Sustainability and Greening through Information Technology Management

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Abstract

This study represents a research-in-progress that looks at greening and sustainability through information technology management. The authors looked at existing research and publications of greening. While much has been written about ways to go green, organizations do not have guidelines to help them gauge the degree of their greening efforts. Using the Capability Maturity Model for software development, we proposed a model called the Greening through Information Technology (GITM) Model to examine organizational greening efforts. The authors are currently in the process of developing questions to be used for each aspect of the greening management to determine the GITM level that an organization is in. Finally, recommendations for action will be suggested.

Keywords: Greening, sustainability, information technology, capability maturity model

1. SUSTAINABILITY AND GREENING

The topic of sustainability has been a topic of interest among various disciplines for many years. Since its inception, sustainability as a concept has had many definitions. In a general sense, sustainability is the ability to maintain a certain process or state indefinitely. In recent years, the concept has been applied to living organisms and systems. When applied to the human community, the most widely acce-pted definition has been that proposed by Brundtland who defines the concept of sustainability as "meeting the needs of the present generation without compromising the ability of future

generations to meet their needs" (Brundtland, 1987). The interdependency of nations requires that sustainability become the goal of all nations if the needs of present and future generations are to be met.

Sustainability is a multifaceted concept. It rests on three pillars: the economy, the environment, and society. Thus, the achievement of sustainability requires interventions in these three areas.

The terms sustainability and greening are often used interchangeably; however, the terms are not synonymous. Greening is one aspect of sustainability which typically focuses on environmental measures (Ivanovich, 2008); greening is about cutting costs as well as saving the environment. One area within organizations which appears ripe for greening is that of technology. While information technologies are critical to the operation and success of today's businesses, these same technologies are also often seen as a cause of environmental burden (Boudreau et al, 2008). The authors of this paper purport that through the management of information technology (IT), organizations can facilitate greening and, thus, move toward sustainability. Greening requires interventions by both governments and organizations. From this perspective, governmental actions through legislation, regulations, and executive orders can provide a top-down approach to impact the achievement of greening and sustainability while organizations by greening through IT management can provide a bottom-up approach to implement governmental actions.

2. STUDY OF GREENING THROUGH INFORMATION TECHNOLOGY MANAGEMENT

In this research-in-progress, the authors are investigating the need to green many aspects of organizations through IT management to obtain sustainability. These aspects include assets, power, and personnel. All three aspects of organizations are heavily impacted by information technologies. For example, power is consumed and generated by technology; organizations' assets include multiple technologies which need to be purchased/reused/retired; and personnel use information technologies.

In the sections of the paper that follow, the authors briefly report on their review of literature to date concerning the roles of government and organizations in greening; the state of greening in organizations reporting best practices; and their work in progress to develop a model for assessing an organization's maturity level in greening. The model, Greening through Information Technology Management (GITM), is adapted from the capability maturity model. The authors then propose a tool (the GITM tool) to facilitate implementation of the model.

3. GOVERNMENT'S ROLE IN SUSTAINABILITY AND GREENING

Research indicates that the European community has been proactive and is a leader in greening through its laws and regulations. In contrast, the United States has been somewhat of a laggard, being reactive and a follower. Some efforts are underway to marshal the forces of U.S. government agencies and organizations in working toward sustainability and greening. For example, in November, 2008 the U.S. Small Business Administration's Small Business Innovation Research program held a conference, bringing together scientists, manufacturers and entrepreneurs with representatives of various federal agencies to address topics such as next generation energy innovation. It was reported that the Federal government is providing monetary and technical support to public-private partnerships that will drive technological innovation in the future.

4. ORGANIZATIONAL RESPONSIBILITY IN SUSTAINABILITY AND GREENING

While governmental attempts at promoting sustainability and greening are important, the execution of the plans lies with organizations. Information technology is an inseparable component of any organizational environment. The availability and use of information systems and technologies has grown almost to the point of being a commodity. As such, the management of

information technology resources is very important in order to ensure that organizations contribute to the worldwide efforts of sustainability and greening.

There are hundreds of approaches that could be qualified as "green" organizational IT practices. For the purpose of this study, the authors divide them into three major streams: asset, power and personnel management.

Asset Management

According to the International Association of Information Technology Asset Management (IAITAM), IT asset management (ITAM) is the set of business practices that join financial, contractual and inventory functions to support life cycle management and strategic decision making for the IT environment. Assets include all elements of software and hardware that are found in the business environment.

By channeling the procurement process toward purchasing environmentally friendly IT products and by managing the usage of these products, organizations could contribute greatly to the power consumption reduction. By expanding the life cycle of the products and disposing wisely the used products, organizations can limit their contribution to the creation of environmentally threatening landfalls.

Hardware asset management is of utmost importance in dealing with environmental issues. Hardware asset management entails the management of the physical components of computers and computer networks, spanning the acquisition process to the disposal of these components. Common business practices include procurement management, utilization management, and disposal management.

Procurement (Buying Green)

Metrics such as Energy Star (ES) and EPEAT (Electronic Product Environmental Assessment Tool) allow organizations to determine which products qualify as most environmentally-friendly and to review the comparative environmental impact of competing products.

One of the most popular initiatives used in organizational IT purchasing practices is the acquisition of Energy Star (ES) products. Initiated in 1992 by the United States Environmental Protection Agency as a voluntary labeling program to identify and promote energy efficient products, the Energy Star Program began with labels for computer products. As of 2006, more than 40,000 Energy Star products are available in a wide range of items including major appliances, office equipment, lighting, home electronics, and more. The EPA estimates that it saved about $14 billion in energy costs in 2006 alone.

Another initiative, utilized widely by purchasers in the public and private sectors, is the use of EPEAT (Electronic Products Environmental Assessment Tool) registered products. EPEAT is a system for evaluating, comparing and selecting desktop computers, notebooks and monitors based on their environmental attributes. EPEAT also provides a clear and consistent set of performance criteria for the design of products and provides an opportunity for manufacturers to secure market recognition for efforts to reduce the environmental impact of their products.

In the process of purchasing information technology products, many organizations use the Electronics Environmental Benefits Calculator (EEBC) to calculate the specific environmental benefits from the purchase of EPEAT registered computers and monitors. The Electronics Environmental Benefits Calculator (EEBC) was developed by the University of Tennessee Center for Clean Products to assist organizations in quantifying the positive effects of making "green" decisions when using, reusing, or recycling electronic devices such as computers, monitors, and cell phones. The EEBC is available to any organization interested in determining the benefits of their own electronics stewardship activities.

Utilization and Disposal

In order to be environmentally friendly and green, the utilization of information technology products in any organization should be aimed at maximizing the life of the product and minimizing the energy used by the product. Sanitizing data and

refurbishing computers for reuse within the same organization is a practice used by many organizations.

At the end of the information technology products' life cycle, the products must be disposed of responsibly by organizations. The approach towards disposing of electronic waste (E-waste) provides a marked difference between environmentally responsible and environmentally irresponsible companies.

As stated earlier, organizations are the entities that act on governmental legislations in greening and sustainability. For example, the WEEE (Waste Electrical and Electronic Equipment) Act was approved in 2003 in the European Union and is currently being implemented in all countries of the European Union. Also, the EPR (Extended Producer Responsibility) Act has been implemented requiring European sellers and manufacturers to recycle 75% of the products sold.

In the United States, the White House Task Force on Waste Prevention and Recycling, in conjunction with the Environmental Protection Agency (EPA) of the U.S., has been working on the National Computer Recycling Act since 2005, but this act has yet to be approved. Currently, there is no national legislation that governs the disposal of e-waste in the United States. Some states, however, have taken the initiative to provide some guidelines on e-waste. The Californian Electronic Waste Recycling Act of 2003 is the first example. This act leaves the initiative and the responsibility for recycling and disposal in the hands of the manufacturers and the organizations using the information technology products.

Power Management

Energy consumption of information technology within the organization can be better managed by reducing power consumption of individual computers and data centers and by implementing innovative technologies such as virtualization.

Individual Computer Power Management

A typical desktop system is comprised of the computer itself (the CPU or the "box"), a monitor, and a printer. Typically, the power usage of an individual system can range from 250 to 350 watts. The CPU may require approximately 100 watts of electrical power, the monitors 50-150 watts, and the printer 5-100 watts. Even in the idling mode, a computer uses up energy.

Data Center Power Management

Data centers consume an enormous amount of energy. According to an August 2007 report released by the U.S. Environmental Protection Agency (EPA), in 2006 the electricity use attributable to the nation's servers and data centers was estimated at about 1.5 percent of total U.S. electricity consumption.

Any attempts to reduce the use of energy consumption in data centers would significantly affect the greening efforts of an organization. One such effort is to consolidate an organization's disparate data centers into a single environment.

Another way of increasing energy efficiency is to make a physical server perform the role of multiple servers. This is made possible by the concept of virtualization which allows multiple virtual servers to run on one physical server, regardless of the platform. By streamlining the number of physical servers, floor space is reduced. Cooling and capital costs are also reduced. Similar to consolidation, virtualization efforts are often undertaken with a business continuity benefit in mind, and these benefits are far-reaching. While the green benefits are often not the initial business driver in implementing virtualization technology, they can serve as an added incentive for funding and implementation.

Personnel Management

While organizations may focus their enterprise efforts on asset and power management, they should not overlook the impact of individual personnel management. Through inculcating a personal green IT culture and promoting telecommuting (where possible), organizations can also work towards sustainability through greening.

Individual computers

As stated in the discussion of power management, energy consumption of individual computers is not insignificant. By encouraging individuals to take pride in implementing organizational initiatives for green IT, the organization benefits not only in cost savings through reduced energy consumption but also a greener environment. For example, assuming the energy cost of $0.16 per kilowatt hour, the annual electrical cost is over $250 per 200 watt PC system running continuously. By having computers turned to "sleep mode" when they are not in use, the EPA estimates that energy consumption would be reduced by as much as 70%. Furthermore, by operating computers 40 hours a week savings of $190 per computer per year would result. Reducing printing is also another way to reduce energy use.

Telecommuting

Telecommuting is defined as working from home or from a remote site. One of the causes for carbon emission is the increased traffic congestion. John Edwards estimated that "for every 1 percent reduction in the number of cars on the road there's a 3 percent reduction in traffic congestion" (Samson, 2007). Technologies such as wikis, discussion boards, and web conferencing tools have made it possible for individuals to interact online in real-time. Use of these technologies reduces the need for unnecessary employee travel, decreasing the amount of fuel emission. It is estimated that if everyone who was able to telecommute did so for just 1.6 days per week, there would be a savings of 1.35 billion gallons of fuel (NTRS, 2006).

5. MODEL AS A FRAMEWORK FOR GREENING THROUGH INFORMATION TECHNOLOGY MANAGEMENT

In an effort to help organizations better manage their IT greening efforts, the authors are in the process of developing a model. This model, the Greening through Information Technology Management (GITM) Model (Figure 1), is based on the Capability Maturity Model (CMM), created in early 1990s in response to what was then called the software crisis (Fitzgerald, 1996; Mathiassen et. al, 1996.) The model could be used to help organizations identify their level of greenness based on the model's four levels.

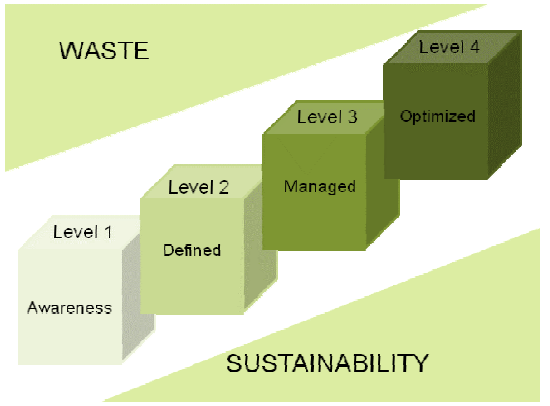

Figure 1. Greening Through Information Technology Management (GITM) Model (Adapted from the Capability Maturity Model)

Level 1: Awareness

At level 1, the Awareness stage, organizational leaders recognize that greening through IT management is an important concept. Possible organizational actions have been discussed.

Level 2: Defined

At level 2, the definition stage, organizations define and redefine existing processes for greening through IT management. Organizations have clearly started to examine what can be done and have also taken concrete steps to implement identified changes. The extent to which Level 3 is attained can be elucidated by the comprehensive nature and the completeness of efforts. For the authors of this study, this means examining existing greening policies as they pertain to asset, power and personnel management.

Level 3: Managed

Once programs, policies, and initiatives have been put in place, the next logical step is to begin measuring the effects of what has been done; i.e., the extent to which the policies have been enforced through processes and initiatives. Management of the greening efforts becomes possible when performance is monitored and measured and when policies in response to observed results can be adopted. The intent here is to measure costs and benefits and to try to manage the efforts in an attempt to obtain the greatest greening bang for the resource buck.

It should be made clear that a transition between Level 2 and Level 3 is not a one-way, waterfall progression. Identification of new greening processes can certainly be done well after management of previously defined processes is in place. This is akin to the "iterative" method of software development, in which going back to a previously attained level is sometimes required to make long-term progress possible.

Level 4: Optimized

The distinguishing feature of Level 4 (Optimized) is the introduction of Total Quality Management (TQM) techniques to greening. This is about having an on-going, continuous effort to improve some aspect of the organization's operation, production, or service activities. The intent is to create an organizational culture that goes beyond policies and programs.

Level 4 could be treated as the nirvana level, toward which efforts are constantly expanded but the end of being completely optimized is never quite reached. This is a program that constantly addresses some issue that could be improved upon in a constant and continuous, circular, fashion. The organization is always looking for something to improve upon.

Once the authors have refined the model, the next step is to develop a Greening Through Information Technology Management (GITM) Tool to facilitate implementation of the model. The tool would allow organizations to determine their level of greenness for each of the major categories of asset management, power management, and personnel management.

For example, for Asset Management (Figure 2) which the authors have categorized as Procurement Management (Buying Green) and Utilization and Disposal, organizational leaders would respond to questions relating to each category to determine the level of greenness. Based on the responses obtained, a rating for each category of Asset Management might be generated to guide the organization in what steps they next needed to pursue. As a result, an organization would be better prepared to determine ways to move towards sustainability by greening through IT management.

Figure 2. Graphical Representation of GITM Tool for Asset Management

6. DIRECTIONS FOR FUTURE WORK

The authors are in the process of refining the model and developing questions for each part of the greening management aspect of the GITM tool. Once the questions are finalized, we would pilot the GITM tool with one or two organizations and use that to validate and modify our model. Next, we would want to develop a questionnaire that could be used to collect data from various organizations on their greening efforts. This would serve to further fine-tune our model which we hope would be used by organizations to gauge their greening efforts towards the sustainability of the organization.

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