Sustainability and Globalisation: a positive role for engineering

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***Abstract**: The paper explores the various meanings and implicit values of the two central concepts, 'sustainability' and 'globalisation', and considers their relevance for twenty-first century engineering education and practice. It discusses social and cultural issues associated with technology development and transfer, including their potential for strengthening communities. The paper concludes by suggesting how the engineering profession can recognise and build on positive values associated with globalisation.*

***Keywords**: engineering practice, globalisation, sustainability, values*

Introduction

Discussion of the concepts of *sustainability* and *globalisation* can be unhelpfully woolly and unfocussed. In this paper I will explore some of the competing meanings for these terms and suggest how, as a profession, engineers can respond positively to the forces underlying them. In order to map out sensible future directions for our disciplines, we need to acknowledge the complexities involved and face them squarely. Starting by acknowledging just how value-laden and emotionally charged this topic is may help us to make better sense of it. I make no apology for the fact that this paper is based on strongly held personal values. I will try to make these values explicit, so that they can be examined by my readers and tested against their own values.

Like every other profession, engineering faces a range of challenges in maintaining its relevance, fulfilling its responsibilities, and meeting social expectations for effective performance. The difficulty in meeting these challenges is compounded by both the dynamic nature of engineering practice and the lack of broad understanding of its role and character. Engineering is a social as well as a technical activity. The efforts of the engineering profession have shaped our modern world. Engineering activity underpins our material culture and is central to the production of knowledge and wealth in modern societies. As commerce and industry have taken on an increasingly global character, so have the engineering practices that support them. However, our self-awareness as engineers and our appreciation of the character of our profession have not necessarily kept up with these changes.

The practice of engineering changed rapidly over the twentieth century, and particularly during its last few decades (see, e.g., Johnston *et al*., 2000). Engineers have always managed human and technical resources. In the twenty-first century, engineers are also increasingly required to work across national and cultural boundaries and in multi-disciplinary and even

multi-lingual teams. Mathematics, Physics and Chemistry were the scientific disciplines underpinning traditional engineering specialties. As the boundaries of engineering have expanded, Biology and Computer Science have been added, supporting new specialisations.

As part of their work within multi-disciplinary teams, engineers are required to solve technical problems in their own specific disciplinary areas. In engineering, these areas continue to be based on reductionist engineering science approaches, which rigorously eliminate contextual issues from the process of analysis. Preparation for working within these specialised disciplinary areas continues to characterise engineering education, while consideration of the context in which the specialty will be exercised is commonly dismissed as involving 'soft' areas of study, unworthy of attention from 'real' engineering scholars. This narrowly focussed engineering education is inadequate and misleading. Engineering practice involves negotiation across disciplines and coping with the ambiguity and uncertainty that characterise real world technical decision making (Bucciarelli, 1994: 109-110; Vanderberg, 2000). Both the practice and the impacts of the engineering profession are now so powerful and so clearly international in scope that much more serious attention needs to be paid to the sustainability of our work at the global as well as the local level. Indeed, sustainability needs to become a major driver for change in engineering education and practice.

Sustainability

Both *sustainability* and *sustainable development* are contested terms, with a range of approaches and definitions (see, e.g., Beder 1996; Johnston, 1997). Perhaps the most useful way of thinking about *sustainability* is as an ideal state of long-term social, economic and ecological stability, a target towards which we strive, rather than one we expect to reach. The processes of striving towards sustainability, while still pursuing production goals and overall economic growth are commonly referred to as *sustainable development*.

Discussion of *sustainability* and *sustainable development* highlights questions about the extent to which it is possible and acceptable to draw down on the physical resources of the Earth. Since the pioneering work of the Club of Rome (Meadows, 1972) we have developed a more sophisticated understanding of the likely character of global limits to growth (see, e.g., Diesendorf and Hamilton, 1997). In one form or another, such limits exist, and they will constrain the range of our possible futures.

Biocentric or Anthropocentric?

The basic divide in the debate on sustainability and sustainable development is between approaches which can be characterised as anthropocentric (human-centred) and biocentric (concerned for all living things). The latter treats human life as part of the whole system of life on Earth. Its focus is on maintaining the integrity of all of nature's processes, cycles and rhythms. On the other hand, those following human-centred approaches emphasise human standards of living and are more willing to trade off the interests of other species. The Australian Government takes an anthropocentric approach, while environmental organisations like the Australian Conservation Foundation have adopted a more biocentric one (Beder, 1996). In practice, differences focus on environmental issues, and particularly on the extent to which biodiversity needs to be maintained, or to which 'natural capital' can reasonably be replaced by other forms of capital. The assumption that an 'appropriate value' can be put on loss of species or destruction of soils seems desperately shortsighted, particularly in a country like Australia, where half our topsoil has been lost since white

settlement. However, this value underpins much of what is still widely described as 'development'. Framing the difference in conceptual and design terms, we might see anthropocentric approaches as corresponding broadly with attempts to dominate nature, while biocentric approaches emphasise working with natural systems and respecting their possibilities and limitations.

The Australian Government policy development process in 1990 and 1991 referred to *ecologically sustainable development* (ESD). The s*ustainable development* part of that phrase is particularly problematic, in that 'development' has been widely used to mean increasing resource consumption, while 'ecological sustainability' carried an implication of limiting resource use. While the Brundtland Report (WCED, 1990: 85) defined sustainable development as: 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs', Beder (1995) pointed out that this definition is inadequate for the solution of modern environmental problems.

Issues of values and ethics are embedded in the everyday decisions of engineering practice. When we think deeply about the larger purposes of engineering, what we hope to achieve and how we can best go about our work, it becomes clear that these are matters that we need to discuss seriously and rationally, both within the engineering profession and with other stakeholders, including our clients and the wider community. In this process, sustainability needs to be recognised and accepted as a central value, and one not limited to environmental engineering, as seems commonly the case at present, but consciously incorporated into every specialisation across the whole profession of engineering.

A personal definition of sustainability

Sustainability has strong social, ethical, economic and environmental dimensions. I have tried to come up with a definition of sustainability that I would consider satisfactory, and I have been surprised at how difficult that is. This reflects the disjunction between what I want to happen, and what I see happening around me. I am reluctant to propose an unrealistically utopian definition. However, I am comfortable with nominating key values and directions that decision making with a sustainability focus should aim for. They include:

- Respecting and maintaining the social and cultural quality of life, including life at work;
- Promoting equity of opportunity across and between generations;
- Open, transparent, responsible and consultative decision making processes;
- Recognising the difference between capital and income and only taking what can be replaced;
- Respecting and maintaining the quality and diversity of our natural and built environments;
- Respecting nature and working with it rather than seeking to dominate it.

Positive approaches to sustainability

Engineers can contribute to advancing these values through socially responsible and socially responsive practice. One example would be to move from *technocentric* to *high-performance* design, moving away from using technology to eliminate jobs and towards using technology to maximise the effectiveness of human skill and knowledge in adding variety (and value) to the work they do (Johnston *et al*., 1999: 372-378).

If the world as a whole is to move towards more equitable resource use, affluent groups and nations will need to reduce their rate of resource consumption. Energy consumption on a per

capita basis in Australia and Western Europe is about half the US rate, but twenty times that of Asia, excluding Japan (Johnston *et al*., 1999: 444). While people may be prepared to change their focus from standard of living (rate of consumption) to quality of life (satisfaction of human needs), they are only likely to do so willingly if they believe that they are in well-informed control of their choices, in an open and responsive process. One role for engineering expertise in this context is to help consumers to think about the end results they need, for example in terms of *energy services*, like hot showers, or cold drinks. Moving from a *supply* to a *need* focus can help us to optimise energy and other systems in more sustainable ways.

Sustainability presents both technical and ethical challenges for professional engineers. There are potential drivers for change from inside the profession, including increasing attention to systems engineering, and to systems approaches generally (Johnston *et al*., 1999: 64-74). One of the problems with present approaches is the ways the system boundaries are drawn. If we think for example of the transport system, and the way motorcars fit into it, we can see high levels of sub-optimisation. More explicit consideration of systems issues can also broaden the 'discourses' of engineering – the range of issues we accept as proper and relevant when we think and talk and write about engineering. Once we start to consider urban transport systems, we can recognise that vehicle speed and performance are generally more constrained by the context than by the capabilities of the vehicle. We can then come to a more realistic assessment of appropriate and ecologically sustainable technical specifications for individual vehicles. Drawing on structured thinking about preferred futures, and specific techniques like Life Cycle Analysis, we can lift the quality of our decision making to a higher level (Johnston, 2002).

From outside engineering, 'triple bottom line' approaches to corporate accountability (with economic, social and environmental balance sheets: Elkington, 1997) and 'ethical investment funds' (AEI, 2001; EIT, 2001) can give important support for more sustainable approaches to engineering practice. So can regular broad assessment of corporate performance, like the 'Good Reputation Index', promoted by the *Age* and *Sydney Morning Herald* newspapers, which uses community and industry organisations to evaluate corporate performance in terms of: employee management; environmental performance; social impact; ethical performance; financial performance; and market position (SMH, 2001).

As engineers become aware of the importance of futures and sustainability problems, and as circumstances emerge that allow them to initiate positive changes, I believe that attitudes in the profession will respond to the strong leadership given by the Australian professional body (IEAust, 1992, 1997). The Institution of Engineers Australia's annual Engineering Excellence Awards explicitly require consideration of sustainability. I believe that there should also be more specific sustainability awards.

Globalisation

In the development, transfer, adaptation and adoption of technology, the term *globalisation* (or *globalization*, to use the U.S. spelling) highlights the importance of *place* and related cultural issues. We focus on a range of very different issues when we look at globalisation from commercial, engineering, social, cultural or environmental perspectives (see, e.g., Johnston, 2001).

Environmental issues and neo-liberalism

From the late 1960s, people started to see the Earth as a single entity (even as a 'village') and to recognise the extent of global as well as local environmental challenges. Environmental groups proliferated. In a scholarly and well-documented analysis, Beder (1997) shows how transnational corporations fought back at what they saw as environmentalist threats to their power and profit. In the process they established a multi-billion dollar propaganda machine to change the way politicians and the public thought about the environment. Right-wing think tanks were an important part of this strategy, and they have had a significant effect on a range of policy debates, not only on the environment but also on how the idea of globalisation is understood. Their efforts underpin the extreme free market position in the globalisation debate, promoting a neo-liberal (or 'economic rationalist') 'ideology of globalisation' which presents globalisation as a 'natural force' (see also Johnston, 2001). This position has been described by one commentator as a 'crude rationalisation of strictly capitalist interests', which reduces 'societies to economies, economies to markets, and markets to financial flows' (Castells, 1998: 345).

There has been a backlash against this position, and against the extreme volatility of economic prospects associated with this approach to globalisation. Despite pressures for opening up of global trade, regional groupings and nation states still effectively limit access to significant sections of their economies (Castells, 1996: 97-99; Harvey, 2000: 68).

It is obviously futile to try to ignore the fact of global change. However, it is simply a form of economic determinism to deal with the globalisation of commercial activity as if it were an inevitable process, which cannot be challenged. When we consider this issue in terms of sustainability, we can see that accepting such an approach to globalisation has the potential to cause terrible social, economic and environmental damage. I have argued elsewhere (Johnston, 2001) that we need to understand what is happening and work towards directing change into the most appropriate channels.

Globalisation has also been described as a new economic and cultural imperialism, exemplified by US control of the distribution networks for technology and products. We can see the force of this description when we look at the extent to which the US government has been prepared to intervene internationally on behalf of US businesses.

Key Drivers of Globalisation

Harvey (2000: 60-63), a geographer and a recognised authority on globalisation, offers a valuable critical perspective. He characterises globalisation as a profound geographical reorganisation of capitalism. Harvey highlights the extent to which globalisation embodies uneven development around the world. Since 1945 globalisation as a process has been led by the USA and centred on US interests, but he argues that there has been abundant support from a wide variety of other sources. Japan in particular did well in global competition. However, some areas of the globe, including much of Africa, have been increasingly marginalised.

Harvey sees the globalisation process as driven by the interaction of four key elements:

- *financial deregulation*, which began in the USA in the 1970s and has become associated with the promotion of the virtues of 'globalisation'. The establishment of regional power blocs is seen partly as a reaction to uncontrolled deregulation;
- *waves of profound technological change and product innovation and improvement* since the mid 1960s. Increasingly competent technical elites around the world have supported rapid diffusion of these technologies [see also Johnston *et al*., 1999: 409-420];

- *explosive expansion of information and communications technologies* (ICT). With its origins in the military, and conceptualised as an 'information revolution', ICT has allowed financial institutions and multinational capital [and global crime syndicates, (Castells, 1998: 169-211)] to coordinate their activities instantaneously around the globe;
- *rapid reductions in the cost and time of moving commodities and people around the world*, which have facilitated technology transfer and the redistribution of production.

One of our ongoing concerns must be that, in the process of globalisation of technology, there is serious potential for corruption. At the height of the Cold War, data from Transparency International (TI) indicated that bribes had reached as much as twenty or twenty-five percent of international project costs. Large projects involving sophisticated technologies were prime targets for corruption. Even when projects were well matched to the needs of the countries involved, the inflated costs meant that intended economic and social benefits went unrealised. Reports this year on how projects for the reconstruction of Iraq are being allocated cause renewed concern (Johnston *et al*., 1999: 364-365, 420; TI, 2003).

Positive approaches to globalisation

How might globalisation be interpreted in a much more positive way? Cultural issues will certainly be important. An example from my own experience: Finland is the home of the mobile telephone, and young Finns make extensive use of text messaging, with its specific syntax and abbreviations. They also use English extensively in their studies and daily life. Together, these cultural influences cause increasing concern in Finnish society about the extent to which traditional Finnish language skills and Finnish culture are being undermined. Such anecdotal evidence could be replicated in very many parts of the world. I have a mixed response. While I value diversity, I believe that we need to develop a shared global sensitivity as part of moves towards sustainability, and I see improved global communication, possibly based on an ‘international’ version of English, as having the potential to facilitate it.

Historical evidence shows the importance of cultural sensitivity and of recognising that technologies are neither culturally nor politically neutral. Where technologies are adapted to local conditions and cultural values before they are adopted, they can strengthen local communities and enhance the local quality of life. Scale is an issue here, as is the need to ensure the ongoing availability of necessary technical support. The political, economic and ethical contexts in which international technology development and transfer take place also have an important effect on their social and cultural impacts. Powerful technologies like electrification are typically neither wholly good nor bad, but (as with technology generally) are inherently ambiguous, with overall impacts that depend very much on their detailed implementation. Key factors are how the technology transfer takes place, and who controls the process. Where the community controls and implements the transfer, with a focus on self-reliance and sustainability, the social fabric can be strengthened. However, where change is imposed from outside, the uncontrolled introduction of new technologies can sweep away traditional values and culture and accelerate the destruction of the community (Johnston *et al*., 1999: 389-394).

There is a fundamental conflict here between, on the one side, the individualism that is fundamental to neo-liberalism and underpins an emphasis on personal accumulation and consumption and, on the other side, community-focussed cultural and spiritual values that appear to be central to indigenous cultures around the world. One positive approach to Globalisation would be to see it as ‘a fundamental reconceptualization of the universal right for everyone to be treated with dignity and respect as a fully endowed member of our species’

(Harvey, 2000: 94). Movements for a global living wage, and actions by the Zapatistas in Mexico and others to harness global communications links in their struggle for human rights (including maintenance of cultural diversity) suggest that there are real, if vigorously contested, possibilities in this direction. In Australia, I see moves towards Reconciliation and demands for a Treaty with the original Australians as a fundamental starting point from which to move towards the attitudes to justice and equity that must underpin social and cultural (and ultimately economic and ecological) sustainability (see, e.g., Reconciliation Australia 2003).

The increasing complexity of engineering tasks has been one significant effect of globalisation on engineering practice. Some of this complexity results from the need to take account of a wider variety of stakeholders and of linguistic and cultural contexts. Group and team working and learning are even more significant in the knowledge-based organisations in which engineers and others are increasingly working.

Conclusions

Globalisation of the world economy has led to the globalisation of engineering activity. In this paper I have briefly explored and analysed processes of globalisation from an engineering perspective. I have also described some of their implications for changes in the skill and knowledge demands on engineers.

We can see how far we still are from tackling global sustainability problems in a positive and effective way when we recognise Australian and U.S. reluctance to take even such preliminary steps forward as signing the Kyoto Protocol. While we have made some progress, we have a long way to go before engineering educators, the engineering profession, and society generally start seriously to address the problems facing Australia and the world.

For sustainability to be a real prospect, global engineering needs to be more culturally inclusive, and the term globalisation must be reclaimed for the celebration of rich diversity, rather than as a prescription for narrow domination by one or perhaps two regional perspectives. The education and professional formation of engineers needs to develop in them a sympathetic awareness and understanding of the variety of cultures, languages, belief systems, levels of affluence, education and technological competence, in the wider world in which they will increasingly work. In the last few years the engineering profession in Australia and around the world has taken a stronger role in the discussion of infrastructure problems and sustainability generally. With a broadly based professional formation, including a heightened awareness of social responsibility, engineers can play an essential role in the formation of public policy that takes more account of sustainability.

Creating the sorts of preferred global and local futures through which we would wish to live, and which we would want to leave to our grandchildren, will require a strong and positive contribution towards sustainability from the engineering profession. An important prerequisite for this will be for the engineering profession to understand the challenges of globalisation and to incorporate sustainability more effectively into its practice.

References

AEI (Australian Ethical Investment Ltd) (2001). *The Australian Ethical Charter.* Retrieved from: www.austethical.com.au/charter.html.

Beder, Sharon (1995). Engineers, Ethics and Sustainable Development. *Tenth International Congress of Logic, Methodology and Philosophy of Science*, Florence, Italy. Retrieved from: www.uow.edu.au/arts/sts/sbeder/Florencetalk-2.html.
– (1996). *The Nature of Sustainable Development*. 2nd ed., Scribe, Newham, VIC.
– (1997). *Global Spin: The Corporate Assault on Environmentalism*. Scribe, Carlton North, VIC.
Bucciarelli, Louis L. (1994). *Designing Engineers*. MIT Press, Cambridge, Mass, USA.
Castells, Manuel (1996-1998). *The Information Age: Economy, Society and Culture*. 3 Vols [*The Rise of the Network Society,* 1996; *The Power of Identity,* 1997; *End of Millennium,* 1998], Blackwell, London.
Diesendorf, Mark and Hamilton, Clive (1997). *Human Ecology, Human Economy*. Allen & Unwin, St Leonards, NSW.
EIT (Ethical Investment Trust) (2001). *Investment Criteria*. Community Aid Abroad, Melbourne. Retrieved from: www.caa.org.au/EIT/crieteria.html.
Elkington, John (1997). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Capstone, Oxford.
Harvey, David (2000). *Spaces of Hope*. University of California Press, Berkeley, CA.
Institution of Engineers, Australia (IEAust) (1992). *Environmental Principles for Engineers: Principles for the Engineering Profession for the Planning, Implementation and Management of Engineering Works that are Socially, Ecologically and Economically Sustainable*. IEAust, Canberra.
– (1997). *Towards Sustainable Engineering Practice: Engineering Frameworks for Sustainability*. IEAust, Canberra.
Johnston, S.F. (1997). Sustainability, Engineering and Australian Academe. *Journal of the Society for Philosophy and Technology,* Vol. 2, No. 3-4, pp. 80-101. Retrieved from: http://scholar.lib.vt.edu/ejournals/SPT/v2n3n4/pdf/johnston.pdf.
– (2001). Towards Culturally Inclusive Global Engineering. *European Journal of Engineering Education*, Vol. 26, pp. 77-89.
– (2002). *Engineering and Society: Broadening the Discourses of Engineering Practice*. PhD thesis, UTS, Sydney.
Johnston, S.F., Gostelow, J.P., and Jones, Evan (1999). *Engineering and Society: An Australian Perspective*. 2nd ed., Longman, South Melbourne.
Johnston, S.F., McGregor, H.T. and Taylor, E. (2000). Practice-focused Ethics in Australian Engineering Education. *European Journal of Engineering Education,* 25, 315-324.
Meadows, D.L., *et al*. (1972). *The Limits to Growth*. Universe Books, NY.
Reconciliation Australia (2003). Website at: http://www.reconciliationaustralia.org.
SMH (Sydney Morning Herald) (2001). *Good Reputation Index*. October 20, Sydney.
TI (Transparency International) (2003). Website at: http://www.transparency.org.
Vanderberg, Willem H. (2000). *The Labyrinth of Technology*. University of Toronto Press, Toronto.
WCED (World Commission on Environment and Development) (1990). *Our Common Future*. Oxford University Press, Melbourne (called the Brundtland Report for the Commission Chair).

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