What do engineers need to learn about sustainable development?
Engineering Sustainable Development aims to balance the three elements:

- **Economic:** what things cost - and how to make a business out of providing infrastructure, goods or services
- **Environmental:** what impact those things have on nature and the earth’s support systems - which are finite
- **Social:** how those things serve the needs and quality of life of people and their communities
The current world view - relative importance?

- Environment ("technology can fix it")
- Economy ("inevitable laws")
- Society
But *this* is what we all ultimately depend on for life - so...
Becoming sustainable requires leaders who recognise this world view, and act accordingly.

Therefore - engineers can't be neutral - we are either making things better, or worse.
Engineers’ designs have a critical sustainability impact:

• “by the time the design for most human artefacts is completed….80-90% of their life-cycle economic and ecological costs have already been made inevitable”

• Or, in design:

  “All the really important mistakes are made on the first day”

  “Natural Capitalism” - 1999

So: to lead sustainable development, engineers must think differently - use a different design mentality - from that first day
Over the last 50 years, ‘development’ - comprising engineering projects, and products - has benefited large numbers of people, worldwide……………

The way we have been doing our development is often “unsustainable” - in social and environmental terms

This leads to real fears about the security and quality of life that my children, and grandchildren - and yours - and the world’s - can expect

“We do not inherit the earth from our ancestors - we borrow it from our children”

(Anon – Native American Indian)
Global Society in 2005: Unsustainable

- inequality, much poverty left;
- threat of decreasing quality of life

Sustainable Development is the journey towards Sustainability

A Future Sustainable Society

- basic needs and life quality provided;
- tolerable inequality;
- living within the Earth’s limits
What should engineers be doing about it?

• Choosing Technology

• Understanding the environment

• Appreciating the social challenges in making it happen
We need new challenges - redefine engineering culture away from “Building things”

The 19th (& 20th?) Century Engineer

Visible construction, at great public expense, to meet society’s wants

The 21st Century Engineer

Providing and Refurbishing the minimum to meet society’s needs
A huge new technical challenge:
- energy and materials efficiency

We can drive materials efficiency:
• “600 tonnes of material are used to make 60 tonnes of product of which 6 tonnes are in use 6 months later”
  (Lord Sainsbury, Minister for Science and Industry)

We can drive energy efficiency:
• “The whole economy is less than 10% as energy-efficient as the laws of physics permit”
  (From “Natural Capitalism” 1999)
Which of these is worth more of an engineer’s purpose, energy & interest?

“Video toothbrush”

In development by Panasonic, this electric toothbrush has a miniature video camera mounted beside the bristles to allow the user to see on a monitor the ‘40%’ of debris they normally miss.”

(TYNKYN - EC 11/01)

Rachel Battilana - refugee tent linings - 2001 Young Engineer of the Year
Choosing what you are engineering for - engineers can’t be neutral.

- Affluence
- Luxury
- Quality
- Needs

- OK
- Not So Good
- Good
- Maybe
- Good
- Not So Good

- Brilliant!
- Good
- Maybe

- No Net Impact
- In-Between
- High Impact

Leadership Impact
A new approach

- Sustainable development is NOT about doing things we are doing now, but doing them “less bad”.

- It IS about designing and producing products we need for a growing and prosperous society that are actually good.

Bernard Bulkin, Chair of the Sustainable Development Commission
The environment is unknowably complex. We need a "paradigm shift" in how we think about it...

**Mechanistic World** → **Systemic, Complex World**

- Newtonian Mechanics → Chaos and Complexity Theory
- Independant, linear, cause and effect → Interconnected, feedback loops
- Predictable outcomes → Uncertainty; patterns within disorder
- Arrogance over nature → Humility, within nature

So - technology can remove "natural" limits

Hence - narrow, blinkered, technical solutions

Hence, analyse systems holistically; understand feedback loops; apply the "Precautionary Principle"
Consultation - Society’s Changing Expectations

- "Trust Me"
- "Tell Me"
- "Show Me"
- "Involve ME"

Trend: Decrease in Transparency and Increase in Trust

Trust: Low to High

Transparency: Low to High
‘Social’ components can help deliver sustainable solutions

Local community ownership:

- 70% local co-operative ownership seems to be the key to Denmark’s success in avoiding ‘NIMBY’ for wind farms - ~ 10% of Danish power

- UK, wind farms are almost entirely private corporation owned, and overall market penetration is less than 0.15%

Is there any connection?
Engineers need to learn to engage better with communities, to implement the complex solutions that sustainability needs.

**Technical Complexity:**

We are developing the GIS, data handling and modelling to deal with geography, physics, chemistry, and even with the uncertainties of biology.

**Social Complexity:**

Now we also need to engage with the community, and develop the capability to consult, facilitate and agree on the complex solutions.

*This needs new engineering skills*
What do you think?  
- do you agree, or not?

• Should engineers be concerned with the ‘purpose’ and social dimensions of technology application?

• Is all this soft ‘society’ stuff not a proper subject for ‘real’, scientific engineers?

• How well do we really need to understand the environment?

• Can we extend our professional ‘ethic’ to include the environmental and social consequences?

• Can engineers take a lead in ESD – and would this encourage more young people to be engineers?
‘The Engineer of the 21st Century’
- some of the outputs:

• “Individual engineers should understand their personal ethics and values and those of their employers if they are to recognise those of others and influence change.”

• “Our vision is of an engineer who demonstrates through everyday practice:
  • an demonstrates of what sustainability means
  • the demonstrates to work towards this aim
  • demonstrates that relate to their wider social, environmental and economic responsibilities
  • and encourages and enables others to learn and demonstrates”
Conclusion…?

• So: we are not (yet) educating our engineering graduates to deal with the key issue of the 21st Century
Engineers can invent a sustainable future?

“We are all part of the continuum of humanity and life. We will have lived our brief span and either helped or hurt that continuum and the earth that sustains all life. It’s that simple. Which will it be?”

Ray Anderson, Interface Carpets - to other CEOs

“The best way to predict the future, is to invent it”

Alan Kay, Apple Computer
ImpEE is based at the Department of Engineering at the University of Cambridge and is funded by the CMI Institute.

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