PracticeNote 05

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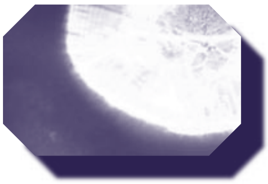

Sustainability and Engineers

May 2005

The Institution of Professional Engineers New Zealand Incorporated (IPENZ) is the non-aligned professional body for engineering and technology professionals in New Zealand.

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Sustainability in an Engineering Context

The IPENZ Code of Ethics states as one of its five fundamental values the following:

"Sustainable Management and Care for the Environment: Members shall recognise and respect the need for sustainable management of the planet's resources and endeavor to minimise adverse environmental impacts of their engineering activities for both present and future generations."

Sustainability is about the long-term survival of humanity. Sustainable development recognises that decisions made today must enable both those in the present, as well as people of the foreseeable future to make effective choices about their quality of life. Engineers have many opportunities to be involved in implementing sustainable development.

This Practice Note is based on the work of the IPENZ President's Task Committee during 2003 and 2004. It identifies key sustainability factors for engineers and provides a checklist illustrating the role of engineering in sustainable development – a role that will become increasingly important as society's understanding, and requirement for the application, of sustainable development principles grows.

As New Zealand develops its policy for the implementation of sustainable development, engineering has an important contribution to make. This Practice Note will help engineers by providing a means to evaluate and improve their own commitment to sustainability.

Four Key Sustainability Factors for Engineers

1. Managing changes in the environment

- *Maintain the integrity of global and local biophysical systems*

  Projects or plans that will have a significant impact on the life support functions upon which human well-being depends, many of which are irreplaceable, must be considered thoroughly. For example dams on waterways, or the deployment of a technique, material or process with new or unknown side effects, such as nanotechnology.

- *Ensure the full cost of resource depletion is included in all feasibility studies and estimates*

  Usually the market cost is assumed to include all costs but this is not always the case; where alternatives exist the more sustainable product or material should be used. For example a recyclable or reusable container is inherently more sustainable than a single-use container of similar cost, even though on a first cost basis this is not apparent.

- *Optimise processes on a life cycle basis*

  The true cost of a process over its life cycle must be assessed. This is necessary not only to minimise the absolute use of resources and maximise recycling and reuse, but to facilitate the transition to new technologies and methods. For example, life cycle costing may assist the transition from a fossil-based energy source to a renewable energy source. This applies both to scarce resources, and apparently abundant resources such as concrete and timber; all of which have an embedded energy content.

- *Optimise the use of renewable resources* but always within sustainable extraction or harvest rates and taking into account environmental damage. For example using biomass from sustainable forests as a boiler fuel instead of oil or gas.

- *Minimise waste products* particularly hazardous ones, in the total life cycle of engineered products, processes or systems, and restrict waste to as near to the source as practicable. Any unwanted output from a process should be in such a form as to make its further use as easy as possible. Ensure that any waste discharges are within the short-term assimilative capacity of the environment, without long-term accumulation.

2. Equity and safety of engineering activities

- *Improve the overall quality of life*

  Engineering projects, products or processes should be aimed primarily at improving the overall quality of life for humans, but not at the expense of the natural or physical environment without due consideration of the broader costs and benefits.

- *Balance increased consumption with improvements in quality of life*

  Any increased consumption of resources and energy must be weighed carefully against the improvement in quality of life to be achieved. Excessive consumption raises equity issues in how we share resources around the planet.

- *Long-term resource use*

  Resource use must be considered over a sufficiently long time scale so that present and future generations are not disadvantaged economically, socially or environmentally by excessive and unnecessary consumption. We should not be dissuaded from acting as sustainably as possible because an anticipated project's lifetime is short in comparison to a resource lifetime.

- *Prioritisation*

  Encourage projects, products and processes that close significant gaps in health, security, social recognition and political influence between groups of people. Also give priority to projects that positively enhance or restore the natural and physical environments. Those that do the opposite should be carefully considered before embarking on them in whole or in part.

- *Consultation*

  All those affected by engineering projects must be consulted where practicable, and given equal opportunity without repercussions to voice their concerns. Consider their relevant opinions and where practical incorporate them into the planning, decision-making and implementation process.

- *The precautionary principle*

  Where outcomes cannot be accurately foreseen, choices must be based on risk reduction and the precautionary principle – where new risk is avoided in the absence of data – as much as practicable or foreseeable.

3. Holistic problem solving

- *Take a holistic approach*

  An integrated systems or overall holistic approach, including all stakeholders and the physical and social environment, must be taken when attempting to solve problems. Rather than focussing solely on the technological aspects and solving one problem at the expense of another, a coordinated solution must be aimed for.

- *Base solutions on human needs*

  Solutions must be based primarily on existing or new human or environmental needs rather than finding profitable uses for a newly available technology.

- *Take a synergistic approach*

  Approaches that are multi-faceted and synergistic are preferable to single issue approaches. For example using transportation in such a way that viable loads are available for both journeys is more sustainable than single load journeys.

4. Making good on existing problems

- *Remedy past environmental degradation*

  Where desirable and technically and economically practicable, past environmental degradation must be remedied. For example land degradation, groundwater contamination and hazardous waste sites should be considered for stabilisation works at a minimum, and where possible considered for total clean-up to a current or foreseeable future standard.

- *Past hazardous practices must cease and be cleaned up* in a cost effective way and time frame. These include hazardous materials such as asbestos, lead, mercury and PCBs.

- *Reduce the use of non-sustainable practices* such as the combustion of petroleum and fossil fuels to zero over a finite time frame. Acknowledge that sometimes transitional processes may be needed to cover the intervening period, for example using coal more efficiently on a short-term basis, rather than oil or gas for electricity in the transition to a fully renewable power system.

- *Support social and economic accounting methods* which disclose, identify and quantify previous or developing environmental problems.

Conclusion

The implications of sustainability for engineers are major. Long-term thinking on resources and paradigm shifts in economics and technology design are necessary. Improving the quality of life without merely increasing the quantity of goods is required. Engineers must become more effective at identifying real needs rather than wants. This will require them to become problem framers so they can help decide on the most effective directions for technology to take. In addition there is an educational function; some clients may not be aware of sustainable alternatives when scoping a new project. The engineering profession must lead the way and be seen to lead the way towards a more sustainable future.

Acknowledgements

This Practice Note is based on the work of the IPENZ Presidential Task Committee on Sustainability during 2003 and 2004.

Engineering and Technology Checklist

1.	Have you thoroughly considered if the project or plan will have a significant impact on the life support functions upon which human well-being depends?	☐
2.	Have you ensured that the full cost of resource depletion is included in all your feasibility studies and estimates?	☐
3.	Have you minimised the absolute use of resources on a life cycle basis and used renewable energy as much as possible?	☐
4.	Have you maximised the use of renewable resources within sustainable extraction or harvest rates and taken account of environmental damage?	☐
5.	Can you minimise waste products, particularly hazardous ones, during the total life cycle of engineered products, processes or systems, and restrict waste to as near to the source as practicable?	☐
6.	Does the project, product or process improve the overall quality of life for humans and other life forms without large increases in the consumption of resources and energy, or at the expense of the environment?	☐
7.	Has resource use been considered over a sufficiently long time scale so that present and future generations are not disadvantaged by excessive and unnecessary consumption?	☐
8.	Does the project, product or process close comparative gaps in health, security, social recognition and political influence between groups of people as much as it could?	☐
9.	Have those likely to be affected by the project been consulted if practicable, and will any relevant opinions be considered and where practical incorporated into final planning?	☐
10.	If outcomes cannot be accurately foreseen, is your planning based on risk reduction and the precautionary principle?	☐
11.	Have you taken an integrated systems/overall holistic approach, including consideration of the perspectives of stakeholders and the impact on the environment in your proposed solution?	☐
12.	Is your project, product or process based on human needs rather than just finding a use for some newly available technology?	☐
13.	Does the project, product or process involve past hazardous practices, and if so can these be eliminated and cleaned up in a cost effective way and time frame?	☐
14.	Does the project, product or process contribute towards reducing non-sustainable practices to zero over a finite time frame?	☐
15.	Can social and economic accounting methods be used at the planning stages to disclose, identify and quantify previous or developing environmental problems?	☐

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