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8-2010

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ABSTRACT

The current buzz of 'going green' has been a recent fad for many companies. But what does 'going green' really mean? How did going green get started? Who are the current leaders of sustainable information technology? It is clear that going green is more than a fad and that green technology can provide a number of cost reducing advantages to companies. This paper will explore the history of green IT/IS and sustainability. The paper will discuss current issues with sustainability and offer solutions to those problems. It will also study the current leaders in green IT/IS to serve as an example to companies looking to go green. Finally, the paper will make future recommendations for companies considering increasing their sustainability.

Keywords

Green IT, Green IS, sustainability, server virtualization

INTRODUCTION

In today's economic environment, the ability for companies to be able to reduce their costs to help maintain profits has become increasingly necessary. Due to the global recession and inflated costs associated with maintaining Information Technology departments, this is the perfect climate for industries to start looking towards a more sustainable and cheaper future. Using emerging information systems (IS) and information technology (IT) systems that are "green" and sustainable in nature, a company can gain a competitive advantage in their industry while also discovering the economic benefits associated with the technology.

The use of new Green IS and IT can provide a strong benefit for most organizations. Currently these green systems are becoming more applicable but are not being fully utilized. Thus, there are three main reasons that green IT/IS technologies need to be implemented: for sustainability purposes, for economic advantages, and for the positive global benefits they provide. Three main research topics have arisen:

- What is the history of Green IT/IS?

- How are companies currently using Green IT/IS systems?

- What is the future potential of Green IT/IS systems?

HISTORY OF GREEN IT/IS

The history of Green IT/IS is a relatively new and constantly expanding area of research. The goal of green IT/IS is to allow companies or organizations to become more sustainable. The following paragraphs briefly define a few terms to clarify concepts and provide a brief history of green IT/IS.

The Green Revolution

If sustainability, defined by Bruntland (1987) as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" has become such a prevalent topic today, what has the initial effect of the Green

Revolution been on companies? Currently, if a company is able to shoulder the initial costs of going green, research has supported a large positive return for companies in the long run. According to Will Thrope, Vice President of Intel's corporate sustainability group, economics have shown, "that companies that maintain a more sustainable footprint have done better-- even in economic meltdown--than those that don't" (Harmon, 2009). Also, a King and Lenox study in 2001, found that companies who go green and reduce pollution levels have been found to increase their profits in the following year. They also discovered that by reducing a company's emission levels in its information and communication technology (ICT) operations, a firm can gain a completive advantage in the industry that can lead to large economic profits (King and Lenox, 2001). With this positive data showing that the Green Revolution can clearly be beneficial for a company if properly implemented, why are more companies not seizing the opportunity to go green?

Differences between Green IT and Green IS

While Green IS and IT are commonly grouped together, and will generally be grouped together for the majority of this paper, there are notable differences that should be acknowledged between the two concepts. The idea of Green IT is centered around the reduction of energy levels and conservation in general; Green IS, in turn, focuses mainly on sustainability initiatives (Watson, 2009). Better stated, Green IT is geared towards creating a more efficient system. By making a more energy efficient model or utilizing IT machinery in the most effective way possible, a user would then be implementing Green IT initiatives. Green IS is used in creating more sustainable footprint for users and society. The French public bike rental system of Vélib and the green supply chain ideas of Sony, further discussed in later paragraphs, are two working examples of Green IS systems.

CURRENT USES OF GREEN IT/IS

The Green Revolution has helped jumpstart sustainable and green practices in corporations today. Austin Energy, PricewaterhouseCoopers, Vélib, and Miami University (anonymous name used for review reasons) are all organizations that can proudly describe themselves as leaders in the Green IT/IS field, and their contribution to this emerging field are all detailed in this section. While there may be a large amount of potential benefits for Green IT/IS, there are also several issues that must be managed. Some of these current issues are described below.

Current Issues

For a typical large corporation in the United States, it is common for ICT to account for 25% or more of the total electricity consumption. Because this high amount of consumption, it is clear that sustainability can strongly reduce the excessive uses in the ICT departments. In addition to approximately a quarter of a company's electricity usage spent by ICT practices, between 30% and 60% of the electricity consumed in a company's data center in server rooms is wasted (Green IT, 2009). Google and IBM are two of a number of corporations that have had a large problem with the excessive amount of power consumption by their data centers. Google has tried to solve the extreme power usage by building data centers near hydraulic plants with the hope that it will help reduce the amount of energy lost in its data centers. IBM has started project Big Green, which spends over one billion dollars a year in an attempt to reduce power usage by 40% within its data centers (Sumita, 2008). While these processes may seem simple, they are a very effective way to help reduce energy costs and save money for a corporation.

Data centers are clearly the main source of energy consumption at a company; however, they are not the only area of a corporation that creates an extra burden for a company due to the large amount of energy being consumed. According to a 2006 Gartner report, although energy costs typically comprise less than 10% of an overall IT budget, in a few years these costs could rise to more than 50%. Also, Google and a number of other large organizations already claim that their annual energy costs exceed their server costs. These high costs make it very difficult for a company to continue to be profitable. Finally, it is estimated that in 2025, the amount of energy used by IT applications will swell to over 200 times the current usage (Green IT, 2009). With these extreme energy costs predicted to continue to rise, something has to be done to curb usage and help keep costs low. If nothing is done, it will be near impossible for companies to keep their current profit margins as the IT departments will consume three times more energy than their current levels. By implementing sustainable practices, companies can take these cost concerns and turn them into a benefit for their corporation.

Potential Solutions

While Green IT/IS has many positive ways it can help the environment, there are still some current problems with Green IT/IS. However, an Ohio-based company, Redemtech, is working to help companies identify if they are 'green' or not. In 2009, Redemtech conducted a survey and reported that companies were only making limited progress towards "making their corporate IT programs more sustainable." Redemtech reported that 75% or better on their survey signified a 'mature' green company. However, Redemtech reported that most companies' scores were averaging 32%-37% (Cable, 2009). Obviously, companies still have significant progress to make to be considered mature green companies, but at least Redemtech and the companies using their survey are conscientious of their need to go green and have found a way to quantify 'mature' green status. Surveys and other steps are key to not only raising awareness about going green, but also to helping companies know when they need to be doing more. In addition to the survey, Redemtech also came up with "5 Easy Steps to Going Green," Redemtech's effort to offer additional tips for companies to improve their green score. Their steps include

- Establishing a baseline: Set quantitative target; free online tools to monitor progress (e.g., Software as a Service (SaaS))

- Review and revise policies: Make going green a foundation of company with management level support

- Extend desktop and laptop lifecycles: doing so will produce long-term IT improvements

- Optimize utilization: find the right inventory levels to maximize efficiency

- Create accountability through good governance: metrics needed, reward good performance ("Green Computing", 2009).

Current Leaders in Green Industry

In order to better understand future ways for companies to go green, it is possible to study current green leaders to learn why their green practices have been so successful. Companies who are planning to go green can study the current leaders and strive to imitate and expand on their effective practices. A few green leaders that deserve recognition include: Austin Energy, PricewaterhouseCoopers, Vélib, and Miami University. The following section details what makes each of these organizations a green leader to be followed. Please see the Figure 1 for a summary of the problems, goals and methods of the following companies.

Company/Project	Problem	Goal	Method
Green University of Tokyo Project	The University of Tokyo's Hongo campus is emitting an extremely large level of CO_2 due to their heavy use of IT equipment	To use IT/ICT processes to reduce CO_2 emissions, while also working on saving energy in the process	Create an IT/ICT "Eco-System" that can properly address The University of Tokyo's emission and energy problems.
Austin Energy	Energy company is not being energy efficient; poor example for consumers	Understand current energy uses; reduce energy use; implement new green technology	Implementation of DC power in data center; new temperature sensors for cooling of data center; reducing number of physical machines; running on all green energy; even enticing workers to reduce carbon footprint

			by not driving a car to work
Vélib	Traffic Congestion in Paris	Reduce Traffic congestion via green solution	Implement a bike company that uses information systems to uniquely track each bicycle's location and usage relative to other bicycles in the fleet.
Pricewaterhouse Coopers	High energy Costs	Create a new data center to cut costs both financially, as well as, environmentally	Created a new data center to maximize energy efficiency; also fewer cooling/ air conditioning units are needed that at a normal center; lastly the new center is so efficient, employees can get the same amount of work done in 4 days as in the normal 5, thus cutting the carbon footprint driving to work
Miami University	High energy consumption; data center growing too large for its current environment	Cut energy consumption; find a way to reduce number of units needed to meet increasing demands	Miami began virtualizing servers, so fewer physical units are needed; Miami also began initiatives encouraging employees to turn off/use sleep mode on their computers when out of their office, as well as, creating a printing initiative that encourages the use of shared, more economically friendly duplex printers

Figure 1. Current IT/IS Implementation Cases Summary

Austin Energy

Texas based Austin Energy is a green leader. In 2008, Austin was Computerworld's #7 Green-IT Company. As of 2008, Austin Energy was the number one seller of green energy six years in a row. This green energy includes both solar and wind energy (King, 2008). In 2009, Austin fell to number nine, but still has a number of innovative ideas (Pratt, 2009). Some of

these ideas include: virtual data centers, reduction of physical machines, and use of green energy. Five years ago, Austin Energy began to switch their data centers to a virtual environment. This allowed Austin to reduce their number of servers from 600 physical machines to just 150. In addition to reducing their number of servers, Austin also runs their data centers on 100% green energy (Pratt, 2009).

PricewaterhouseCoopers

Another green leader is "Big-Four" public accounting firm, PricewaterhouseCoopers (PwC) (Fanning, 2009). PwC was named Computerworld's #5 Green-IT Company of 2009. PwC has constructed a new data center that uses a high-voltage system to maximize energy efficiency and reduce copper consumption. With this design, PwC uses 40-50 fewer air conditioning units than needed to cool a normal data center. The center will be so much more efficient than other centers that employees can complete a full week's worth of work in just four days, thus making PwC more sustainable by reducing the carbon footprint left by employees commuting to work and allowing employees to complete a larger set of tasks.

Vélib

Another area that should be recognized for its advances in the green IS and IT field is Vélib, the French public bicycle rental service. Vélib is highly reliant on information systems to operate; it uses a system that not only uniquely tracks bicycles and riders, but also determines the availability and placement of bikes to help ensure the ease of use for riders. The system alerts Vélib operators when there may not be enough bikes at a certain station, and stations are also able to alert users about other nearby stations. Vélib's system is also able to inform users of other nearby stations' location, number of available bicycles, and if another station has open spots to return a bike (Watson, 2009). For Vélib, information systems are helping to solve a traffic management problem in France's capital, and in doing so, the bicycle service is creating a very green system that has become extremely popular. This shows that green IS/IT can be combined with a green idea in itself to create an extremely beneficial outcome for all users.

Miami University

In order to provide new research on a current green leader, we conducted a mini-case at Miami University located in Ohio. Our research consisted of unstructured conversations with two key members of the University's IT Services function. Miami has taken a number of steps towards going green recently. In the past twelve months, Miami's information technology department has made great strides in three areas to help the university go green. These three areas include:

- A server virtualization project

- A power management initiative for Miami faculty and staff

- A concerted effort to be more resourceful with the use of printing

For our research we focused mainly on the server virtualization because this was the university's biggest green undertaking. Over the past years Miami experienced a steady growth in power consumption from the addition of physical servers added to accommodate new initiatives as well as growth in use of existing systems. The server virtualization at Miami consists of 128 virtual machines. Fifty-four of these machines are running production systems, while the other seventy-four are used for development and testing. Miami converted sixteen of these servers from physical servers to virtualized servers, while the rest of the servers were never physical servers; thus, Miami was able to avoid purchasing and powering physical machines. Miami has "several projects in the queue for moving existing physical servers into the virtual environment. The virtualized servers consist of three blade chassis, each of which will hold fourteen blade servers. Our production cluster consists of seven blades spread over these three chassis and our test/development cluster consists of six blades" says Carrie Ledford, Miami's interim Associate Director for Enterprise Systems and Operations.

Miami University is hoping to build a new data center, as the current physicality is approaching maximum capacity. However, the virtualization of servers has currently allowed the university to continue to use its current location while continuing to meet increasing demand. Carrie Ledford stated that, "We have not yet realized power savings but have avoided additional power expense. Our anticipated power savings resulting from continued virtualization is $89,000/year." In a 2008 study, Miami identified fifty-one servers that could perform well in a virtual environment and another one hundred and sixty-four that need further evaluation, but are likely to be converted to virtual servers. The estimated $89,000 a year is based on having those additional one hundred and sixty-four servers converted. Ledford also commented on the heat and power usage of the machines. She stated that the machines generate 280,000 BTUs of heat and use 82.47 KW of power. The virtualization of servers should allow for the reduction of heat and power usage to 61,400 BTUs of heat and 17.8 KW of power.

The power management initiative taken by Miami University focuses on encouraging faculty and staff to make use of power-saving tools while using their computers. Research by the IT department found that a large percentage of faculty and staff had been leaving their office computers on when they went home. The university encouraged employees to save power by either turning off their computers or using the sleep feature to help reduce power usage. While this may seem basic, constant reminders from the IT department have allowed the university to save a significant amount of money by cutting power usage.

The printing initiative taken by Miami University includes, "decreasing the number of printers on desks, using larger multi-functional devices, and encouraging duplex printing" says Joe Bazeley, Miami's Chief Security Officer. Miami has basically reduced both the financial and environmental costs of printing by encouraging the use of duplex printers shared by departments. The walk to the shared printer down the hall is often less convenient for Miami employees; however, the IT department has encouraged the use of these printers and has even implemented a program to keep employees from printing at their desk. The program charges a cost to department of only 2 cents per copy on the shared duplex printers rather than 7 cents per copy on an employee's office printer. Through these three initiatives, Miami University is clearly a sustainability leader.

HOW TO USE GREEN IT/IS IN THE FUTURE

The use of Green IS/IT is clearly still being molded and shaped into an effective method for corporations today. Through our research, we have developed our own Top 5 ways to go green. They include:

- Understanding the company's current footprint;

- Virtualization of servers;

- Power Management: look to improve/decrease watch you currently are using;

- New Technologies: explore options such as SaaS;

- Challenge your industry to go green.

Although these points may not be pertinent for all companies, we believe that they provide an excellent foundation for an individual organization to start planning a sustainable future from. With careful planning and proper implementation, a company can clearly reap the benefits of a greener IS/IT department using these five concepts.

Understand the Current Footprint

The first, most basic step to beginning a sustainable IS/IT program is to determine one's current footprint. After understanding its current patterns of energy usage and waste creation, a company can then set meaningful goals for improvement. A company that wants to go green can start by setting simple conservation goals that can hopefully show the importance of sustainable practices. To help with these conservation goals, a basic initiative that the Green University of Tokyo Project is attempting to develop is a measurement system that accurately records the power usage of all IT/IS devices. By being able to monitor the power usage of employees and certain machines, the IT/IS department will be able to recognize problematic areas and help set goals to reduce power usage power levels (Yoshida, 2009). Although simple conservation techniques may seem very basic and trivial, the simple power reduction efforts on IT and IS devices can help make companies more sustainable and develop a plan to become a successful, sustainable corporation.

Virtualization of Servers

Once a company understands its current footprint, there are a number of practices in the IT/IS field that can be implemented to help make a corporation greener. One idea, as discussed in the Miami University example above, is converting an organization's servers from physical to virtual models. The basic definition for virtualization of servers is the division of one physical server into multiple, isolated virtual servers. Currently, 76 percent of companies from a wide range of industries are planning or have already implemented server virtualization within their data centers. With such a large majority of companies supporting the concept, it shows that the virtualization of servers is clearly at the forefront for sustainable IT practices. Companies that have made the switch to server virtualization have praised the technology's ability to reduce data center space requirements, slash staffing and power costs, and provide support during a natural disaster or hardware malfunction. Also, fifty percent of companies that have deployed virtualization believe that the technology has yielded direct cost savings (Daniel, 2006). While the field of server virtualization may still be developing and imperfect, it is clear that this green movement is clearly a significant opportunity for IT centers across the globe.

Power Management

One company that is looking to the future for more ways to go green is Austin Energy. A large part of their achieving #7 and then #9 on Computerworld's Top Green-IT Companies is the Austin Plan for the future. Austin currently has a new data center in the works. Austin is "exploring other energy saving opportunities, such as using DC power in the data center to eliminate the energy loss that occurs when converting DC (power) to AC" (Pratt, 2009). This is a huge step for Green-IT not only to find new green sources of energy, but rather to work with the energy Austin already has to make it more efficient. Additionally, Austin is a leader in developing more-advanced temperature sensors in their data centers in order to reduce cooling demands. Thus, cooling could be turned down when not needed, or focused on specific areas, again, providing another great way to modify what they currently have (Pratt, 2009). Austin is a true green leader because they have currently implemented a number of reforms and are looking for more ways to go green in the future.

Using SaaS to Go Green

Another interesting future way to go green is using Software as a Service. Athenahealth is a healthcare provider that in one month processed over 23,000 pounds of paper (Reid, 2009). Athenahealth then switched to SaaS and has significantly cut down on paper use and is looking to go paperless in the future. Another example of a company that has gone completely virtual is iSold It. iSold It is an eBay drop-off store that is now 100% completely virtual. iSold It no longer has a physical office space, but rather only rents meeting rooms as needed. iSold It saves both monetarily and environmentally on utilities, maintenance, and commuting costs (Reid, 2009). These two companies are both testing SaaS as a way to go green and succeeding; thus, they both serve as excellent models for other companies to follow.

Challenge Your Industry to Go Green

While most companies usually focus only on improving green practices within their own company, Sony Corporation has taken a very different approach to the Green Revolution. Instead of just focusing on their company; Sony has become an active promoter of green practices for all parts of its supply chain operation. Sony has created an initiative called Green Partners Activities that helps to ensure that its supply chain is becoming greener through environmental management. If a

mass-produced parts company does not join the Sony Green Partners Activities program, Sony will discontinue business with the company and find a new supplier who will adhere to Sony's strict standards. This indirect pressure that Sony applies on its whole operations system helps to create a more sustainable and greener industry. Sony has created a green information system that is effective for not only its corporation, but also for the whole operation process that is involved with the construction of a Sony project. Since Sony is a multi-national corporation, it is not as difficult for them to apply pressure to its suppliers, and it is inspiring to see them use this pressure to create a more sustainable practice (Sony, 2005).

CONCLUSION

As shown in our findings, implementing green IT/IS initiatives can create large scale benefits for an organization. By simply being aware of the opportunities that green technology can provide for an environmentally conscious company, a firm can possibly gain a competitive advantage in their industry. A strategic advantage for a company can be found by reducing energy and increasing sustainability. For a company to gain this advantage, they have to be willing to take risks and implement new IT/IS technologies. If properly implemented and supported, other external benefits will follow from the installment of green IT/IS. Through our discussion of the history of sustainability in IT and IS, of companies currently using Green IT/IS, and of future uses of IT/IS, it is clear that green information technology and information systems should be put into operation at almost all organizations due to the large scale benefits that this emerging technology initiative can provide.

ACKNOWLEDGMENTS

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