2009

Developing Organizational Capabilities in SMEs: Enabling Environmentally Sustainable ICT

Steve Elliot
University of Sydney, steve.elliot@sydney.edu.au

Follow this and additional works at: http://aisel.aisnet.org/bled2009

Developing organizational capabilities in SMEs: Enabling environmentally sustainable ICT

Steve Elliot

Business Information Systems

University of Sydney NSW 2006, Australia

s.elliot@econ.usyd.edu.au

Abstract

Information and Communication Technologies (ICT) have made significant contributions to business innovation and wealth generation for organisations, societies and nations. ICT have also made significant contributions to environmental degradation. Confronted by the necessity to respond to growing environmental concerns in society, regulatory imperatives and market pressure, many business leaders express uncertainty about how best to proceed. The challenges of environmental sustainability are particularly acute for small and medium enterprises (SMEs) due to their limited capabilities to initiate significant change without external assistance. With a track record of investigating diverse aspects of Information and Communications Technology (ICT) applications and practices in organizations, Information Systems (IS) researchers appear well placed to provide such assistance. Unfortunately, IS researchers have failed to engage with environmental sustainability of ICT as either a problem requiring resolution or as an opportunity to present innovative solutions.This paper aims to facilitate development of SME business practice in the environmental sustainability of ICT and promotion of an industry-relevant IS research agenda. Contributions are: identification and categorization of a diversity of literature sources to inform SMEs on the topic; proposal of a stages of development framework for building SME capabilities in ICT environmental sustainability based on current literature and a case study of leading SME practice; and proposal of an industry-relevant IS research agenda. Implications of the framework for SMEs and for IS research are discussed.

Keywords: Environment, Sustainable, SME, IS Research, Framework

1 Introduction

Since the 1950s, Information and Communication Technologies (ICT) have made major contributions to business innovation and wealth generation. Unfortunately, ICT have also

made major contributions to environmental contamination. The manufacture of ICT products produces hazardous occupational and environmental by-products. The disposal of hundreds of millions of computers and mobile devices in land-fill each year results in further contamination. Increasingly high levels of electricity consumption in the manufacture and operation of ICT products leads to increased carbon dioxide (CO_2) emissions since, internationally, energy is predominantly generated by carbon emitting coal-fired power stations. The volume of Green House Gas emissions produced world-wide is growing rapidly, increasing by 70% between 1970 and 2004 (Friedman 2007, GAO 2005, Gartner 2007, Greenpeace 2005, IPCC 2007, p5, Jacques 2007, McKinsey 2004, S2 2008, UNEP 2005).

Consequently, maintaining current commercial practice, i.e., business as usual, is not a feasible option due to "increasing risks of serious, irreversible impacts from climate change" (Stern, 2007, pii). Environmental sustainability issues cut across most areas of organisational practice (Porter and Reinhardt, 2007). An international survey of more than 10,000 consumers and global executives in 2007 shows climate change to be the single most important issue of concern for the next five years for both consumers and executives (McKinsey, 2008). While most executives are concerned about the issue, comparatively few are taking action (MCA 2007, p15). The domain is small and medium enterprises (SMEs) due to the number and impact of SMEs in the global economy and the limited capabilities of SMEs to initiate strategic innovation without external assistance.

In response to business uncertainty about environmental sustainability of ICT and a paucity of IS research to assist its resolution, this paper aims to facilitate the development of business practice in SMEs and to promote an industry-relevant IS research agenda. To address these aims the paper's structure is: an introduction to the topic and establishment of its relevance to IS; definition of terms; review and categorization of relevant literature; explanation of the research approach; development of a research framework based on the literature; description of a case study of leading practice in a SME and lessons learned; and discussion of conclusions and their implications.

1.1   Relevance to Information Systems (IS)

This issue is particularly relevant to the ICT industry and to ICT-using organizations. Globally, the ICT industry accounts for approximately two per cent of CO_2 emissions. This estimate includes manufacture and operation of personal computers, servers, cooling, fixed and mobile telephony, local area networks, office telecoms and printers. While that percentage may seem modest, it is too large to be maintained. *"During the next five years, increasing financial, environmental, legislative and risk-related pressures will force IT organisations to get more environmentally sustainable,"* Simon Mingay, research vice president at Gartner (Jaques, 2007).

The IS discipline is distinguished from other disciplines as: "it examines more than just the technological system, or just the social system, or even the two side by side; in addition it investigates the phenomena that emerge when the two interact." (Lee, 2001, p iii). The environmental sustainability of ICT is located precisely at that point of interaction between technology and society and so is central to the IS discipline. The IS discipline has been called on to undertake more high visibility research with high impact to avoid becoming marginalized (Agarwal and Lucas, 2005). The environmental sustainability of ICT would certainly be one area of research that is highly visible and, with elevated levels of business uncertainty, the research outcomes could be assured of high impact.

1.2   Defining terms

The Brundtland Commission (1987) formally initiated this field with its use of the term "sustainable development" to mean "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". A sustainable organization "is one whose characteristics and actions are designed to lead to a desirable future state for all stakeholders over the longer term" (Funk, 2003). Sustainability requires "both an efficient allocation of resources over time and a fair distribution of resources and opportunities between the current generation and between present and future generations, and a scale of economic activity relative to its ecological life support systems." (Gray and Milne, 2002).

The terms "Environmental Sustainability of ICT" (ESICT) and "Green IT", are used widely but lack common and consistent meaning. Many articles and papers focus on a particular aspect of the issue without acknowledgement of its multi-faceted nature. In this paper, a holistic definition is utilised:

> *the design, production, operation and disposal of ICT and ICT-enabled products and services in a manner that is not harmful and may be positively beneficial to the environment during the course of its whole-of-life (Elliot, 2007)*

This definition encompasses ICT as a problem (e.g., creating contamination from its manufacture and disposal as well as contributing to carbon emissions through inefficient consumption of electricity) and as a potential solution to environmental problems. The definition's focus of analysis is primarily at organizational and industry levels. The scope of ESICT is based on organizational activities and responses. While the definition and scope of this issue lies clearly within the focus of IS research, to date IS researchers have failed to engage with the subject.

The term 'small and medium-sized enterprises' (SMEs) also lacks standard definition but they are often described as enterprises with fewer than 100 employees in the manufacturing sector and fewer than 50 employees in the services sector. SMEs vary widely including: startup and established firms, market leaders and followers, primary producers, manufacturers, retailers and service providers. In most nations, SMEs represent over 95% of employer businesses.

The World Bank estimates that SMEs internationally account for between $US 11 and $US 21 trillion each year in Gross Domestic Product (ISO, 2005).

Persistent presumptions that a small business is just a little big business with similar management principles, objectives and challenges were discounted many years ago (Welsh and White, 1981). Each firm has its own unique circumstances, culture, business approach and challenges but small business owner / managers share experiences including severe constraints on financial resources, lack of trained personnel and a short range management perspective imposed by a volatile competitive environment. While corporate executives are required to become increasingly sophisticated in their management practices, owner / managers must focus on business basics with liquidity being their prime objective. Analytical models applicable to big business have been found to be of limited utility to SMEs due to their assumption of steady state conditions and incremental change (Welsh and White, 1981).

2   Literature review - Environmental sustainability of ICT

A selection of current literature on ESICT at an organizational capabilities level has been analysed to identify its contribution to informing organizations in five major categories:

describing problems; identifying potential solutions and opportunities; providing a rationale for action; depicting possible actions; and discussing possible approaches for evaluation (see Table 1). Each of these categories represents an issue relevant to companies seeking to address environmental sustainability. The literature was selected on the basis of potential relevance to organisations uncertain about how to respond to the emerging challenges of ESICT. The literature is from specialist environmental groups, practitioners and government and inter-governmental bodies with the addition of some academic papers from non-IS disciplines. With few exceptions (notably ISO, 2005) there has been little attention to any requirements specific to SMEs.

Searches in the IS discipline's top journals over 30 years reveals that IS researchers have had little engagement with this topic (Elliot, 2007). Since the first volume of the first IS journal in

Table 1: Classification of ICT Environmental Sustainability literature in business

Category	Focus	Description	References
Problem	ICT as a source of ESICT problems	ICT design, manufacture, use, disposal as a source of environmental degradation: E-waste and Green House Gases (GHG)	E-waste: Basel Convention 2006a, 2006b, Bhalla 2007, EU 2003a, 2003b, GAO 2005, 2006, Greenpeace 2005, 2007a, Hasan, 2002, UNEP 2005, GHG: Friedman 2007, IPCC 2007, McKinsey 2004, Stern 2007, WMO 2007, Chen *et al* 2008
Solution / Opportunity	ICT as a potential solution or business opportunity	ICT and ICT applications as a potential solution or source of business opportunity	Solutions: Intel 2006, Sun 2006, Stern 2007 e.g., p394, S2 2008, ISO 2005 Opportunities: Friedman 2007, Magretta 1997, McKinsey 2007
Rationale for action	Rationale for corporate action	Why should corporations respond to ESICT challenges?	EU 2003a, 2003b, Gartner 2007, Jacques 2007, McKinsey 2008,
Actions	The nature of corporate actions	What can be done & how to do it	De Groot 2000, Funk 2003, GeSI 2005, Hart 1997, Magretta 1997, MCA 2007, McKinsey 2004, Shrivastava 1995, S2 2008
Evaluation	Evaluation criteria	How to assess outcomes of ESICT initiatives	Elkington 1998, Gray and Milne, 2002, McDonough and Braungart 2002,

1977, none of the leading IS journals has published a single paper focusing on ESICT. One paper was identified by keyword in the abstract (Howard-Grenville and Carlile 2006) and several other papers were identified by full text searches in a last resort to find papers with any mention of the keywords (e.g., Avgerou 2001, Saravanamuthu 2002) but ESICT was not the focus of those papers in the top IS journals. Some papers are beginning to emerge in less prominent IS journals but, clearly, an opportunity exists for IS researchers to make rigorous contributions in industry relevant areas on an issue of global importance (Chen *et al,* 2008).

3   Research approach

To address business uncertainty, calls have been made for research to examine key issues in environmental sustainability and to identify and share organizational best practices (e.g., GeSi, 2005). In response to both uncertainty and calls for action, this paper aims to facilitate the development of business practice for the environmental sustainability of ICT and to facilitate IS research able to address uncertainties by further development of an industry-relevant IS research agenda. The research scope and the unit of analysis are SMEs since these organizations are the largest in number internationally and so have the greatest potential to make significant contribution to the environmental sustainability of ICT. The research focus is on building organizational capabilities to address the critical issue since SMEs are constrained in their capacity to initiate strategic change (ISO, 2005).

Consistent with these aims, the research questions were:

1. *What contribution does current literature make to business practice by SMEs in environmental sustainability of ICT;*

2. *What can SMEs contribute to resolution of environmental sustainability of ICT challenges;*

3. *Can current literature and practice by SMEs be presented in an integrated framework;*

4. *Can an IS research agenda based on this framework be proposed to facilitate industry-relevant IS research activity?*

The most appropriate approach to address the research aims and questions was analysis of a diverse range of literature to identify a framework of developing organizational practice in environmental sustainability of ICT; preparation of a case study of leading-edge SME practice; and comparative analysis of the framework and the experiences and practices of a corporation pioneering in this area. The framework was reviewed and revised and an IS research agenda based on current leading-edge SME industry practice proposed. Since the service sector represents the vast majority of wealth generation in developed countries and a rapidly rising proportion in transition and developing economies, this case study reported in this work was an ICT-services providing SME.

3.1   Framework development

A 'stages of development' framework to inform practitioners and researchers appeared suitable to meet the research aims as this type of model previously had been successful in raising organizational awareness: notably Nolan's 1970's seminal stages of development model to address uncertainties in IT management (Nolan, 1979). Unfortunately, no generally applicable models or frameworks of organizational stages of development in ICT environmental sustainability were identified in the literature. Table 2 presents the composite structure and activities for a stages of development of ESICT framework based on elements from diverse publications. These sources include: a 2x2 matrix to compare organizational strategies with sustainable objectives (Hart, 1997); a chemical company's approach to sustainability (Magretta, 1997); a 10-step model for an IT manufacturer to progress from regulatory compliance, product stewardship, partnerships with environmental activists to incorporation of social aspects in business strategies (de Groot, 2000); advice on how to prepare a business case for sustainability with value creation models (Funk, 2003); key issues

in environmental sustainability for the IT industry (Gartner, 2007) and consideration of how business could adapt to a low-carbon world (MCA, 2007). In Table 2, the stages, titles and activities were derived from the literature, RSS columns from the case study and the agenda

Table 2: ICT Environmental Sustainability: Stages of Development for SMEs Framework (developed from Hart 1997, Magretta 1997, de Groot 2000, Funk 2003, Gartner 2007, MCA 2007, Elliot and Binney 2008)

Stage	Title	Activity	RSS activities	RSS ICT actions, e.g.,	Agenda for Research & Practice
8	Business opportunity	Seeking business development & other market opportunities	Unanticipated outcome – newly acquired capabilities attracted clients	Green IT hosting opportunities, direct shipping, & green IT consulting	Strategies to exploit sustainable business opportunities with existing customers and in new lines of business
7	Integration	Integrating organisation-wide options	Green Policy drives innovative business solutions across firm	Integrated server, wireless hub, shared Internet access, firewall security, networked printers. Phone & IT integrated	Integrating solutions across organisation, seek new technologies to enable innovative solutions. Implementing environmental management systems & reporting
6	Proliferation	Determining, championing implementing organisation-wide options	Green Policy exploring broader options	Replace PABX, soft phones, unified messaging, single handsets across firm	Proactively seeking & implementing organisation-wide strategies to reduce energy consumption, & prevent pollution. Environmental reporting
5	Evaluation	Solution evaluation	Green Policy metrics: power, waste, space & shipping; Monitoring tool acquired	Power (servers, cooling, PCs) recycling, office space & direct shipping to clients	Determining appropriate, organisation-wide metrics and evaluation processes. Determining actual contributions, developing informed business cases
4	Action	Implement & monitor solution	Green policy & business case approved & deployed	$US200,000 allocated to reduce carbon footprint & e-waste	Implementing solutions to reduce energy consumption & / or prevent pollution. Developing capabilities & means of evaluation. Engaging staff.
3	Determination	Solution seeking	Identifying drivers and potential solutions and preparing the business case	Monitoring impact of ICT, identifying drivers & potential solutions	Determining & monitoring environmental impact of ICT activities, identifying drivers, identifying & examining potential solutions, preparing business cases

2	Investigation	Problem identification & scoping	Identifying and scoping problem areas and possible solutions	Building awareness, collecting data on power use & regulation for business case	Building awareness of general problem areas & business drivers, commencing data collection on energy consumption, pollution contribution & regulatory requirements
1	Awareness	Issue identification	Awareness of e-waste generated by business	Re-think how we could do business differently	Becoming aware of carbon footprint & e-waste pollution issues; relevance to ICT & organisation became clear

for research and practice column was developed from both literature and the case.

In a previous study, the stages, titles, activities and agenda items were compared with the ESICT activities of a major, multi-national ICT services corporation and found to be consistent (Elliot and Binney, 2008). The eight-stage model consists of an initial awareness stage focusing on identifying issues relevant to the organization. Stages 2-5 are essentially operational, determining the level of impact, the range of options, and implementing and evaluating those options. Stages 6-8 focus on integrating environmental sustainability activities across the organisation and incorporating the capabilities developed in prior stages into business strategy.

A SME ICT-services organization recognised as a pioneer in the environmental sustainability of ICT was selected for this study. The research sought to capture the range and diversity of sustainable activities and experiences and to place the sustainable ICT activities into context. Triangulation was obtained by data collection from public and internal materials and presentations, and interviews with the CEO.

4   Case study

RSS (not the company's real name) is an ICT solution provider in a thriving city of 90,000 inhabitants in regional Australia. Founded more than 25 years ago, today the company has grown to 30 staff. Their focus on providing total technology-enabled solutions to meet clients' business goals has been a key factor in their success.

In December 2006, the co-founder and Chief Executive Officer (CEO) unexpectedly received six weeks notice to vacate the premises they had occupied for over 20 years. At short notice, the only office space available had little more than half the space of the old location, a prime motivator to review operations requirements as well as update and rationalize hardware and software. The CEO also began to appreciate that their current business practices were not sustainable:

> "After generating 30 large bins of e-waste, we realized our operations were wasteful and so we began to consider how we could do business differently." CEO.

In 2006, there was considerable uncertainty about the issue of environmental sustainability: its meaning, causes and impact. There was even more uncertainty about what actions business leaders could take if they sought to address the challenges presented by environmental sustainability. Lacking comprehensive sources of information and guidance, RSS had to

search for information, source their own equipment and experiment with possible solutions - all while relocating the business.

Today, there is increased awareness of environmental sustainability issues but uncertainty remains for business leaders as they seek solutions for their own, often unique, business situation. Some assistance has become available in the form of a management framework for establishing environmental sustainability of ICT (Elliot and Binney, 2008).

But how relevant is a framework based on the experiences of a multi-national corporation to the experiences of a small–medium sized business? The processes used by RSS to develop and implement a green ICT policy have been compared with the Stages of Development model, with surprising results.

4.1   Challenges and Lessons from a SME

Located in a regional centre remote from the major capitals in Australia, RSS sees itself as being a distinctly different IT company. 'Different' because in times of increasing business specialization, the company provides a full range of ICT services to support their clients' business objectives. Today, they are also different because they are well advanced to becoming an environmentally sustainable organisation. Although their initial motivation was business necessity to relocate their offices, this necessity became increasingly influenced by a sense of social responsibility to reduce the business' environmental impact. Their traditional practices were challenged by dual imperatives to reduce office space and to become more environmentally sustainable. Their critical review of business practices was good for business as they reduced costs and developed capabilities to assist their clients to become more environmentally sustainable. Today, their customer base has grown from a local to a national market, with clients from Cairns to Hobart, a distance of 3,000 kilometres. The CEO considers,

> "It is still early days in the company's journey towards total environmental sustainability, but the outcomes for the company in terms of energy efficiency and space savings have been significant. The staff are happy with a commitment to improving the environment and have developed professionally during the process. Given that attracting and retaining good staff is one of the major challenges facing companies today, these types of outcomes are as valuable as the energy and cost savings achieved through a 'green' approach to business." (CEO).

As a pioneering small business in implementation of environmentally sustainable business practices, RSS's experiences are relevant to other organizations. Their experiences have been mapped across a stages of development framework (Elliot and Binney, 2008) to see how they compare to the experiences of a large multi-national corporation. RSS' activities were found to be strikingly consistent with activities in each of the eight stages. As should be expected in a SME, the activities are less formal and are often treated as a single solution to a problem rather than separate steps in a more complex process to determine, implement and evaluate a particular solution. The proliferation and integration stages are more likely to be combined as SMEs are less likely to have separate functional systems and much more likely to have an integrated multi-functional system. With allowance for these cautions, RSS' experiences are still a useful contribution to executives of companies large and small seeking to address the challenges of environmental sustainability

As a result of re-thinking their approach to business, RSS identified and deployed innovative applications of new technologies. In the process, they updated their existing capabilities to

support their core business: providing full-service technology-enabled solutions for their clients. In addition, they developed new capabilities to assist a business to improve its environmental sustainability.

> "To our surprise, this became a new area of business that attracted clients from across the country. New business opportunities included expanded hosting opportunities, direct shipping and, most recently, the potential of 'green' consulting to other firms." CEO.

Green consulting has considerable potential as RSS could work not only with other ICT companies to 'green' their businesses but potentially those company's own clients to improve their environmental performance. Strategic partnerships have been established with Rotary and Planet Ark to increase both their and their clients recycling of e-waste.

5 Conclusions and implications

The environmental sustainability of ICT presents numerous challenges of considerable and growing significance to society. Business organizations are confronted by the necessity to transform business activity to become more environmentally sustainable but experience uncertainty about how they could and should transform current practice. Small-Medium Enterprises are the most numerous of business organizations and so have the potential to make a major contribution to environmental sustainability but are not well equipped to undertake strategic change without assistance.

Environmental sustainability of ICT has been shown to be a core topic for IS and IS researchers have the potential to make a significant contribution to assisting SMEs in their endeavours. This paper aimed to assist SMEs develop internal capabilities to address these environmental challenges and to promote IS research by presenting an IS research agenda relevant to SMEs.

The research questions sought to: identify current literature relevant to business practice by SMEs in environmental sustainability of ICT; describe the contribution made by an SME to resolution of environmental sustainability of ICT challenges; present an integrated framework of current literature and practice by SMEs and propose an IS research agenda based on this framework to facilitate industry-relevant IS research activity?

The paper addressed each of the research questions. To assist executives and IS researchers confronted by uncertainty about this area, Table 1 presents analysis of more than 30 papers and reports relevant to the environmental sustainability of ICT in practice. The literature is sourced from specialist environmental groups, practitioners, government and inter-governmental bodies as well as some academic papers from non-IS disciplines. The papers on Table 1 are categorised as focusing on the environmental sustainability of ICT: as a problem, as a solution or opportunity, with a rationale for business action, and with possible actions for implementation. Table 1 also includes references on approaches to evaluating initiatives. No IS research is included on Table 1 since searches of the premier IS research journals over a period of 30 years failed to identify a single paper focusing on environmental sustainability of ICT, whether in large corporations or in SMEs. The domain for this work is SMEs since they represent about 95% of all businesses internationally and so, potentially, would be able to make the greatest contribution to the environmental sustainability of ICT. More than large corporations, SMEs have limited capacity to initiate strategic change without external assistance (ISO, 2005).

Based on the literature and on the experiences of an SME pioneering in ESICT, an integrated framework and a research agenda are proposed for IS research and practice. The Framework serves as a means of assisting organizations to address uncertainty about how to respond to pressures to change current business practice by becoming more environmentally sustainable. IS researchers can utilise the Framework to contribute to environmental sustainability by developing investigations based on the literature and leading practice.

This paper reviews the approach used by RSS to create and implement an environmental sustainability policy. The result was a process of review, action, evaluation and integration that has successfully reduced office space, transport and e-waste; generated greater energy efficiency; and created new business opportunities. The company's experiences were compared with a management framework designed to assist organizations address the challenges of environmental sustainability that was based on the activities of a multi-national technology services corporation. Allowing for differences in complexity and formality of process, the experiences of small business and large corporation are surprisingly aligned.

The applicability of the ICT Environmental Sustainability Stages of Development for SMEs Framework may be limited by the literature selected and by the nature of the source firm confirming and informing its elements: a consulting, systems integration and ICT services firm with 30 staff. It is likely that this Framework is applicable more generally to other SME service organizations, although this contention will need to be tested through further research. The Framework is based on SME-level drivers to transform current business practices to become more environmentally sustainable and so it may not be applicable to non-services organizations exposed to external drivers such as regulatory imperatives for change in jurisdictions penalizing environmental pollution or mandating reductions in energy consumption.

With allowance for these limitations, this paper contributes to addressing the challenges and opportunities of ICT environmental sustainability that apply to most aspects of business practice. The categorization of relevant literature, the ICT Environmental Sustainability Stages of Development for SMEs Framework and the supporting case details combined provide sufficient information and justification to overcome uncertainty and to place this issue firmly on the executive agenda.

This paper also contributes to the IS discipline, which has its own challenges as well as those relating to the environmental sustainability of ICT. Challenges to IS include calls to increase the industry relevance of its activities and to address major issues confronting the global community. The environmental sustainability of ICT presents a logical area for IS research focus since it falls within the scope of the discipline. The opportunity clearly exists for IS researchers to make rigorous contributions in industry relevant areas on this issue of global importance.

References

Agarwal R. and Lucas H.C. (2005) The IS Identity crisis: focusing on high-visibility and high-impact research, *MIS Quarterly* Vol. 29 No. 3, pp. 381-398/September

Avgerou C. (2001) "The significance of context in information systems and organizational change" *Information Systems Journal*, 11, 43-63, p49

Basel (2006a) *"Meeting the Challenge of E-Waste"* Basel Convention / UNEP http://www.basel.int/pub/leaflet170806-1.pdf

Basel (2006b*)"Illegal Traffic under the Basel Convention"* Basel Convention / UNEP http://www.basel.int/pub/leaflet091006.pdf

Bhalla N.,(2007) "India's Toxic E-Waste", *Reuters News Service*, 26th February.

Chen, A. J., Boudreau, M.-C., and Watson, R. T. (2008). Information Systems and ecological sustainability. The Journal of Systems and Information Technology. 10, 3, 186-201

de Groot F., (2000) "Different Stages in the Process of Growing to a High Level of Environmental Management", *Second OECD Workshop on Environmentally Sound Management of Wastes Destined for Recovery Operations,* OECD, 28-29 September 2000

Elkington J.(1998) *Cannibals with Forks: The Triple Bottom Line of 21st Century Business.* New Society Publishers' Conscientious Commerce Series, Canada, p2-3

Elliot S (2007) 'Environmentally Sustainable ICT: A Critical Topic for IS Research?' *Pacific Asia Conference on Information Systems (PACIS 2007)*, Auckland, New Zealand,

Elliot S. and Binney D.J. (2008) 'Environmentally Sustainable ICT: Developing Corporate Capabilities and an industry-relevant IS Research Agenda', *Pacific Asia Conference on Information Systems* Association for Information Systems,. p1-13.

EU (2003a) "DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the Restriction of the use of certain hazardous substances in electrical and electronic equipment" (RoHS), *Official Journal of the European Union*, 13 February, p 21.

EU (2003b) "DIRECTIVE 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on Waste Electrical and Electronic Equipment (WEEE)", *Official Journal of the European Union*, 13 February, pp 27, 29, 33.

Friedman T.L. (2007)"The Power of Green", *New York Times*, April 15. Magazine, Section 6, p40

Funk K. (2003) 'Sustainability and Performance' *MIT Sloan Management Review* Winter, pp65-70

GAO (2005) *Electronic Waste: Strengthening the Role of the Federal Government in Encouraging Recycling and Reuse,* US Government Accountability Office GAO-06-47, Washington D.C.: Nov, Highlights.

Gartner, (2007) "Key issues in Environmentally Sustainable IT" Gartner Inc, Stamford CT, USA, Jan, p3

GeSI (2005) *Global e-Sustainability Initiative Progress Report ,*GeSI Secretariat UNEP, p14, 32-33

Gray R. and Milne M.J. (2002) "Sustainability Reporting: Who's Kidding Whom?" *Chartered Accountants of New Zealand Journal*,

Greenpeace (2005 *Hi-Tech: Highly toxic* Greenpeace March,

http://www.greenpeace.org/international/campaigns/toxics/electronics

Greenpeace (2007a) *Cutting edge contamination: A study of environmental pollution during the manufacture of electronic products* Greenpeace February, pp 72-73

Hart S.L. (1997) "Beyond Greening: Strategies for a Sustainable World". *Harvard Business Review* January-February, pp66-76

Hasan S.E., (2002) "E-waste; a new challenge in waste management"**,** *in Abstracts with Programs - Geological Society of America* (October), 34(6):418)

Howard-Grenville J.A. and Carlile (2006) P.R "The incompatibility of knowledge regimes", *European Journal of Information Systems*,15, 473–485

Intel (2006) "Energy-Efficient Performance on the Client" Intel September. http://www.intel.com/technology/eep/EEP_whitepaper.pdf

IPCC (2007) Climate Change 2007: AR4 Synthesis Report Summary for Policy Makers, Intergovernmental Panel on Climate Change, Geneva. www.ipcc.ch/#

ISO (2005) *The Global Use of Environmental Management Systems by Small and Medium Enterprises: Executive Report*, ISO/TC207/SC1/ Strategic SME Group, May, p12

Jaques R. (2007) "Global ICT carbon emissions unsustainable" *IT Week*, UK (http://www.itweek.co.uk/vnunet/news/2188710/global-industry-guilty)

Lee, A. S. (2001) Editorial, *MIS Quarterly,* 25, 1, iii-vii.

Magretta J. (1997) "Growth through global sustainability". *Harvard Business Review*, January-February pp78-88

MCA (2007) A growing concern: how should business adapt to a low carbon world? Management Consultancies Association, London.

McDonough W. and Braungart M. (2002) 'Design for the Triple Top Line: New Tools for Sustainable Commerce, Corporate Environmental Strategy, Vol. 9, No. 3, 251-258

McKinsey (2004) "Preparing for a low carbon future" *McKinsey Quarterly* Number 4,pp78-87

McKinsey (2007) 'Curbing the growth of global energy demand' *McKinsey Quarterly* Nbr 1, 20-33

McKinsey (2008) 'Addressing consumer concerns about climate change', *McKinsey Quarterly*, March.

Nolan R.L. (1979) "Managing the crises in data processing" Harvard Business Review, Mar/Apr, Vol. 57 Issue 2, p115-126

Porter ME. and Reinhardt FL., (2007) A strategic approach to climate, Harvard Business Review, October, 22-26

S2 (2008) *S2 Innovation Review 2008,* S2 Intelligence, www.s2intelligence.com.au

Saravanamuthu R. (2002) "The political lacuna in participatory systems design", *Journal of Information Technology* 17, 185–198.

Saunders C. "Editorial: A camel going through the eye of a needle", MISQ Sept. 2007, pp iv-xviii

Shrivastava P. (1995) 'The role of corporations in achieving ecological sustainability' *Academy of Management Review* 20:4, pp 936-960

Stern N. (2007) *The Economics of Climate Change: The Stern Review*, Cambridge University Press, Cambridge UK,.

Sun (2006) "Sun Microsystems Received 2006 Environment Prize for the UltraSPARC T1 Processor" April, Sun Microsystems" http://www.sun.com/smi/Press/sunflash/ 2006-04/sunflash.20060413.1.xml

UNEP (2005) *GEO Year Book 2004-2005* United Nations Environmental Program, Nairobi, pp17-18

Welsh JA. And White JF. (1981) A small business is not a little big business, Harvard Business Review July-August, pp18-32

WMO (2007) *Climate Change 2007: The Physical Science Basis Summary for Policymakers,* Intergovernmental Panel on Climate Change, World Meteorological Organization, Geneva, February, p2.