ISSN: 2473-3857
v3 n4353

Sustainability in Greening IT for Educational Systems

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Abstract

Digital usage and impact on the environment has become a critical topic among the Information Technology (IT) industrials and school systems. While facing the challenges of greening the information technology, many issues are needed to address, reverse, or prevent further environmental deterioration. Eight schools were investigated to study the participants' understanding in Green IT, sustainability issues, and greening buildings. Also, the participants' understanding in power usage, cloud technology, and sustainable practices were studied in order to identify the common obstacles in promoting Greening IT. This research found that most school administrators and their IT professionals have a solid understanding of Green IT, Sustainability issues, cloud technology, and Greening Buildings. However, the obstacles are identified as cost and availability. The Greening IT strategy might be bypassed to the situation where the cost and availability are limited due to funding issues and long-term budget priorities. It is found that success of the Greening IT initiative is based on the decisions that are made by administrators when establishing the network and strict adherence to network policies that will be written to accompany it. Students will have a great environment in which to learn and will have a sustainable model to follow as they transition into their future careers.

Keywords: Sustainability, Green IT, Infrastructure, Energy

1. INTRODUCTION

Measuring sustainability by evaluating our environmental footprint has been discussed in terms of energy consumption, water consumption, and waste disposal. Life-cycle assessment includes greenhouse gas emissions for all stages related to electricity generation including plant construction; operation; maintenance and decommissioning; and fuel extraction, transport, and processing (Johnsson, 2012). While we are aware of our digital usage and impact on the environment, there is a critical need to address, reverse, or prevent further environmental deterioration.

The term of Green Information Technology (IT) could be defined in a various way by the users. BCS (2012) recognized that most economies today are service-based and heavily dependent on information and communication technologies which lead Green IT as a means to deliver on most environmental and social commitments. While IT empowers energy users and create completely new business opportunities, BCS (2017) suggested that energy production should have been transformed to a more sustainable path, such as the practice of process in a culture change that transforms businesses and societies. Moreover, Energy Information Administration (2016) projects renewables as the world's fastest-growing energy source which increasing by 2.6% per year through 2040. However, future developments in technologies, demographics, and resources cannot be foreseen with certainty. The energy market projections could be only endeavored to make them as objective, reliable, and useful as possible as the current and proposed laws, regulations, and announced policies stand (EIA, 2016).

ISSN: 2473-3857
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2. CHALLENGES

The educational systems in the US have been developing in the way of toward to the enterprise system. To include the educational systems as part of our social practices in life, the sustainability and greening IT issues will be treated as the common practices of industries in this paper. The following discussion and literature reviews would include the school systems as part of enterprise entities.

Pfister (2016) stated that sustainability needs to be thought of as embedded in different social practices where the discursive practices leads to define, regulate, elaborate, and contest the notion of sustainability. The historical sustainable development has brought up some debatable key ideas among communities, states, and the globe, such as structure actions, expectations, and judgments. We live in a profoundly interrelated world where everything we do affects other parts of the systems with humans and non-humans live in (Jacques, 2014). The systems we live in are therefore a complex society. "Understanding Sustainability as an idea is also helpful because it implies that this concept is neither an objective description of the world nor necessary consequence of the human impact on it. Instead, it is always necessary for someone for certain reasons. (Pfister, 2016, p.11)".

International Energy Outlook predicted that the energy consumption throughout the world will grow by 56 percent between 2010 and 2040 and Information Communication and Technology (ICT) industry will be the major culprit. The Climate Group (2017) also predicted that the overall emissions from all sources will increase by 30 percent, while the emissions by the ICT sector will reach up to 180 percent from 2002 to 2020. Regarding to the cost for the consumers, the Department Of Energy estimates that the average American household spends $1,500 - $2,500 US dollar every year on energy bills which 45 percent of this amount is for heating and cooling. The Eugene Water and Electric Board reported that IBM, a leading maker of computers of all sizes, claimed that turning off the desktop computers for one hour each day can save the company $1 million per year in energy costs.

A greening IT trend is more about changing an organization's culture (BCS, 2012). The greening sustainability focuses on making the organization greener by improving end-user practices, creating an energy-efficient office environment, and reducing energy consumption. Driving down energy, monitoring the utilities, equipment and data center costs can be all attributed to IT audits and assessments.

In order to have the manufactures labeling their products as ENERGY STAR certified, the ENERGY STAR Partnership Agreement must be committed (Energy Star, 2016). The certification criteria includes significant digits and rounding, power supply requirements, energy efficiency feature requirements, and active state efficiency criteria for all large network equipment products. After meeting these criteria, test setup procedures would be required to complete five areas of tests: input power, ambient temperature, relative humidity, power meter, and network test equipment which should meet the requirements of number of ports and traffic generation. All testing performed shall adhere to the requirements provided in the Alliance for Telecommunications Industry Solutions (ATIS)-0600015.03.2013 standard unless otherwise specified.

Energy (2017) announced that ENERGY STAR-labeled office products use about half the electricity of standard equipment. Moreover, following the guidelines of turning off the monitor and CPU if they are not in use for extended periods would save energy.

Greening IT would save the money in the long term. Such as cabling of replacing with fiber optic cables which the lifespan is about 25 years and has a major savings factor of minimal maintenance. The immediate savings in power consumption with the used of fiber and with the energy star compliant components would bring in big impacts as well. Addressing energy consumption and reducing it is an important aspect of sustainability. Utilizing the recycling options can allow the school to dispose of the equipment and possible allow for funds to be obtained through resale. Green schools are healthier for students, faculty, staff, and community. It improves learning and working conditions, while saving money and resources. Moreover, it is embracing opportunities to develop green technology and IT enablers that help cut down carbon emissions.

Complete Rainwater Harvesting Systems (2017) imagine today's students learning the value and importance of conserving the earth's resources by making school buildings and grounds a sustainability laboratory. A rich curriculum tie-ins to weather, water quality, physical sciences,

ISSN: 2473-3857
v3 n4353

pollution, energy, and sustainability would be an ideal learning environment.

Geothermal heating and cooling systems are designed to take advantage of thermal constant by pumping air or water into the ground to be heated or cooled to the earth's stable temperature. Danks (2014) found that geothermal climate control systems make buildings more comfortable and may save their schools a substantial amount of energy as compared to conventional heating and cooling options. It is found that geothermal climate control systems have reasonably short payback period, also take up less room in the school and run quietly (Danks, 2014).

Regarding to provide resale or recycling services, Dell (2017) offers Return Leased System for customers choose the lease return option that could be feasible for the business: transportation only, off-site data wipe, or on-site wipe. If the Return Leased System was not applied, Dell (2017) reviews the asset resale and recycling options. Also, protect the privacy and data security to prevent sensitive data fall into the wrong hands.

3. GREEN IT IMPLEMENTATION IN EDUCATIONAL SYSTEMS

This study is to focus on the Greening IT implementation in educational systems. Disregarding the size of schools, this study investigated the social practices from the administrators, IT staffs, and teachers' position. Looking at the current funding gaps in various levels of educational systems, the Green IT with sustainability issues might be a solution to resolve the budgeting issues. Investing in Green IT would be a benefited approach to provide the educational systems with opportunities of lowering its environmental footprint and reducing operational costs.

In summer 2016, eight schools were invited to participate in this study. Two schools were small private school which had less than 500 students. Two were large public independent school districts levels with more than 3000 students. Two public high schools had 800 to 1,500 students. One small middle school which is a high-tech new developed school had less than 800 students. And one community college had approximately 5,000 student enrollments. This study results cannot be generalized to represent all school systems. However, the findings would provide a guideline to lead for a more in-depth study for future implementation. An informal qualitative survey through email and interview conversation was conducted with the administrators, staffs, and teachers.

The objectives of this study were to focus on the following three areas:

1. Investigate the participants' understanding in Greening IT, sustainability issues, and greening buildings.
2. Evaluate the participants' understanding in power usage, cloud technology, and sustainable practices.
3. Identify the common input of obstacles in promoting Greening IT.

The qualitative research questions were included:

1. How do you define Green IT, sustainability, and greening buildings? Would you support the trends of promoting Greening IT in your school?
2. How much are you familiar with the status of power usage, cloud technology and sustainable practices? Would you support the trends of promoting Greening IT to overcome these issues in your school?
3. Please share your understanding for the common obstacles in your school for promoting Greening IT.

4. FINDINGS

This study investigated what the community's perspectives from the educational systems regarding to the Green IT adjustments for the infrastructure hardware, class room computer hardware, and the educational building's structural components. These changes will allow the educational systems to reduce its environmental footprint and serve as an example from the institutions to the businesses.

The interviews collected from a qualitative method was implemented. Emailing and verbal communication were transcribed. The common terms and suggestions were identified from each research question which are shared in the following sections.

Green IT, Sustainability issues, and Greening Buildings

The research showed that majority of IT professionals and administrators in the school systems have a solid understanding of Green IT, Sustainability issues, and Greening Buildings. They understand what makes network

ISSN: 2473-3857
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components energy efficient and, for the most part, that they choose to use those components when possible. However, the green IT strategy might be bypassed to the situation where there are specialized tasks which must be completed and a component that is certified as being efficient may not be able to handle them.

Power Usage, Cloud Technology, and Sustainable Practices

For the large network environment, some suggested that cloud storage solutions could be used for non-critical storage and file access. To host a data center, it requires heavy power usage to operate the server systems. Also, more power usage is applied to vent the excessive heat produced by the servers. Many suggested of applying cloud technology and hand over the power usage issues to the private firms. However, the main concern of cloud technology would be the security check points. Some suggested having options which can be made available to faculty, staff and students if they wish to access their files remotely, but any students' data or sensitive information will be stored internally behind the network's security features.

For the user practices side, making the organization greener by improving end-user practices was one of the suggestions to promote Green IT on campus. Educate the students, staff, faculty, and administrators to turn off computer, monitor, and printer after complete using the system wherever they are at home or on campus.

Educate the end-users to create an energy-efficient office environment by purchasing Energy Star-labeled office products. Moreover, participating in practices of reducing energy consumption and using IT audits and assessments options of recycling programs. The overall benefits for the home or campus digital environment would be to drive down energy dramatically.

Obstacles in Promoting Greening IT

It's been found that there are two common obstacles associated with Green IT which are cost and availability. The cost of usage and purchasing of the energy efficient equipment could be saved over the life of the unit. However, the stakeholders typically would save money up front and not looking at a long term impact. Availability is a concern which green options for each component or might not be available. Not in all cases, the components that satisfy the need are ones that meet the standards of established energy efficiency guidelines. Prior to December 2015, the Energy Star certification was not available for large network components. Even Cisco Systems, the leading company in the IT field and a strong proponent of making the Energy Star certification available for large network components has not yet released any components that satisfy the requirements. The large network equipment which could be replaced with the certificates including switches, router, firewall, wireless access, network-attached storage, workstations, and printers. Some examples of non-power components would be server rack and patch panel. For the building components, the design and location would make big differences as well, such as windows, heating, venting, and air conditional, and lighting.

5. SOLUTIONS

Based on the findings shared from the interviews in the previous section, the following suggestions might be able to overcome some common issues of implementing Greening IT in the future.

Green IT, Sustainability issues, and Greening Buildings

Sustainable Technology Environments Program (STEP) Foundation has been established to bring sustainability to the process of planning, designing, integrating and operating technology systems as to reduce long-term environmental impact from technology deployment (Flores, Ber-Tek, Le Van-Etter, 2013). One focus area of the STEP program is to help companies develop structured cabling systems that are more sustainable. It's been found that an optical network consumes less energy than copper-based systems over the life of the network (Flores, Ber-Tek, Le Van-Etter, 2013). Based on the Environmental Protection Agency (EPA) Green Power Equivalency Calculator Methodologies, fiber networks use less energy to power the signal which generate less heat and thus require less cooling (EPA, 2013).

The light-emitting diode (LED) is one of most energy-efficient and rapidly-developing lighting technologies (Entergy, 2017). LED has the potential to fundamentally change the future of lighting in the United States which use at least 75% less energy and last 25 times longer than incandescent lighting (Entergy, 2017).

Power Usage, Cloud Technology, and Sustainable Practices

Mouftah and Kantarci (2013) studied parallel and distributed system concepts and project that cloud computing is expected to serve many

ISSN: 2473-3857
v3 n4353

business areas such as health, education, scientific computation, multimedia service deliver, and others. However, data centers emit significantly large amount of greenhouse gas (GHGs). Hence, energy-efficient and green migration of IT services by cloud computing is emergent. Building the data center close to renewable resources at the transport network nodes can minimize the dependency on nonrenewable resources and lead to further reduction in GHG emissions of processing, storage, and transport energies of cloud computing (Mouftah & Kantarci, 2013). Furthermore, the monitoring system and energy-efficient design of storage area networks would be another emergent subjects in energy-efficient cloud computing (Mouftah & Kantarci, 2013).

With long-period records of monitoring the utilities, equipment, and data center costs, it is undeniable for home, small businesses, enterprise, and institutions to see that Green IT does save the money in the long term. The lifespan of cabling is about 25 years by replacing with fiber optic cables. It is a major savings factor of needing minimal maintenance. Along with applying with the energy star compliant components, the power consumption will be reduced and save money.

Moreover, it's suggested that the schools would be allowed to dispose of the equipment for funds to be obtained through resale. Or utilize the recycling options offered from the manufactures to stay with current technology without concerning about the disposing outdated equipment.

6. CONCLUSIONS

School system provides a life-long learning environment for the community. The benefits of being a GREEN school can send the message of being healthier for students, faculty, staff, and community. By improving learning and working conditions under a well-designed green IT environment, the school will be able to save money and collect more resources to benefit the community.

This practice would educate the community to embrace opportunities of being a healthy citizen. More future engineers and scientists could be cultivated and motivated to develop green technology and become IT enablers. For a larger picture of building a global community, each individual would be able to help cut down carbon emissions by applying environmental friendly hardware and building structural components. No matter the buildings would be home, work place at enterprise, hospital, or school, having the concept of creating a green environment is the tread of moving forward to the next century.

Going forward, Green IT would be the best option for the large network environment, because of the cost savings associated with power consumption over the life of the network. Success of the initiative is based on the decisions that are made by administrators when establishing the network and strict adherence to network policies that will be written to accompany it. Students will have a great environment in which to learn and will have a sustainable model to follow as they transition into their future careers. Because graduating from a green school has been serving as an example from the institutions to the future businesses.

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ISSN: 2473-3857
v3 n4353