production with ever longer and more efficient supply chains. • Most critically, the productivist model fails to recognise finite global limits of land and (material and energy) resources.
Futures perspective	• Economic growth is associated with dietary change, including higher consumption of meat and processed food, as well as rising obesity levels and associated health issues. • Potential for mass social unrest and war fuelled by a growth based intensification model within a finite global (land, material and energy) limits, as these limits (e.g. water, land, energy) are stretched and passed.

Whole systems approach

(recognising interconnectedness)

- A worldview characterised by reduction and separation ignores or plays down the reality of a multitude of deeply interconnected features which impact on production and consumption levels, and which are exacerbated by an intensive agricultural model 'solution' e.g.
  - climate change (and associated increase in extreme weather events)
  - water availability and stresses
  - energy security and availability
  - environmental degradation (freshwater resources, desertification, deforestation, soil fertility) and biodiversity loss
  - monoculture agriculture
  - effects of overfishing on marine biodiversity (Worm et al, 2006)
  - corporatisation and rural/agrarian unemployment
  - transnational and multinational land grabs within a globalised framework alongside displacement of indigenous rights and increased concentration of power and wealth, fuelling increased inequality
  - disempowering consequences of corporatisation and control of agricultural inputs e.g. through pushing the spread of genetically modified seeds
  - replacing family farm units with low paid (often migrant) farm workers
  - social disruption due to reduced viability of small farmholdings (unemployment, depression, suicide)
- The additional energy provided by food produced from a productivist model of intensive agriculture which employs large energy inputs (e.g. high technology, synthetic fertiliser and pesticides) is no greater than the additional energy provided by low intensive (e.g. more labour intensive, organic fertiliser) cyclical whole system approaches (Ho and Ulanowicz, 2005), though the former results in increased soil depletion and environmental degradation, as well as greater social alienation and unemployment. Moreover, monoculture crop

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models promote increased soil depletion and reduce productivity (Ho & Ulanowicz, 2005).

- Would support adopting policy supports for food production methods such as family farm units, organic farming, urban agriculture, grow it yourself, cooperative models of production and distribution/sales, small local retailers and markets as well as support for consumption patterns such as unprocessed, locally produced and vegetarian options.
- A circular economy which coheres with social and ecological cycles requires an alternative economics to the linear 'boom-bust' classical model which requires perpetual growth to avoid economic and social hardship (Jackson, 2009; Morgan, 2013; Barry, 2013; Alexander, 2014). Consideration of this, the nature of such a model and its implications for practice may be considered.

Business role

- Taking on board all the above, the case may be made for an alternative business (and perhaps economic) model to emerge, perhaps one based on small localised enterprises within a planetary whole, with an increased respect for the artisan over the mass produced, a transformative shift from the profit and shareholder/share price/quarterly performance driver to a longer term ethos which values the long term sustainability of the enterprise through rooting it in the locality, with local suppliers and customers, empowerment and profit sharing among staff and a recognition of the primacy for care of social and environmental factors.
- Engineers may also reflect on and critique the ethical implications of current business and economic constructs, and on their own future career paths and potential contributions.

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Comparing energy intensive (industrialised) with labour intensive (e.g. organic) agri production modes

Table 2 Comparing energy flow of high and low intensive models of agricultural production (data from Ulanowicz and Ho, 2005).

Rice fields	# Studies	Fossil fuel input (%)	Human input (%)	Energy Output / Input	Output-input (per hectare) GJ
'Pre industrial'	8	2-4	35-78	6.9-29.2	2.4-106.9
'Semi industrial'	10	23-93	4-46	2.1-9.7	51.75
'Full industrial'	7	95	0.04-0.2	>~1	55.66

- The ratio of energy output/input is far higher in the extensive model
- The total ΔE (output-input) can be just as high, and sometimes higher, with low intensive methods.
- *"There seems to be a plateau of output per hectare around 70–80GJ regardless of the total input"*

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Thank you

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