UNIVERSITY OF SOUTHERN QUEENSLAND

Sustainability Philosophy in Engineering Context Review and Discussion

A Dissertation submitted by

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Abstract

Subsequent to the Rio Earth Summit both the engineering industry and the profession alike recognized the need for shifting towards sustainable practices. Similarly literature is mushrooming with sustainability definitions, themes and descriptions in many complex shapes and sizes, thus, presenting an immense diversity of opinion. This research defines the concept and principles of sustainability from an engineering perspective. It also addresses how sustainability philosophy or culture in engineering may one day drive net positive development.

In recent times going "green" has been the focus of governmental agencies, non-governmental organizations, private sector and society at large with a modest universality between these efforts. By way of example the overabundance of sustainability definitions and assessment tools found in literature, poses a unique set of challenges: first and foremost differing values describing how ideal criteria and indicators in sustainability assessment "should be". The surplus of definitions causes perplexity from an operational engineering perspective. This research probed sustainability operational issues experienced by engineers in the course of a series of consultative interviews with experts to account for generic criteria and indicators used in engineering sustainability assessment. This research presents a synopsis of these expert interviews. Furthermore, it reviewed and critiqued existing mechanisms, rating schemes and assessment methods frequently used by the engineering profession, in order to examine current practices purporting to enable or facilitate sustainability in engineering practice.

The study makes a contribution to sustainability science in the sense that it illustrates the concept diagrams of social, economic, environmental, technology and time criteria based on results from expert interviews. It also highlights the limitation of the rampant practice of minimizing negative impacts on the environment and society.

The research will benefit members of the engineering profession by providing them with a background on the development of sustainability within engineering, thus allowing them to make informed sustainability decisions. It is intended to outline non-specific relations between sustainability indicators and criteria for any given engineering project despite the definitional ambiguities indicators and criteria displayed.

Finally scale is important for defining sustainability approach to measurement and the outcomes in decision-making, since the majority of environmental and economic issues cut across several scales. The thesis argues for a transdisciplinary approach to achieve sustainability in engineering and sets out a typology of contexts in which this research finding could be applied and developed further.

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Certification of Dissertation

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged

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Scholarly Publications and Events
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The author has **published** the following:

1. Hasna A.M, Thorpe D, (2005), Sustainable Resource Management of engineering technologies-towards an assessment framework" proceedings of the 9th international Conference on Environmental Science and Technology , Rhodes Island , Greece , 1-3 September.
2. Hasna A.M, (2007), Dimensions of Sustainability, *Journal of Engineering for Sustainable Development: Energy, Environment*, and Health, Volume 2: Number 1, 2007, pages 47-57.
3. Hasna A.M.(2007),The engineering design process with sustainability, Proceedings of Engineering Sustainability SSEE2007, the international conference of the Society for Sustainability and Environmental Engineering, Engineers Australia, 31 October - 2 November, Perth, Western Australia
4. Hasna A.M., (2007), Sustainability and Engineering Philosophy: The Paradigm, *The International Journal of Environmental, Cultural, Economic & Social Sustainability*, Volume 3, Issue 4, pp.107-114.
5. Hasna A. M., (2008), Sustainability in Engineering Design, *The International Journal of Environmental, Cultural, Economic and Social Sustainability*, Volume 4, Issue 1, pp.69-88.
6. Hasna, AM (2009), 'A Review of Sustainability Assessment Methods in Engineering', *the International Journal of Environmental, Cultural, Economic and Social Sustainability*, vol. 5, (volume and page numbers to be advised)
7. Hasna, AM (2009), 'Contemporary Society, Technology and Sustainability', *The International Journal of Technology, Knowledge and Society*, Volume 5, (volume and page numbers to be advised)
8. Hasna, AM (2009), 'Climate Change and technology on the road to Sustainability' in proceedings of International Conference on Energy, Environment, Sustainable Development" Paris, France, June 24-26, 2009.

The author has **presented** in the following conferences,

1. 9th International Conference on Environmental Science and Technology, Rhodes Island, Greece, 1-3 September 2005.
2. *SSEE2007 Engineering Sustainability*, the international conference of the Society for Sustainability and Environmental Engineering**,** Engineers Australia, 31 October - 2 November 2007, Perth, Western Australia.

3. Panel discussion: *"Engineering skills for a sustainable world – what can PBL do?* "Research Symposium on PBL in Engineering Education, Frederik Bajers Vej 7 A, Aalborg University, Denmark, Monday, 30 June - Tuesday, 01 July 2008.

4. EESD 2009: "Climate Change and technology on the road to Sustainability", "*International Conference on Energy, Environment, Sustainable Development*" Paris, France, June 24-26, 2009.

5. "Engineering ethics and sustainability" 8th Global Conference Environmental Justice and Global Citizenship to be held from Friday 10th July -Sunday 12th July 2009 at Mansfield College, Oxford, United Kingdom.

The author was on the **editorial board** of the following Journals,

1. Associate Editor, *the International Journal of Environmental, Cultural, Economic and Social Sustainability*, Volume 3, Common ground publishing 2007.

2. Referee, Engineering Sustainability, *Proceedings of the Institution of Civil Engineers*, United Kingdom, Thomas Telford publishing ,2008.

3. Associate Editor, volumes 1 and 5, *The International Journal of Knowledge, Culture and Change Management*, 2008.

4. Member of the Technical Programme Committee for IEEE International Conference on Sustainable Energy Technologies, ICSET, 24-27 Nov *2008* - SMU *Conference* Center, Singapore.

The author has **participated** in the following conferences,

1. Second International Conference on Environmental, Cultural, Economic and Social Sustainability, East-West Centre, Hawai'i, in February 2005.
2. Third International Conference on Environmental, Cultural, Economic and Social Sustainability, Senate House at the Chepauk Campus of the University of Madras, Chennai, India, 2007.
3. Fourth International Conference on Environmental, Cultural, Economic and Social Sustainability, Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia, 2008.
4. Fifth International Conference on Environmental, Cultural, Economic and Social Sustainability, University of Technology, Mauritius, 5-7 January, 2009.

Refereed International Conferences (Summary)
4 conference papers
1 conference poster
Refereed Journal Articles (Summary)
Five papers

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Abbreviations & Acronyms

ICT: Information and Communications Technology, electronic, digital media, data processing, telecommunications and the Internet.

Information society: modern forms of society and economic activity heavily dependent on the exploitation of ICT

Intrinsic value: An attitude or ethical precept that affirms the worth and significance of other beings regardless of specific human preferences, interests and aversions.

MCDA: Multiple criteria decision analysis, methods of evaluation of resource management options according to a range of criteria considered

Natural capital: Any element or system of the physical world which, directly or in combination with produced economic goods, services of value to society. Open system: an entity, differentiated from its environment, is dependent on interactions between system and environment.

Pollution: Material or energy flow, usually but not always 'by-products' of economic production and consumption activity.

Pressure-State-Response: A framework of analysis that (1) quantifies pressures of human activities of production and consumption on the environment (e.g. water extraction, fish catch, nitrate or toxic effluent emissions) (2) describes the state of the environment and observable changes in state (e.g., algae growth in lakes); and (3) the responses proposed or implemented by society (e.g., water purification stations, changed production technologies).

Sustainability indicator: An index or aggregate of information allowing an assessment of the extent to which economic activity is, or is not, compatible with goals of long-term viability/durability at a defined geographic, ecological or statistical scale.

Utopia: A (non-existing) society, described abstractly or in specific parable form, that is conceived as incarnating ideals of justice, human freedoms, cultural achievement, environmental quality, etc.

Ecocentrism: dynamic, interrelationship between all animate (human and non-human) and inanimate objects.

Green Politics: political movement in which environmental issues are of primary concern.

Framework is a construct that allows the interrogation of a system in terms of risk, cost, benefit and impact.

Industrial Ecology: is the study of the relationships of industry and their surroundings, habits and modes of life.

Model: is defined as the representation of a system include materials flux analysis and industrial ecology. Life cycle assessment is considered to be both a model and a framework.