4-16-2011

Sustainable Economic ICT Strategy: A Proposed Framework

Bing Qian Zhang
Unitec Computing Department, zhangbingqian101@hotmail.com

Kay Fielden
Unitec Computing Department, kfielden@unitec.ac.nz

芽|Sprouts Working Papers on Information Systems ISSN 1535-6078

SUSTAINABLE ECONOMIC ICT STRATEGY: A PROPOSED FRAMEWORK

Bing Qian Zhang
Unitec Computing Department, New Zealand

Kay Fielden
Unitec Computing Department, New Zealand

Abstract
In this proposed research framework, sustainability is added to the list of OECD digital economic rankings (>100), which reflect the ability for the world's countries to absorb information and communications technology (ICT) for economic and social benefit. The framework proposed adds three levels of environmental factors and categorizes the existing criteria into clusters to form a holistic evaluation framework for sustaining economic ICT strategy.

Keywords: Sustainability, Digital economy, Environment, Social benefits, Evaluation framework

Permanent URL: http://sprouts.aisnet.org/11-15

Reference: Zhang, B. Q., Fielden, K. (2011). "SUSTAINABLE ECONOMIC ICT STRATEGY: A PROPOSED FRAMEWORK," Proceedings > Proceedings of SIGGreen Workshop . *Sprouts: Working Papers on Information Systems*, 11(15). http://sprouts.aisnet.org/11-15

Introduction

This framework has been developed in response to (R. T. Watson, M.-C. Boudreau, & A. J. Chen, 2010a), who have proposed that the IS community demonstrate how IS can contribute to creating an ecologically sustainable society. Whilst, Watson et al have suggested that a new subfield of energy informatics be established, the holistic framework presented in this paper incorporates energy informatics as one factor of many. Also, a sub-discipline of carbon-centric computing has been proposed by (Hasan, Ghose, & Spedding, 2009) in which the philosophy of think globally, act locally be adopted to introduce environmental awareness to a wide spectrum of IT research and practice.

The structure of this paper is as follows: literature review, framework, proposed method, discussion, further research, and conclusion.

Proposed Framework

Existing OECD ICT ranking framework

The OECD member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The existing OECD digital rankings reflect member countries' abilities to absorb ICT into its infrastructure and to use ICT for economic and social benefit.

In 2010, OECD member countries agreed to tackle environmental challenges and to utilize ICTs better to accelerate green growth. The 10-point checklist produced includes providing key roles in increasing energy efficiency, managing scarce resources, combating climate change, and tackling other environmental challenges including protection of biodiversity, directly and by systemic behavior change at governmental policy level. These policies should be designed to increase public awareness, change consumer behavior, and improve business performance. The OECD see that member countries have the responsibility of coordinating green ICT policies to bridge the gap between multiple stakeholders including climate, environment and energy experts and policy makers. ICT professionals therefore are central to the implementation of green ICT. Not only are there direct effects of ICT on the environment, but also there are enabling effects of ICT applications on other sectors as well as systemic effects to changed social and cultural behavior through green uses of ICT.

In the connectivity and technology infrastructure category, broadband penetration, quality and affordability, mobile phone penetration and quality, internet penetration and security, and international internet bandwidth were considered. The business-environment category criteria included the strength of the economy, political stability, taxation, competition policy, the labor market and openness to trade and investment. Political factors considered were overall political environment, macroeconomic environment, market opportunities, policy towards private enterprise, foreign investment policy, foreign trade and exchange regimes, tax regime, financing and the labor market. Criteria considered for the social and cultural environment category included web literacy, technical skills of the workforce (evaluated by evidence of a country's population familiarity with IT applications, and the extent to which its schools and governments provide the education infrastructure required. Also included in the social and cultural category is an assessment of entrepreneurship as well as the ways in which the society fosters creative business activity. In the legal environment category criteria include a country's specific laws governing internet use that have a direct impact on the use of digital technology to inform, communicate and transact business. These include legislative approaches to issues such as cybercrime, data privacy, and spam, as well the legal atmosphere that minimizes abuse and non-competitive behavior. A prime requirement is that there is little bureaucracy to interfere with the access to information. Governments with a clear roadmap for the adoption of technology provide policy and vision to increase economic efficiency. Criteria in the government category include how much a government spends as a proportion of GDP, having a digital development strategy, online procurement, availability of online public services for citizens and businesses, and e-participation. In the consumer and business adoption category, criteria considered were IT connectivity, societal adoption, legal and political environments as enabling digital platforms, actual utilization of digital channels, costs associated with accessing ICT services, and the extent to which the range of internet features are used by individuals and businesses. The relative weightings for these

factors are: connectivity and technology infrastructure 20%; business environment 15%; social and cultural environment 15%; legal environment 10%; government policy and vision 15%; and consumer and business adoption 25% (Table 1). All Scandanavian countries (Sweden, Denmark, Finland and Norway), USA and Netherlands, and Countires in the Asia-Pacific region (Hong Kong, Singapore, Australia and New Zealand) are included in the top 10 countries in the top ten OECD digital economy rankings.

Table 1. Country Rankings

	Total	**Connectivity**	**Business**	**Social & cultural**	**Legal**	**Govt**	**Adoption**
Weight %		20%	15%	15%	10%	15%	25%
Sweden	***8.49***	***8.20***	8.13	8.53	8.25	8.90	8.75
Denmark	8.41	7.85	8.18	8.47	***8.10***	8.70	8.90
USA	8.41	7.35	***7.85***	***9.00***	8.70	***9.25***	8.60
Finland	8.36	8.00	8.30	8.47	8.35	8.00	8.85
Netherlands	8.36	8.05	8.05	8.07	8.45	8.25	***9.00***
Norway	8.24	7.95	7.95	8.00	8.30	***8.05***	8.90
Hong Kong	8.22	7.65	8.40	***7.27***	***9.00***	9.18	8.28
Singapore	8.22	7.35	***8.63***	7.33	8.70	9.13	8.48
Australia	8.21	7.35	8.24	8.53	8.50	8.85	***8.18***
New Zealand	8.07	***6.80***	8.17	8.60	8.45	8.50	8.29

Theoretical framework for ICT sustainability

The theoretical framework proposed extends the OECD digital framework by also considering three more levels of environmental factors, which categorize existing criteria into clusters to form a holistic evaluation framework to support a sustainable economic ICT strategy. This theoretical framework will be trialed in a multi-stakeholder study in ICT leasing companies in New Zealand.

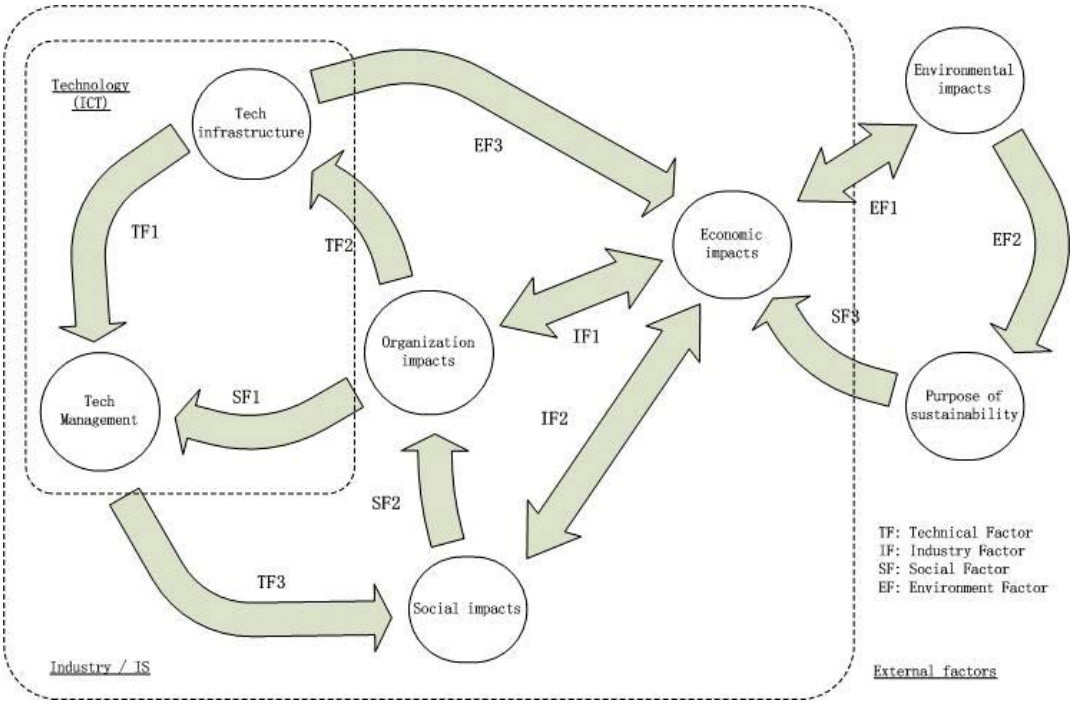

Figure 1. Green ICT Theoretical Framework

This framework contains seven elements and has been divided into three levels, which are technical infrastructure and technical management in the Technology (ICT) layer, organization impacts, social impacts and economic impacts with the technology (ICT) layer in the industry (IS) layer, and the external factors, environmental impacts and purpose of sustainability. Other nodes in the industry/IS cluster include organizational impacts, social impacts and economic impacts. There are links to the external cluster via environmental impacts and the purpose of sustainability. The hypotheses formed are represented as the causal links between the nodes in the framework.

Technology cluster

Within the technical infrastructure node, any ICT innovation that moves the OECD towards a greener ICT-based economy are supported. These could include:

1. Cloud computing, Virtualization, 3R (Recycle, reuse and reduce) of disposal e-waste, energy efficiency, reduce carbon credits, and dematerialization;
2. Develop new (green) ICTs; and
3. ICTs in supporting public communication (Web 2.0, e-learning)

The technology-focused hypotheses are:

TF1: Technical infrastructure has an effect on the ways in which green IT is managed

Efficient green IT management methods could reduce energy consumption, thus decreasing green house gas emissions. This will also have an effect on SF1 (there are green organizational impacts on technical management).

TF2: There are green organizational impacts on selection and use of technical infrastructure

Green ICT infrastructure such as cloud computing, thin-client and virtualization will have organizational impacts. New energy-efficient hardware will also have green organizational impacts.

TF3: The technical management of green IT has societal impacts

Social ICTs such as Web 2.0 technologies, e-learning and e-government could give strong support to enable public communication, which, in turn may contribute to the diffusion of green ICT concepts, as well as a way to apply dematerialization (Dematerialization refers to *"... the concept of industrial metabolism, dematerialization aims at reducing quantitatively the material throughput of the economic system. (Bartelmus, Bringezu & Moll, 2000)"*

Social impacts

In the societal cluster for a green ICT-based economy the following factors are considered:

1. The long-term balance between human development and the natural environment;
2. Any change of customers' interests and government's green policies; and
3. How to meet green policies, public opinion and changes of customers' interests.

The societal hypotheses therefore are:

SF1: There are green organizational impacts on technical management

New management methods could help organizations to manage ICT infrastructure efficiently so that energy consumption could be reduced thus decreasing GHGs emissions.

SF2: There are societal impacts that influence green ICT in organizations

In 2009, WTO-UNEP published the *Trade and Climate Change* report to illustrate large-scale research projects completed to identify impacts of climate change on the economy as well as the possible solutions and opportunities to these issues. There are also societal and governmental responsibilities in protecting the environment.

SF3: The purpose of sustainability will have an economic impact

In 1992, the Brundtland Commission Report defined sustainable development as *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (IISD, 2010)*."* In order to achieve sustainability, in terms of the economy, IISD state in their 2010 Commentary, "*The Digital Economy and the Green Economy: Opportunities for Strategic Synergies"* as follows: *"This can only be done in the long run through policies and strategies that balance economic growth with social development with environmental sustainability."*

Industry impacts

Industry-based considerations for green ICT-based economy includes:

1. Creating jobs by new green economy with customers' requirements changing;
2. New business opportunities in green ICT products; and
3. Raising and driving the direction of the economy to sustainability.

The industry focused hypotheses are:

IF1a: Green IT organizational impacts will affect the economy

For instance, the decrease of the energy consumption will increase organizations' competitiveness by dramatically reducing the electricity costs.

IF1b: The economy will have an impact on green IT organizations

Green ICT has been promoted as a means to future economic growth (OECD, 2009; WTO-UNEP, 2009) through governmental green ICT strategies, customer's new interests on green products and the practice of organizations' social responsibility on the environment.

IF2a: Economic aspects of green ICT will have an impact on the economy

IF2b: Social impacts will be felt by the influence of green ICT on the economy

There may be a causal relationship between increases in customers' interests in green products and the economy. There may also be a link between both social and economic impacts as organizations adapt and choose to apply green ICT.

External factors

The environmental cluster for a green ICT-based economy include:

1. Considerations for reducing energy and raw material taking from the ecosystem;
2. Reducing over consumption of natural resources, green house gases emission, and pollution (e-waste);
3. Tackling climate change, pollution and eco-system decline; and
4. Saving costs, increasing efficiency, and decreasing negative impacts of the economy on the environment.

EF1a: The environmental impacts of green IT will have an impact on the economy

EF1b: The economy will have on the environmental impacts of green IT.

There may be a reciprocal causal relationship between preserving and using natural resources efficiently.

EF2: The environmental impacts of green ICT will impinge on the purpose of sustainability

Hasan, Ghose and Spedding (2009) point out that *"Environmental concerns that threaten the very existence of the human race are arguably the most important issues of our time."* As the response to this serious issue to the human race, issues, such as pollution, global warming and climate change (EF2) are addressed in this hypothesis (EF2). Perhaps it should be the task for all people who come from different sectors of the society, working together towards a sustainable future, as well as the IS and ICT sectors.

EF3: Green IT infrastructure will have an impact on the economy

For instance, pollution such as e-waste and green house gas (GHG) emission reduction will have an impact on the economy.

Literature Review

Whilst a selection of green ICT literature has been consulted (Ahola, Ahlqvist, Ermes, Myllyoja, & Savola, 2010; Allenby, 2006; Babbitt, Kahhat, & Williams, 2010; Babin & McLareny, 2010; Brooks, Wangy, & Sarkerz, 2010; Checkland & Scholes, 2000; Dedrick, 2010; Fernando & Okuda, 2009; Hasan, 2010; Hasan et al., 2009; Hilly, Som, & Köhler, 2004; Iacobelli, Olson, & Merhout, 2010; P. Kim, Ng, & Lim, 2010; Y. S. Kim & Koy, 2010; Kuo, 2010; Melville, 2010; Molla, Cooper, Deng, Lukaitis, & TIS, 2009; n/a, 2010a, 2010b, 2010c; Reimsbach-Kounatze, 2009; Schmidt, Erek, Kolbe, & Zarnekow, 2010; Seidel, Recker, Pimmer, & vom Brocke, 2010; Society, 2007; Som, Hilty, & Köhler, 2009; Watson et al., 2010a), this research project is the initial stages and the literature review is still to be produced.

Method

This framework is guiding postgraduate research in this area thus raising the level of awareness amongst upcoming IS researchers.

This holistic sustainability framework, which incorporates the directions provided by (Watson et al., 2010a) and (Hasan et al., 2009) will be trialled in a case study in New Zealand IT leasing companies. The main research question is: What Green IT strategies exist in New Zealand IT leasing companies?

This research follows the "Seven Steps" of Soft System Methodology (Checkland & Scholes, 2000). Firstly, an observation of the problem situation will be conducted, and then the results will be used to draw a rich picture of the problem situation. Secondly, the data gathered from an online survey of different stakeholder groups (e.g. government bodies, environmental groups, leasing companies, customers of leasing companies) will be used to formulate root definitions of relevant systems for purposeful activity. Thirdly, based on the root definitions, conceptual models for each group will be constructed. Fourthly, these conceptual models, which have been

evaluated against the holistic framework proposed, will be compared with the perceived real world situation. Finally, based on the differences between theory and the real world situation, analysis will be conducted and possible solutions developed.

Conclusion

In this paper, the first stage of a green ICT model has been presented. This framework has been developed in response to (R. T. Watson, M.-C. Boudreau, & A. J. Chen, 2010a), who have proposed that the IS community demonstrate how IS can contribute to creating an ecologically sustainable society. Whilst, Watson et al have suggested that a new subfield of energy informatics be established, the holistic framework presented in this paper incorporates energy informatics as one factor of many. Also, a sub-discipline of carbon-centric computing has been proposed by (Hasan, Ghose, & Spedding, 2009) in which the philosophy of think globally, act locally be adopted to introduce environmental awareness to a wide spectrum of IT research and practice.

References

Ahola, J., Ahlqvist, T., Ermes, M., Myllyoja, J., & Savola, J. (2010). *ICT for environmental sustainability green ICT roadmap*

Allenby, B. (2006). The ontologies of industrial ecology? *Progress in Industrial Ecology – An International Journal, 3*(1/2), 28-40.

Babbitt, C. W., Kahhat, R., & Williams, R. (2010). *Trends in the lifespan evolution of personal computers and implications for life cycle assessment studies: a case study of the U.S. higher education sector*. IEEE Internationam Symposium on Sustainable Systems and Technology

Babin, R., & McLareny, T. S. (2010). *An Inductive Classication Scheme for Green IT Initiatives*. Lima, Peru

Bartelmus, P., Bringezu, S., & Moll, S. (2000). Dematerialization, environmental accounting and resource management: Main issues and how they can be translated into public policy initiatives. *Preparation of the 6th Environmental Action Programme for European Commission*. Retrieved from http://ec.europa.eu/environment/enveco/waste/pdf/demat_resource_man.pdf

Brooks, S., Wangy, X., & Sarkerz, S. (2010). *Unpacking green IT: A review of the existing literature*. Lima, Peru

Checkland, P., & Scholes, J. (2000). *Soft systems methodology in action* (2nd ed.). Chichester, UK: Wiley.

Dedrick, J. (2010). Green IS: Concepts and issues for information systems research. *Communications of the Association for Information Systems, 27*(11)

Fernando, P., & Okuda, A. (2009). Green ICT: A "cool" factor in the wake of multiple meltdowns. *ESCAP Technical Paper, Information and Communications Technology and Disaster Risk Reduction Division*

Hasan, H. (2010). *Was the Copenhagen Summit doomed from the start? Some insights from green IS research*. Lima, Peru.

Hasan, H., Ghose, A., & Spedding, T. (2009). *IS solutions for the global environmental challenge: an Australian initiative*. San Francisco, California Retrieved from http://aisel.aisnet.org/amcis2009/122

Hilly, L. M., Som, C., & Köhler, A. (2004). Assessing the Human, Social, and Environmental Risks of Pervasive Computing. *Human & Ecological Risk Assessment, 10*(5), 853-874. doi:10.1080/10807030490513874

Iacobelli, L. B., Olson, R. A., & Merhout, J. W. (2010). *Green/sustainable IT/IS: Concepts and cases*. Paper 104. Retrieved from http://aisel.aisnet.org/amcis2010/104

IISD. (2010). *The digital economy an the green economy: Opportunities for strategic synergies*. Canada.

Kim, P., Ng, C. K., & Lim, G. (2010). When cloud computing meets with Semantic Web: A new design for e-portfolio systems in the social media era. *British Journal of Educational Technology, 41*(6), 1018-1028. doi:10.1111/j.1467-8535.2010.01055.x

Kim, Y. S., & Koy, M. (2010). *Identifying green IT leaders with financial and environmental performance indicators*. Lima, Peru

Kuo, B. N. (2010). *Organizational Green IT: It seems the bottom line rules*. Paper 99. Retrieved from http://aisel.aisnet.org/amcis2010/99

Melville, N. (2010). Information systems innovation for environmental sustainability. *MIS Quarterly, 34*(1), 1-21.

Molla, A., Cooper, V., Deng, H., Lukaitis, S., & TIS. (2009). *A preliminary report on greent IT attitude and actions amony Australian IT professionals*. Melbourne: RMIT.

n/a. (2010a). *The Digital Economy and the Green Economy: Opportunities for strategic synergies. A submission to the Digital Economy Consultation*

n/a. (2010b). *Digital economy rankings 2010: Beyond e-readiness - A report from the economist intelligence unit*: The Economist Intelligence Unit Limited.
n/a. (2010c). *White paper green ICT. The greening of business*
OECD. (2009). Towards green ICT strategies: Assessing policies and programmes on ICT and the environment. Retrieved June 22, 2010, from http://www.oecd.org/dataoecd/47/12/42825130.pdf
Reimsbach-Kounatze, C. (2009). *Towards green ICT strategies: Assessing policies and programmes on ICT and the Environment"*
Schmidt, N.-H., Erek, K., Kolbe, L. M., & Zarnekow, R. (2010). *Predictors of green IT adoption: Implications from an empirical investigation*. Paper 367. Retrieved from http://aisel.aisnet.org/amcis2010/367
Seidel, S., Recker, J., Pimmer, C., & vom Brocke, J. (2010). *Enablers and barriers to the organizational adoption of sustainable business practices*. Retrieved from http://aisel.aisnet.org/amcis2010/427
Society, A. C. (2007). Australian computer society policy statement on green ICT
Som, C., Hilty, L., & Köhler, A. (2009). The Precautionary Principle as a Framework for a Sustainable Information Society. *Journal of Business Ethics, 85*, 493-505. doi:10.1007/s10551-009-0214-x
Watson, R. T., Boudreau, M.-C., & Chen, A. J. (2010a). Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. *MIS Quarterly, 34*(1), 23-38.
Watson, R. T., Boudreau, M.-C., & Chen, A. J. (2010b). Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. *MIS Quarterly, 34*(1), 23-38.
WTO-UNEP. (2009). *Trade and climate change*. Secretariat, Switzerland.

芽|Sprouts

Working Papers on Information Systems | ISSN 1535-6078

Office:
Sprouts
University of Amsterdam
Roetersstraat 11, Room E 2.74
1018 WB Amsterdam, Netherlands
Email: admin@sprouts.aisnet.org

芽|Sprouts