A Framework for Green Computing

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ABSTRACT

Many organizations attempt to implement Green ICT. Some adopt a deliberate and holistic policy, but most approach it piecemeal. The formal definition and approach to implementing Green ICT remains elusive, because most organizations are unable to properly identify what areas to address. A comprehensive and practical Green ICT framework helps overcome this problem. Measurement is important because it enables benchmarking and comparisons by quantifying the degree of implementation of Green ICT. User organizations can then be compared to each other, or to themselves over time, to determine the extent and effectiveness of their Green ICT strategies. This paper outlines a research-based yet highly practical Green Computing framework. It is based on a 4 x 5 matrix with four vertical "pillars": Lifecycle, End User IT, Enterprise and Data Center IT, and IT as a Low-Carbon Enabler. Applied against each pillar is a five-level Capability Maturity Model metric which can be based on a detailed survey of the organization's policies and practices in each area. The five horizontal dimensions, or "actions" are applied across the four pillars: Attitude, Policies, Practices, Technologies and Metrics.

Keywords: *Benchmarking, Green Computing, Green ICT, Implementation, IT*

INTRODUCTION

This paper outlines a research-based yet highly practical Green ICT framework. My organization, *Connection Research,* has developed this framework in conjunction with RMIT University. It is based on a 4 x 5 matrix with four vertical "pillars": Lifecycle, End User IT, Enterprise and Data Center IT, and IT as a Low-Carbon Enabler. These pillars break down further into smaller, manageable elements that can be applied. Lifecycle, for example, comprise the three components of Procurement, Recycle and Reuse, and Disposal. Across these four pillars are five "actions": Attitude, Policy, Behavior, Technology and Metrics. Such comprehensive framework, I believe, is vital to the application of Green ICT. This is so because Green ICT – sometimes called Green IT – is heavily debated, discussed and analyzed, but there is little agreement on how it should be defined.

Once Green ICT is broken into its constituent components, it becomes possible to measure each component, using the Capability Maturity Model (CMM), a standardized way of quantifying the maturity of a process. These metrics are important for Green ICT because, as the old saying goes, you can't manage what you can't measure. We can take this further and say that you can't measure what you can't define. The

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metrics and measurements discussed in this paper can be turned into a series of indices, which then allow organizations to be compared to each other, and to themselves over time.

This paper explains the Green ICT framework we have developed, briefly examining each of its components. It also looks at the measurement – or benchmarking – process Connection Research has developed to help organizations measure where they are in each aspect of their Green ICT process. The benchmarks are aligned with the Green ICT framework, allowing a granular approach to measuring Green ICT maturity. Such approach is a practical way of approaching Green ICT, and lends itself to configuration in corresponding Carbon Emission Software Management (CEMS) tools (see a later paper which I have co-authored).

Green ICT is often considered to be only about reducing the energy consumption and carbon footprint of the ICT function within the organization. ICT is a significant consumer of electricity worldwide, on a par with the airline industry. Therefore it makes sense, as emission reduction becomes desirable and even mandatory, that ICT users should look at ways of reducing the energy consumption of their systems.

Yet there is more to Green ICT than merely reducing the emissions from ICT devices within the organization. The "low hanging fruit" approach (ACS, 2009), which focuses on basic elements such as "switching off unused computers" is necessary but not sufficient to bring about a substantial reduction in the overall carbon footprint of an organization. That is why Green ICT in its entirety, as discussed here, is becoming an increasingly important issue. Green ICT goes beyond the ICT function and the ICT department – in many ways ICT, and Green ICT, is a central enabling technology to many aspects of sustainability. In very many cases ICT provides the measurement tool, the data repository, the reporting mechanism and the mitigation techniques that make sustainability possible.

WHY IS GREEN ICT IMPORTANT?

Green ICT is becoming an important issue for many reasons that directly affect organizations. This influence is not merely limited to being a good corporate citizen. Green ICT has the potential to positively influence the organization's bottom line. Consider, for example, the cost of data center power. These power expenses are soaring as electricity prices go up and new server technologies pack more and more processors, which consume more and more power, into less and less space (Koomey, 2007). Data centers form an integral and vital part of an organization's overall strategy for reducing carbon emissions. DeCoufle (2010) discusses in detail the importance of the green grid as a glue holding data centre energy efficiency together. A separate dedicated track on Green ICT at a recent conference on Data Center management (http://www.dcgtasia.com) also focused on data center emissions. Reducing the carbon emissions of a data center has the same positive value as reducing the operating expense of that data center. Therefore, the importance of Green ICT permeates all aspects of the organization.

Data centers use a number of different techniques to cool their servers. Water cooling is making a comeback to handle the heat dissipation issues (Cronin, 2008). Similarly, different techniques of air cooling servers, using such concepts as hot-aisle and cold-aisle (i.e. making the servers face different directions to maximize cooling) are being used. These techniques are becoming far more important because they not only reduce the carbon footprint of the organization but, at the same time, improve its economic performance by reducing running costs of power consumption. Furthermore, reporting requirements are becoming increasingly stringent and there is an increased awareness across business and society of the unsustainability of many current consumption patterns (Philipson *et al.,* 2009).

Based on the above discussion, data centre servers need to be considered in the context of