

Applying Sustainable Design Principals to Future Infrastructure Challenges: a Multi-method Approach

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Abstract

This paper discusses the challenges facing local councils and public works engineers in addressing the impacts of climate change and resource constraints in the present and future.

It outlines Sustainable Design principals in the literature and their practical application into the multi-method approach of Eco-efficiency, Systems thinking and Change Management.

The paper discusses how to use this approach through a case study that outlines the results of a Technology Services and Infrastructure project developed with the Municipal Association of Victoria (MAV) in 2009-12.

This method resulted in outcomes such as cost savings, a reduction in energy consumption, resources and waste. As part of this project, not only were the above outcomes quantifiable but the process was also able to implement innovative organisational and management practices that developed future proofing skills for council workers. The framework used also provides new sector wide benchmarking.

This paper then outlines how this approach is applicable to Infrastructure challenges and developing practical frameworks of Sustainable Infrastructure.

Materials and Methods

A literature review was conducted researching the impacts of climate change and resource constraints for local governments in Australia. The particular impacts and role of information technology were investigated and documented and an approach to sector change developed.

A case study including industry best practice research, development of a sustainability framework for assessment and reporting, key performance areas and indicators, over 80 recommendations for implementation. Pilot programme in five Victorian Councils to test the framework and its implementation methods followed by a maturity survey taken by over 80 workshops participants from over 40 different local councils. The work took place between October 2009 and September 2012.

Design Methods

In the introduction of the timely book Infrastructure Sustainability and Design authors (Pollalis and Schodek, 2012) outline a range of issues relating to creating Sustainable Infrastructure projects and networks. The authors discuss the complexity of large scale infrastructure that has technological, social, economic (and sometimes cultural) dimensions. How to account for the economic benefits of a project as well as the social? How to cost and promote projects with benefits over longer timescales that taxpayers have to pay for upfront? How to rate and measure the impacts of sustainable infrastructure projects? How to assess at planning stages against lower cost but less sustainable solutions? How to repair, modify and upgrade for projects in use over long timeframes?

In strategically managing an organisation's shift towards a holistic model of Sustainable business and production, Life Cycle Management (LCM) describes a whole of business approach categorised into 3 main areas Organisational Aspects, Internal LCM Projects and Environmental Profile. These could also be described as strategies relating to Organisational structure, Products and Services and Communications.

This framework mirrors the approach taken by the authors in the papers case study project. It also describes a general trend in Sustainability strategies that require a multi or trans-disciplinary approach and an understanding of social and behaviour systems either consumer or organisational, rather than simply a focus on the technical systems of a product.

Case Study

The main incentives behind the project were based on the the triple role Councils have to play in the "greening" of Councils:

1. Information and Technology (ICT)'s Own Activities
2. Council's Internal Activities (Corporate)
3. Council's External Activities (Community)

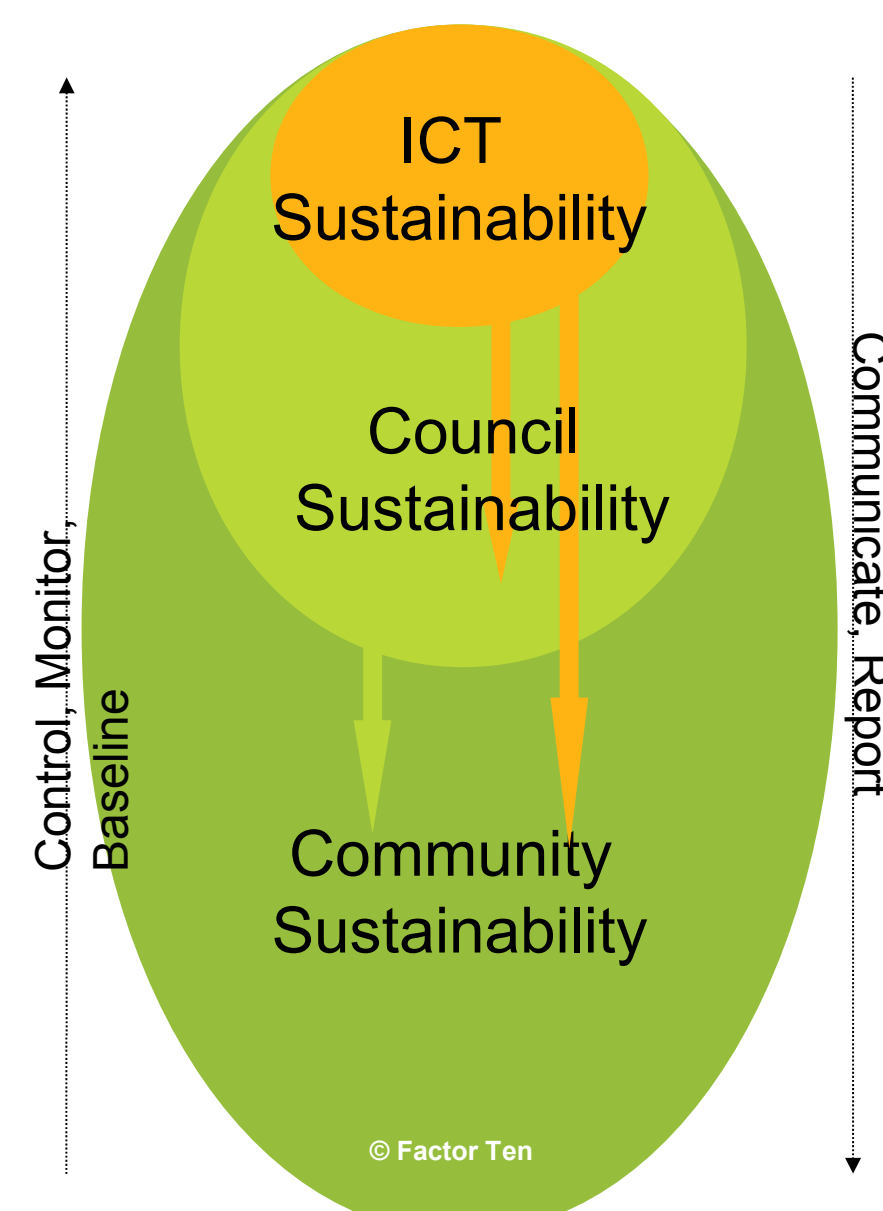


Figure 1: The triple role of Councils in "greening" activities

We formulated a common vision around "Sustainable ICT" in local government and established a workable framework to support ICT staff with these new responsibilities.

We focussed on Key Performance Areas:

- ICT Procurement (embodied energy consumption, resource conservation)
- Data centre and operations (design, energy consumption, paper)
- Disposal (eWaste minimisation)
- IT enabled Internal Council Operations (video-conferencing, paper usage, eLearning)
- IT enabled External Council Operations (suppliers, citizens, local economy and industry, other councils)

The approach, key performance areas, key performance indicators were all based on a life cycle view of the information technology service.

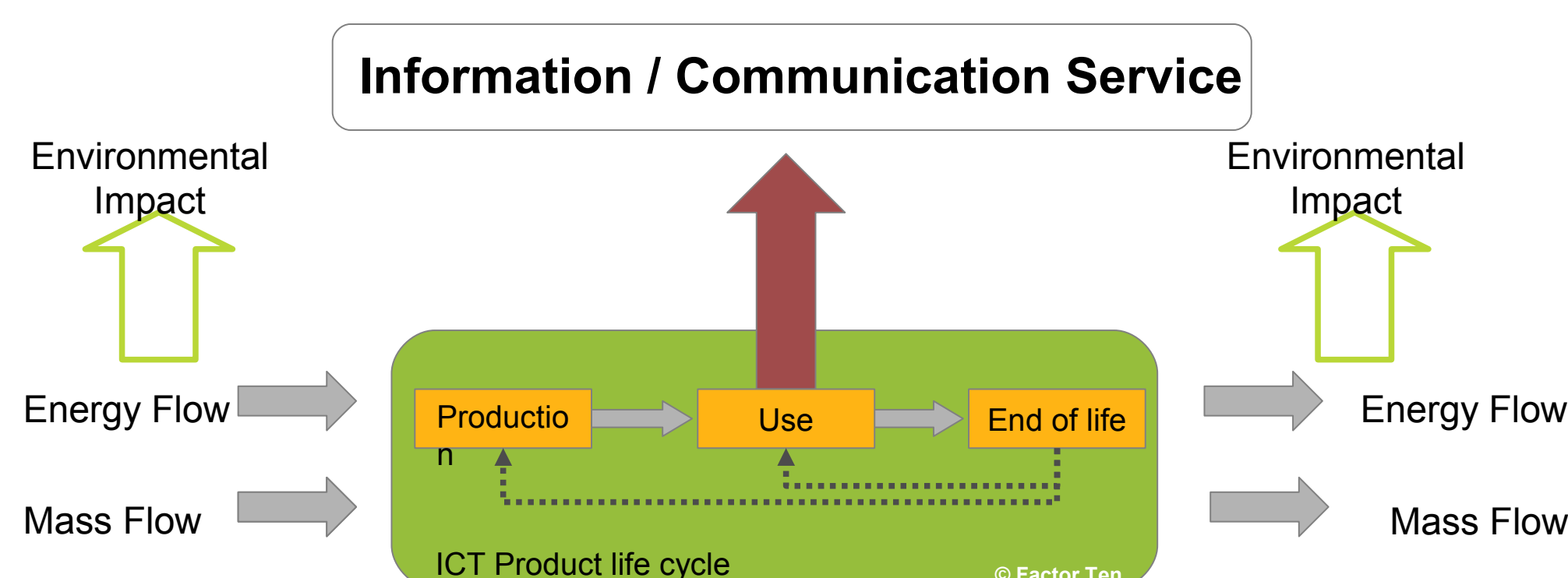


Figure 2: Life Cycle Assessment (LCA) as a basis for the evaluation of impacts in an Information and Communications product system

Design for Sustainability strategies were selected based on the background research conducted at the start of the case study. They were applied and implemented during a pilot program five Councils participated in:

Dematerialisation	avoid, reduce or eliminate paper, transport, waste, reduce material inputs in all purchased products
Lifecycle assessment (LCA)	base purchasing and waste management on LCA methods
Product Service System(PSS)	Privilege Software-as-a-Service (SaaS), shared services and infrastructure
Product Stewardship	Enforce throughout supply chain

Table 1: Design methods and strategies used in the ICT sustainability framework

A range of workshops throughout Victoria (more than 40 participating Councils) to explain the project, get input and feedback from the Local Councils and establish a framework they could easily implement themselves whatever their level of sustainability maturity.

Results

In collaboration with the Information Technology, Sustainability / Environment, Procurement, Waste teams, we defined the Information and Technology Sustainability Framework. This included, the key areas of performance assessment and reporting, the training requirements to support the Councils through the changes and a set of supporting material to be distributed throughout the participants.

Six Performance Areas for Victorian Local Councils Information Technology

- Goal 1: Reduce Energy Use
- Goal 2: Meter, Monitor, Report and Control
- Goal 3: Dematerialise Communications
- Goal 4: Reduce Waste
- Goal 5: Automate Processes
- Goal 6: Governance, Awareness and training programs

More than 80 recommendations across the 6 Key Performance Areas were developed, most of them with KPIs attached and benchmarks in line with global best practice identified.

During the Pilot implementation across 5 Local Councils - Moreland, Nillumbik, Kingston, Wellington, Manningham – The framework was implemented by the teams over a period of 3 months. These are a few examples of what they achieved:

Power Management

Calculation of savings due to shut down of PCs and screens:
Between 212 and 497 tons of CO₂-e (49 to 115 cars off the road)
Between \$12,000 and \$19,000 dollars in savings annually

Printer Rationalisation

Electricity usage drop by 31% - \$3,400 savings yearly
31 tons of CO₂-e reduction yearly
Paper usage estimated to drop by 50% - \$23,000 savings yearly + related emissions

eLearning

24 tons of CO₂-e in savings
68.2 hours in lost time
Calculated with 205 courses given online compared to courses face-to-face in a metropolitan Council.

Another benefit of the framework is to gather data on infrastructure equipment and on processes and to start to make energy and resources consumption visible. As a result, the "real" energy impact of data centres in Local Councils was calculated:

Data Centre energy usage

21% to 38% of Civic Centre electricity usage by the datacentre equipment alone
When including the supporting infrastructure (lighting, Uninterruptible Power Supplies, this can be as high as 55%

The results of the maturity survey for Information Technology Sustainability in Victorian Councils was mapped on the Sustainability Maturity Assessment we developed as part of the case study and serves as a baseline for all future assessments of progress in the sector.

Green IT Maturity Model

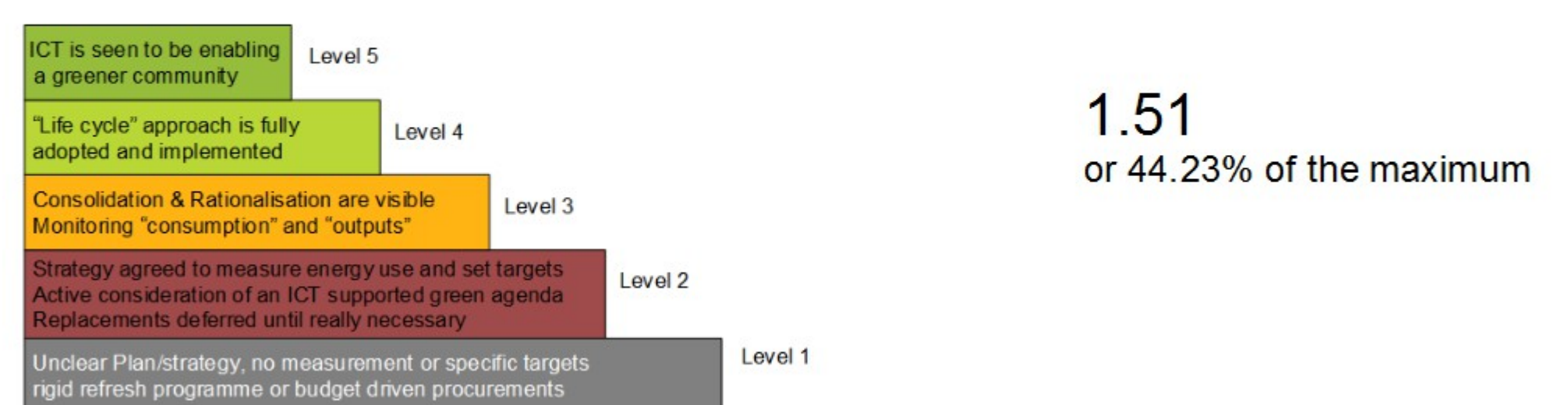


Figure 3: The Victorian Councils' ICT sustainability maturity survey results

Conclusion

Infrastructure providers- companies and government- have to deal with planning for projects with uncertain direct effects (such as temperature change and extreme weather) and then accommodate in the designs an ability to adapt to that uncertainty and adjust/ upgrade projects over the long term.

The 3 pronged approach of Eco-efficiency, Systems Thinking and Change Management is the way the authors describe their multi-strategy approach to Sustainable Projects. It allows for the variations between types of problems but captures what we think are the key categories of consideration as a way of mapping a problem.

These specific methods attached to the approach support to analyse a problem, develop solutions, enact solutions and audit outcomes. It takes into account both the technological aspects of a project and the social, industry or organisational culture.

And in doing so insures that we plan and design for indirect impacts on Infrastructure projects and planning such a political risks and changing regulatory environments, changes to energy consumption and mixes of energy technologies, other technological leaps or changes and social trends.

Further Information

The paper and further information are available on demand. Please address any questions to:

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