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Cradle to Cradle for End-user Computing Devices in Business

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Cradle to cradle for End-user Computing Devices in Business - A short paper

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Abstract

Whilst computers can and do contribute significantly to improving our use of sustainable materials and practices, computers themselves are responsible for the consumption of large amounts of such resources, contributing extensively to hazardous waste. The aim of this study is to develop a model for organisations to collect data regarding their end-user device implementation and identify areas for improving their performance and their sustainability in line with current Green Computing (IT) trends.

Keywords: Cradle to Cradle; End-user Devices; Green Computing; Sustainability.

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1. Introduction

Recent concerns about the environment and energy consumption have become topics of increasing attention and the issue of sustainable computing in particular has become a rapidly expanding area of research. Indeed, although ‘Green IT’ is attracting increasing consideration across both the scientific and business communities there is limited research that focuses on power consumption. However, as consumption rises the focus on IT going Green gains momentum because energy consumption has a significant impact upon CO_2 emissions, Operating costs and Scalability. It is estimated that computing for the internet alone is responsible for using over 5% of the power generated by our planet (Sarokin 2007) and computing as a whole is considered to be responsible for between 3% and 8% of a given countries power consumption depending upon the development level of that country (Somavat, Jadhav and Namboodiri 2007).

More specifically, according to recent research IT is responsible of more than 2% of global CO_2 emissions, and its environmental footprint is comparable to that of the aeronautic industry (Murugesan 2008, Brown and Lee 2007, Kumar 2007) and ICT equipment currently accounts for 3-4% of the world’s carbon emissions, and 10% of the UK’s energy bill. The average amount of energy consumed by a PC in one year corresponds to the emission of 1 ton of CO_2, and a server has roughly the same annual carbon footprint as an SUV doing 15 miles-per-gallon (Restorik 2007). Additionally, 70% of the landfills of lead, cadmium and mercury is derived from the IT industry (Brown and Lee 2007). Moreover, IT has been acknowledged to be a large and inefficient energy consumer i.e. underutilised equipment, poor user practices and policies, inefficient hardware, and lack of hardware disposal policies are a few of the current issues. It is reported that despite advances in hardware and software in many organisations desktop PCs waste is much as 75% of the electricity they consume. Therefore, it is also important for organisations to embrace (sustainable) IT energy efficiency principles and practices to remain productive and competitive in the current increasingly demanding digital age (Aggar 2011).

Consequently, the aim of this study is to develop a model for organisations to identify areas to improve the sustainability of their end-user IT devices for increased performance in line with current Green Computing (IT) trends. Thus, the research question to be addressed is: *'What can be done to reduce the impact of such devices on resources in order to create more sustainable business-practices for the future?'* The research objectives are:

- To investigate the current status of Green Computing (IT) through a critical analysis of extant literature
- To identify, through the lens of the case study, the range of end-user computing devices and their sustainability relative to their key lifecycle stages
- To develop a model for organisations to collect data on the sustainability of their end-user devices in situ
- To analyse the implementation of this model within the case study organisation to identify areas to improve its sustainable IT performance

2. Theoretical Context

Chou and Chou (2011) posit that Brundtland's (1987) report entitled "Our Common Future" defines sustainable development "*as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*." They further suggest that emphasis is placed upon on '*environmental protection', 'economic growth',* and *'social equity'* as the three fundamental components of sustainable development approaches (United Nations General Assembly 2005). The concept of sustainable computing considers total cost of ownership and the total environmental impact. Consequently organisations need concrete sustainable computing strategies and mechanisms that embrace the range of policies, procedures, programs, and attitudes relative to making their IT usage more environmentally sensitive (Ohara 2008).

Since the 1980's and until very recently, most end-user computing was carried out on either a desktop or laptop computer. In the last 10 years, the way we work and the devices that we work on has changed significantly. Today organisations are likely to work on those same two devices, but we will also be using tablets, netbooks, thin-client PC's and smartphones. Each end-user computing device is aimed at assisting organisations by working in different ways. While desktops and, to a somewhat lesser extent, laptops, are still considered the primary productivity devices, as they are still considered to be more effective at both data creation and consumption (due primarily to operating system restrictions and restrictive data creation mechanisms) tablets and smartphones are rapidly becoming a firm favourite when it comes to consuming data, especially in a non-desk-bound or mobile setting.

So why do many employees now own both? Do organisations advise and guide staff on what they should be buying? Are organisations therefore doubling up on computer devices without proper justification, thus contributing to an increase in all of the factors which decrease the sustainability of the organisation, when it comes to computing? It is clear that each end-user computing device type is perceived as being better than others whilst performing different tasks. This research will identify those device types and seek to assess them against the most appropriate tasks. It is likely that generally most organisations will, if at all, explore only the most obvious factors that contribute to the sustainable footprint of a given computing device, such as power consumption and packaging. Furthermore, it is even more likely that that few will take extra steps to establish the sustainable credentials of the equipment that they are buying and using - organisations will usually only see the facts and figures given to them by the suppliers of such equipment.

The intent is to assess the extent to which the case study organisation has considered and implemented sustainability factors surrounding the end-user computing devices utilised in situ. Thusly, considering the impact that end-user computing (EUC) devices are having on finite resources and the environment today, plus the likelihood that usage will grow over time the intent is to design a model to assess the extent to which the organisation has implemented sustainable technologies. For example, we will examine the usage of organisational EUC devices throughout the various stages of their lifecycle from cradle-to-grave and, through recyclability, back to cradle.

3. The Lifecycle of End-user Computing Devices

When viewed as a life-cycle, it becomes clear that every stage of a computing device may have several factors that contribute towards its sustainability footprint, for example:

- *Design* - is, arguably, the most significant phase of determining the devices sustainability footprint. As it is here that the designer can potentially influence the highest number of aspects of the construction and operation.

- *Manufacture* – not just materials. Most computers are constructed of components fabricated by dozens, if not hundreds of other organisations around the world. What are the employment, waste and material policies of those organisations?
- *Transportation* – of components and completed units. What distances are travelled in order to get the unit to the end-user?
- *Use* – Does the organisation have robust policies for controlling the power consumption and management of end-user devices? (the focus of our study - see section 4)
- *Disposal* – What are the expected lifetimes of such devices? Does the organisation control the employees' desires to keep up with technology for the sake of it?
- *Recycle* – Does the organisation take responsibility for what happens to the device after it has been disposed of?

4 Proposed Model Development

The proposed model will define the lifecycle stages of different end-user computing devices and, as a secondary intention, make the organisation more aware of these lifecycle factors, the impact that each can have, and an indication of what improvements are possible.

The main aim of this stage of the research project is to create a model for measuring the sustainable performance of the organisation in its application of end-user computing devices. The assessment of current sustainable best practices identified within the literature review will be ranked according to their sustainable efficacy. It is thought that the model will consist of a data collection form which, for each device-type and stage of lifecycle, will allow the organisation to compare itself against each of the best practices as identified through the research study and record a score that represents the position that best reflects where in the rankings that organisation sits.

The score, once recorded, will allow the organisation to achieve subsequent benefits:

- To assess itself relative to top and bottom ranking for each category, i.e. how well it is doing, relative to what is possible.
- The potential to compare its performance to other organisations who have participated in the same model.

- To compare future assessments again each other in order to identify performance improvements or regressions.

Below figure 1 is a representative ‘mock-up’ of the envisaged model

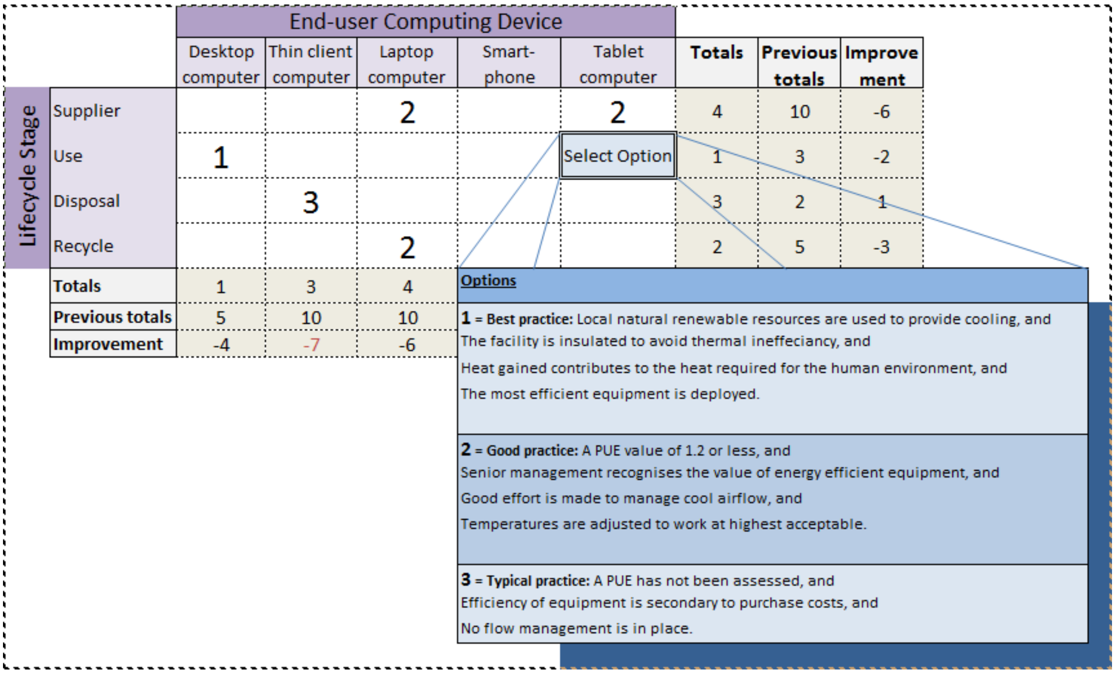

Figure 1. Mock-Up of the Assessment Model illustrating a Series of Options against which the Organisation can select a ‘Best-Fit’.

The proposed model will be developed and evaluated through trialling and analysis. The general intention is that the model would be able to produce a report outlining the results of the assessment and identify the areas where improvement could be considered and, as the model includes ranked best practices, for areas where the organisation had not attained the highest ranking, it could also make recommendations on what those improvements could consist of.

5 Model deployment

As discussed above the intention is to pilot the model within the case study organisation which would be asked questions relating to several key areas after it had applied the model:

- *Culture* - whether the application of the model has or could have a positive impact on the understanding and culture of the organisation, either for the individual or indirectly to other staff.

- *Planning* -Whether the model could or would be used as a tool for, or as evidence to, contributing towards planning and budget-setting within the organisation.
- *Professional benefit* – whether the individual using the model believes it to be of value to them in their work.
- *Organisational benefit* – whether the application of the model had contributed to a change in working practices or approach within the organisation.
- *Personal benefit* – whether the individual using the model believe it had contributed to their learning or understanding of sustainable computing.
- *Financial benefit* – whether the application of the model had led to a reduction of resource expenditure, either financially or materially through improvements in technology selection. Additionally, whether it had led to an increase in expenditure (buying more expensive, but also more sustainable technology).

The ultimate phase is to then target a number of other organisations who would be willing to trial and provide feedback on the model and its performance (This is not the focus of the research paper). In order to make the analysis of feedback statistically significant, it is thought that responses from at least 10-15 organisations would be required.

6. Research Approach

As the principle researcher is an employee of case study organisation an interpretative action research stance is planned within the case study setting as advocated by Yin (2009) and Blumberg *et al.* (2005) utilising both qualitative and quantitative methods of data collection. The case study setting concerned is that of the IT department of Cardiff Metropolitan University. Action research has been used in social science since the 1940's as a research strategy that combines theory with practice through change and reflection (Lewin 1946; Myers 2009) Thus, an exploratory design is proposed in order to investigate *'what is happening; to seek new insight and to ask questions...'* (Robson 2002, p.59) to investigate the key issues involved. The intent is to capture extensive and rich data relative to the research objectives (Cooper and Schindler 2006) and to discover what Remenyi *et al.* call *"the details of the situation to understand the reality or perhaps a reality working behind them"* (1998, cited in Saunders *et al.* 2009, p84) within the case study context (Yin 2009). The multi-method approach will facilitate the triangulation of the empirical data during analysis in order to increase validity of the research findings (Myers 2009, Saunders *et al*., 2009).

The secondary data gathering is focused on the systematic review of current literature i.e. books, journals academic papers and so forth and will include the following areas:

- Researching and defining the concepts of sustainability in computing.
- Identifying a range of end-user computing devices in use within organisations today.
- Identifying and describing the cradle-to-cradle stages in relation to these devices.
- Research and draw up an assessment of the current sustainable best practices for each stage and device-type.

Proposed primary data collection methods will involve face-to-face semi-structured interviews complemented by a questionnaire that will facilitate the collection of both qualitative and quantitative data to address the research aims and objectives (Myers 2009; Saunders *et al*. 2009; Silverman 2010). Rigorous triangulation is planned to ensure the reliability and validity of conclusions drawn from the findings.

Prior to the proposed data collection process a high priority will be placed on adhering to the ethical guidelines set out by the Research Ethics Committee of Cardiff Metropolitan University. In this way the research process will be conducted in an appropriate and ethically sound manner (Cooper and Schindler 2006; Saunders *et al*. 2009). Attention will also be paid to the key issues of bias put forward by Diener and Crandall (1978 cited in Bryman 2004) i.e. avoidance of potential harm to participants, obtaining participants informed consent, ensuring confidentiality and anonymity of participants and data, and the prevention of deception occurring.

7. Contributions of the Research.

The findings, analysis and conclusions of the empirical data collected will aim to inform, and thus benefit, those organisations who had applied the model. Moreover, the primary data outcomes will contribute to the extant but limited body of literature.

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