Practical Skills and Techniques for the Transition to a Sustainable Future,

A Case Study for Engineering Education

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Context

The 1997 report of the Joint Conference on Engineering Education and Training for Sustainable Development in Paris called for sustainability to be:

“integrated into engineering education, at all levels from foundation courses to ongoing projects and research”

and for engineering organisations to:

“adopt accreditation policies that require the integration of sustainability in engineering teaching” (JCEETSD, 1997).

Research Questions

The following questions arise from a review of sustainability based initiatives:

1. *How does the view of sustainability, as held by peak engineering bodies, tally with the perceptions of those engaged in transitioning organisations to a sustainable future?*
2. *How have these principles been communicated through practitioners' education?*
3. *What aspects of practice are not reflected in these principles?*
4. *How might these be incorporated into engineering education?*

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Energy Management; original focus at the company's inception (1985) as cost savings and performance were clients' principal drivers.

Life Cycle Analysis; relationship between energy and emissions is becoming increasingly important for major companies with increasing awareness of climate change and its implications.

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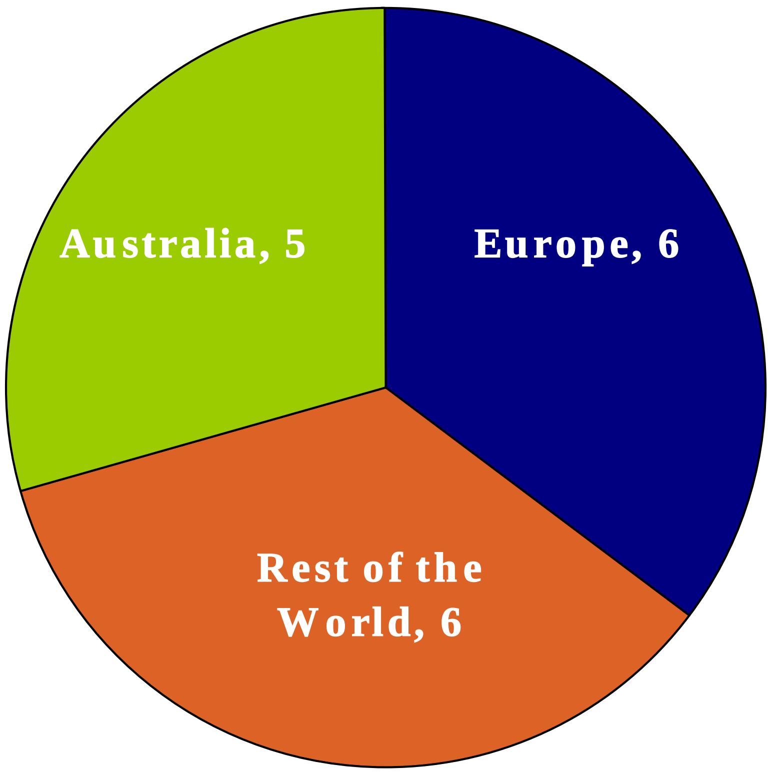
Mission: To be the climate change partners: tackling the challenges of climate change with ideas that unlock more value at the bottom line.

Vision: To be recognised as a leader in tackling the challenges of climate change.

http://www.energetics.com.au/

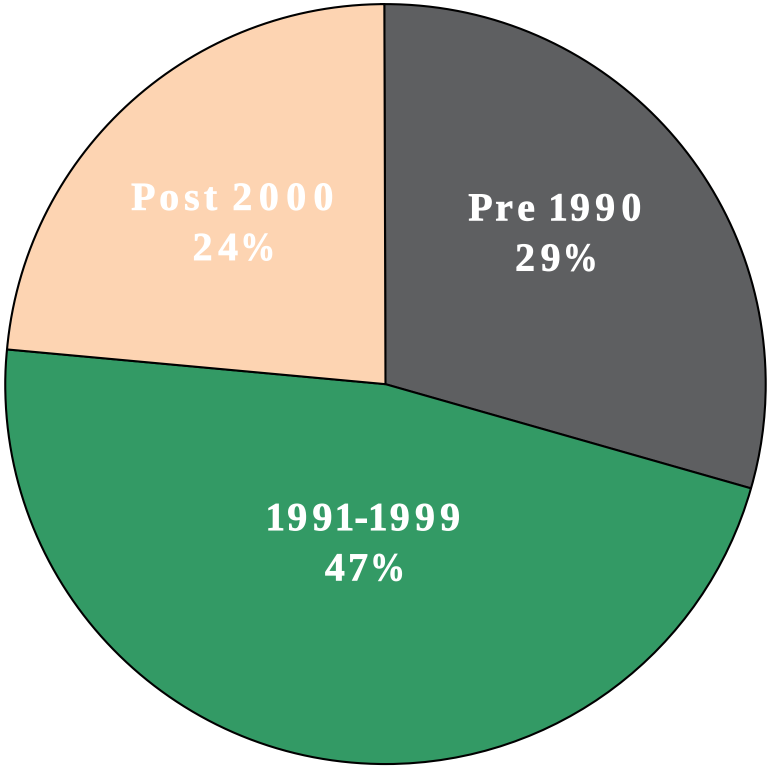
Participants' backgrounds

Geographical Distribution of Participants

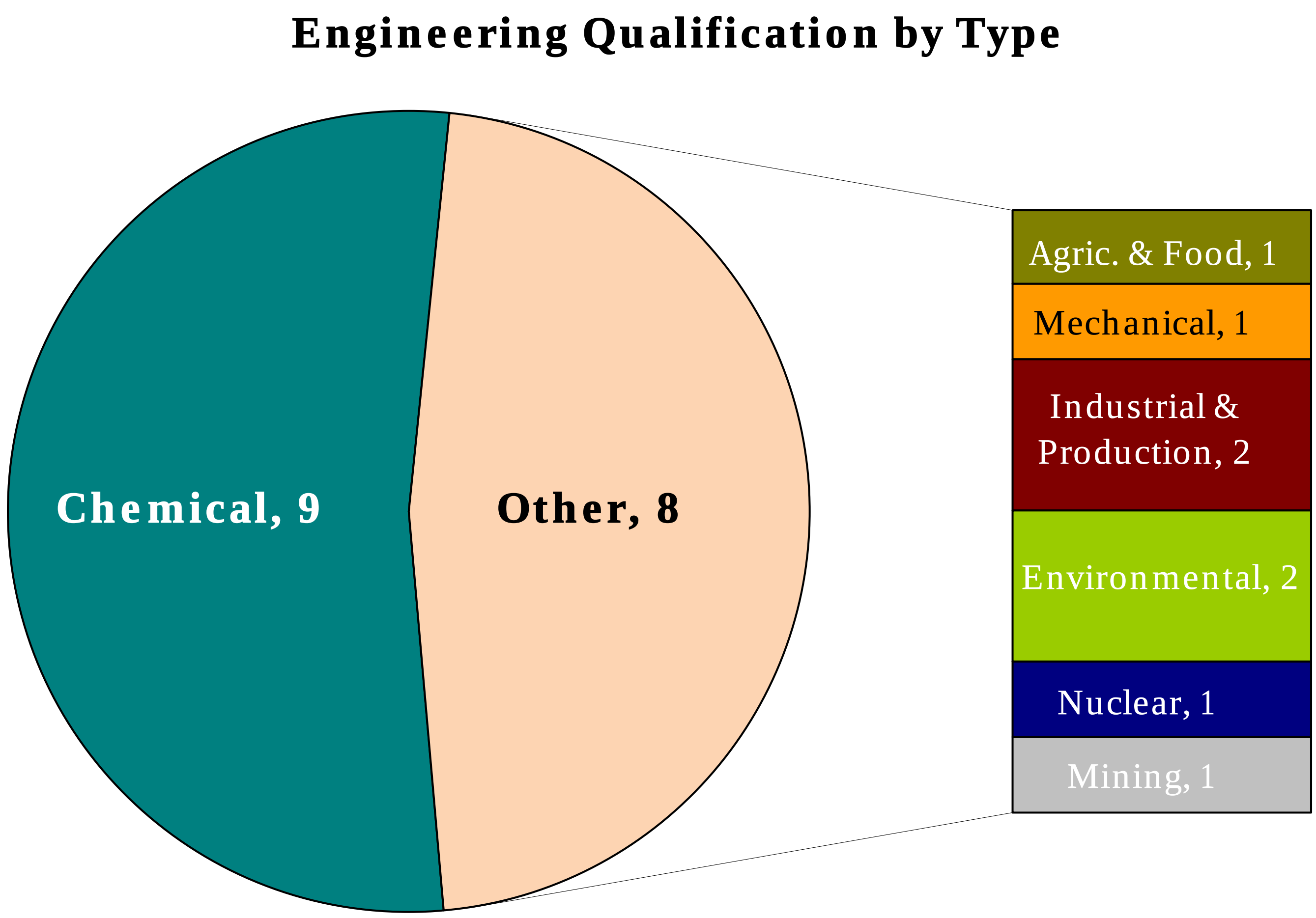


Participants' degree attainment

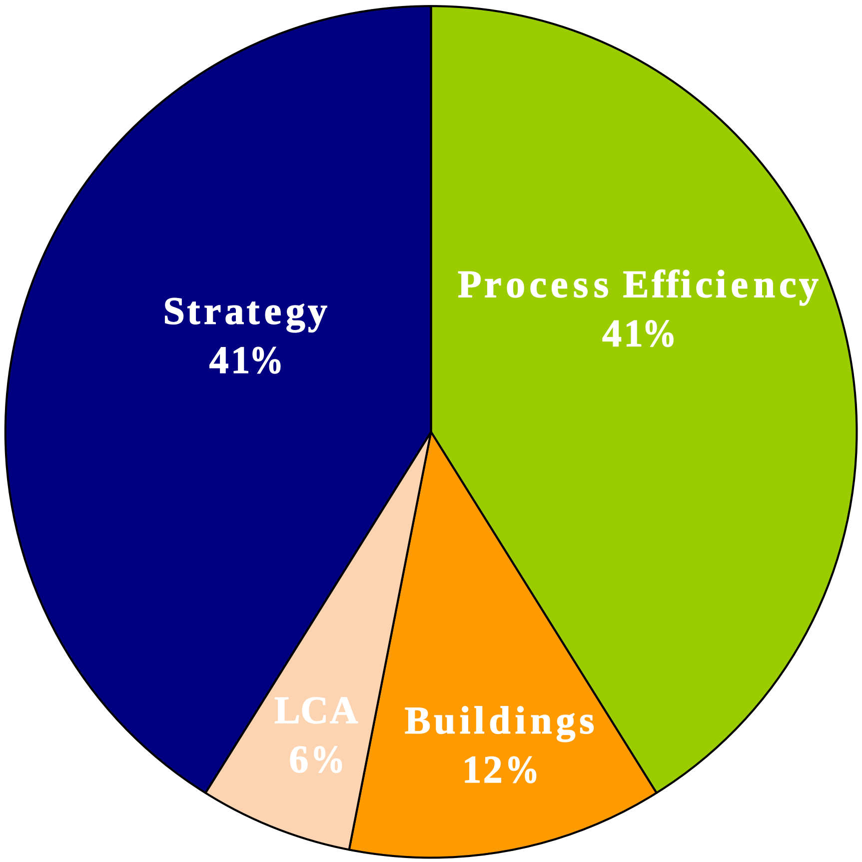
Participants' Year of Graduation



Primary degree of participants



Nature of work of participants



Sustainable Engineering Practice Review

- Melbourne Communiqué (2001)
- Shanghai Declaration on Engineering and Sustainable Development (WFEO, 2004)
- Engineering for Sustainable Development (RAE, 2005) Sustainability and Engineering in New Zealand-Practical Guidelines for Engineers (IPENZ, 2005)
- National Guideline on Environment & Sustainability (Canadian Council of Professional Engineers, 2006)
- Declaration of Barcelona (2004)
- Protocol for Engineering – A Sustainable Future for the Planet (ASCE/CSCE/ICE, 2006)
- Engineers Australia Sustainability Charter (EA, 2007)
- Guidance on Sustainability for the Engineering Profession (ECUK, 2009)

plus: Gagnon et al. (2008), Stasinopoulis et al. (2008), Ehrenfeld (2009)

Emerging Themes from Review:

1. Understanding how engineering decisions impact on a local and global basis
2. Providing cultural, political and social context to engineering design
3. Incorporating information from non-engineering stakeholders into designs
4. Providing an ethical framework for engineering decisions
5. Providing balance in solutions between cost and benefits, both to the client and the environment
6. Identifying qualitative aspects that may be impacted by engineering decisions (heritage, social exclusion, etc.)
7. Participating in problem formulation, not only solutions
8. Applying a Life Cycle Costing or Analysis to proposed designs

Emerging Themes from Review:

9. Regulations – understanding them, applying them and engaging in their development
10. Capacity to explain technical/engineering issues in layman's terms
11. Engaging with non engineering stakeholders in the decision making process/acting as part of a multidisciplinary team
12. Distinguishing between “weak” and “strong” sustainability *(the former allows natural capital to be substituted by human made capital, the latter does not)*
13. Recognising the importance of finding a pathway towards attaining sustainability as opposed to simply reducing unsustainability *(through for example, methods such as “backcasting”, as rather than just improved eco-efficiency)*

Participants' Interviews

These themes formed the basis of participants' interview. For each of the themes, participants were asked the following questions:

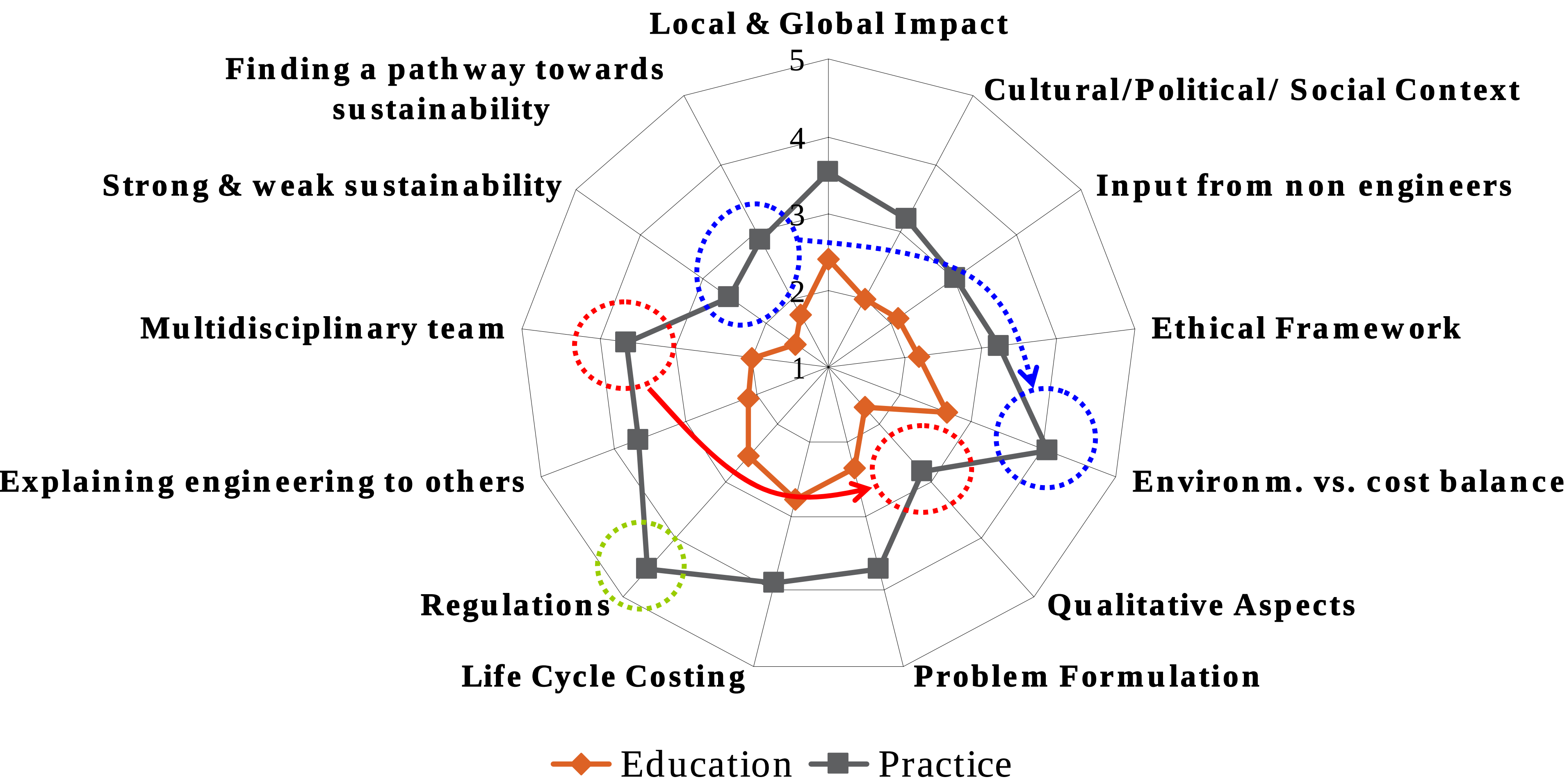
a) To what degree did your engineering education address the following areas?

b) To what degree do you employ these aspects in your current work?

c) What other areas do you feel you employ in assisting organisations to become more sustainable?

d) From these other areas, do you feel any of them should have been addressed by your engineering education?

Cover in Eng Degree vs. Employ@Work



Ethical Conceptions of Participants

Participants were asked to consider two models of engineering practice (Bucciarelli, 2008):

- *Ethical professionals with a responsibility to society as well as the client*
- *Agents of the client, bounded by client needs and legal requirements.*

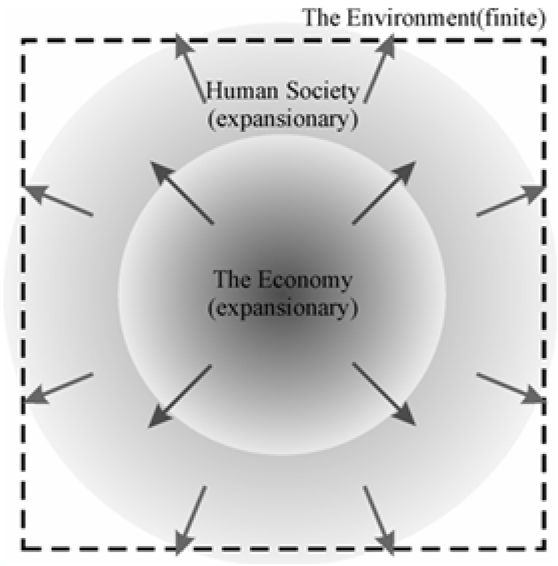
- Almost all considered their practice to be the latter.
- Ethics did not feature highly in people's education (apart from the Canadian respondent)
- Consequently engineers tend not to try to address sustainability issues unless directed to by the client & solutions are sought within regulations.
- However, this minimalist approach is usually insufficient in the achievement of sustainability: also conflicts with the ECUK Guidance on Sustainability (2009) which calls on engineers to:

"Do more than just comply with legislation and codes"

Business & Engineers' Role

Current business paradigm views sustainability in terms of efficiency and cost savings:

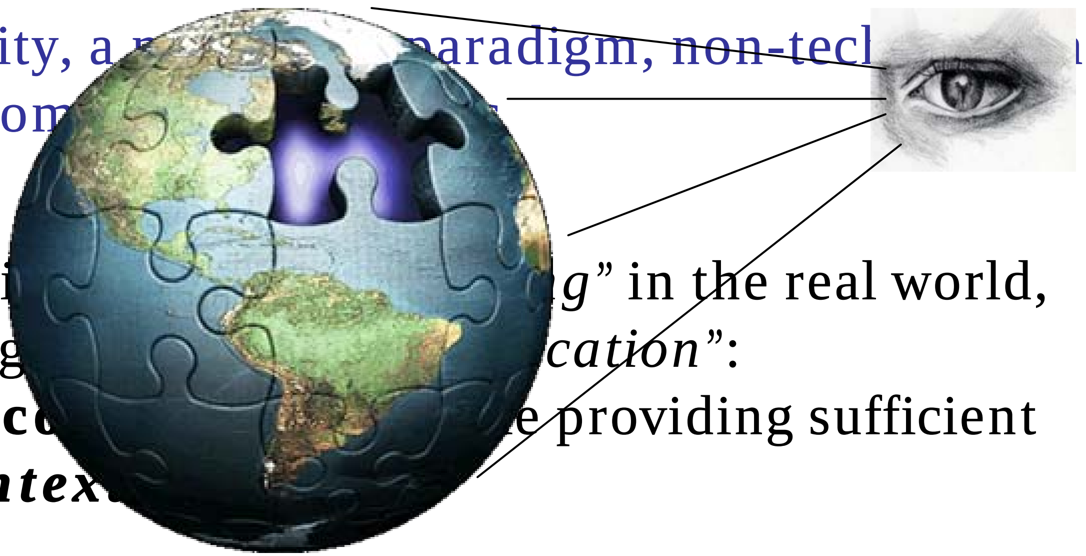
"Sustainability is viewed by the majority of our clients as resource efficiency. There is little commercial appetite in defining resource use limits at present. The case is made regularly to clients, but we are then directed to focus on cost and resource efficiencies."



Commentary

A **new role** for engineers is required to enable engineers be fit for purpose to engage with society in facing up to the substantial challenges of the 21st Century.

A broader role necessitates a **broader education**:
e.g. Embedding sustainability, a … paradigm, non-tec… nd
transdisciplinary courses, com…



Essentially, in order to achi… *g*" in the real world,
universities will have to eng… *cation*":
- i.e. Teach key **technical c**… e providing sufficient
understanding of their ***contex***…

Conclusions

Sustainability in engineering practice is still focused on the **technical and financial** impacts of perceived sustainable solutions.

Broader aspects have yet to be achieved in education or practice: Engineers have **narrow perception** of their role.

Regulation is a principal theme, but it can slow the deployment of sustainable practices in business, as it promotes lowest common denominator rather than encouraging best or **innovative practice**.

A sustainability informed **ethics** paradigm is required.

Engineers can be **agents of change**, but only when they can envisage a ***broader role*** and ***context*** and then ***communicate*** effectively with clients, partners and stakeholders.

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