RESEARCH ARTICLE OPEN ACCESS

Green Computing-A Study

Lakshmy Sukumaran, Reetu Singh, Supriya Kulkarni P, Sutapa Sarkar
Student, Electronics & Communication Dept, MVJ College Of Engineering, Bangalore, India

Abstract
Information technology as an industry has been steadily increasing over the past decade or so. With an ever increasing presence of internet and e-commerce in the life of an average citizen, the growth on industry at such an alarming rate is only quite reasonable. Along with such a substantial growth it becomes vital to see what adverse effects this will cause to the environment. Moreover it is essential to check the impact these newly formed or existing corporations have on the environment and any measures taken on their part will be a direct measure of the company's corporate social responsibility.This paper discusses as to what is green computing ,why it is required and highlights the practices an organization cn follow to achieve the same.
Index Terms—Green computing, Sustainable practices,IT standards

I. INTRODUCTION

Green computing refers to the responsible use of computers and technology related resources. Usage of energy efficient CPU's peripherals and servers, reduction of resource consumption and improve disposal of electronic waste, implementation of other best practices all constitute green computing. Green computing also referred to as Green IT is defined as the study of designing, manufacturing and engineering and usage of computing devices that reduces its environmental impact.

With the advent of cloud computing where the cloud provides the services and consumers pay for the services rendered, there has been a considerable increase in the number of data centres. The data centres at present consume a lot of power and also adversely affects the environment through emission of CO2. Also efficient methods of recycling and disposing IT waste become very important as the landfills are being filled with IT waste.

IT multinational corporations are spending/need to spend sufficient amount of time in this direction to ensure that such sustainable practices are employed in their respective organizations. Green computing is one such direction which the companies are pursuing. It refers to the responsible use of computers and technology related resources. With so much scrutiny around the activities of any company by the general public and concerned departments it becomes vital for any organization to embrace such sustainable practices like green computing.[1].

II. WHY GREEN COMPUTING

The term itself has a distinct strong positive connotation associated with it which will generally give the reader a nudge as to why it should be implemented or considered. Cited below are some reasons as to why it becomes necessary for any organization to spent sufficient time in this direction.[2]

- Environmental Impact: Emission of CO2 and other gases have been proven to adversely affect the environment and is seen to affect the global climate.
- Energy and cost savings: Adopting green computing techniques can significantly reduce cost and energy costs and can result in serious cost savings. Given below in fig 1 is an indicator of energy consumption in the IT industry. With the IT industry constituting such a big slice of the pie and the potential of IT to infiltrate the existing other industries, it is absolutely vital that we take steps for energy conservation.[3]

III. EASE OF USE

Fig1: Commercial Energy Consumption

Source: http://www.verdiem.com/blog/2012-06-11/achieving-hard-roi-verdiem-surveyor-and-cisco-energywise

- Power- demand and supply in balance: Demand for energy has been steadily increasing and organizations are very cognizant of their energy consumption considering the well-known fact that there is a finite nonrenewable energy source we are depending at the present. Adopting green computing techniques can ensure in a healthy power system.
- Landfills: Landfills have been filled with this electronic waste. So repurposing computers and recycling of computers and electronic waste has to be thought off so as to prevent these landfills from accumulating so much waste.

IV. GREEN COMPUTING- APPROACHES

Green Computing represents a set of principles which should be considered at the time a product is assembled and manufactured, set of principles that needs to be remembered and put in practice when using the product and set of directives by the company to deal when the product is no longer deemed worthy of use. Four approaches have been proposed to implement green computing in all levels of an organization. These approaches ensure that these best practices are followed/enforced at all levels of the organisation.

- Green Use: Minimizing consumption of electricity of computers and peripheral devices in an ecofriendly manner.
- Green disposal: Disposal of electronic waste is also essential. Recycling of equipment and re purposing an existing computer are methods adopted in this approach.
- Green design: Design of Energy efficient printers, servers and computers and other digital devices.
- Green manufacturing: Steps should also be taken to ensure that the impact on environment is reduced while manufacturing these devices.

The figure 2 depicts the various levels at which green computing could be employed.

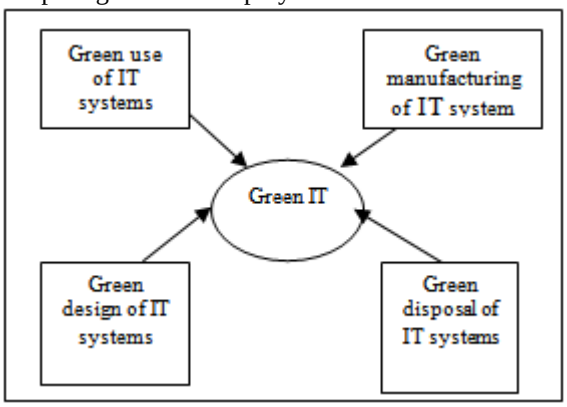

Fig 2: An approach to green computing

V. SUSTAINABLE PRACTICES

Since we have identified the levels where green techniques have to be enforced in an organization, we can further distill into the practices that can be employed at these four levels. [4]

A. Judicious Use of Systems

Judicious use of systems can reduce energy consumption by PCs and can be achieved to a great extent by simple steps as mentioned below.

- Usage of power management features: Features can be enabled to ensure that the computer when not in use can be automatically powered down to an energy saving state. As per figures by US EPA the energy reduction can be in the range of around 60-70 percent.
- Shut down idle systems: Most often it is seen that even when not in use computers are switched on. Ensuring that sufficient awareness is created by the management to educate the workers the need for green computing and the practices that needs to be employed can greatly help in energy reduction.
- Usage of thin client computers: Employing thin client computers rather than using desktop can further reduce energy consumption.
- Usage of blank screensavers: Using a blank screensaver can conserve more power than a screensaver with moving images as it has to continually interact with CPU.

B. Greening Data Centes

Rapid rise of Internet and web applications have accelerated the number of data centres. The increase in the number of data centres has also increased the operational cost of the organization. Some measures are as discussed below.[5]

- Virtualization**:** This is a key strategy to reduce data centre power consumption. It enables energy conservation by hosting multiple virtual servers on a physical host server. In addition to energy cost savings, it can reduce data centre floor space and makes use of computing power.
- Energy Conservation**:** Liquid cooling systems, nano fluid cooling systems and in-server, in-rack cooling are new technologies being researched upon by Companies like HP and IBM which will further reduce the energy consumption. Companies also encourage the clients to switch from legacy mainframe applications to servers.

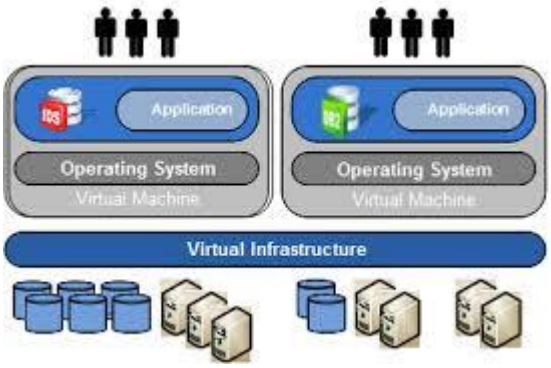

Fig 3:Virtualization
Source:
http://www.ijarcsse.com/docs/papers/Volume_3/6_June2013/V3I6-0320.pdf

- Eco-Friendly Design: Eco friendly designs involve use of natural light to power the data centre. Using recycled products and adopting other sustainable methods of development and construction can greatly improve the performance and productivity of the data centers.

C. Reuse/Refurbish/Recycle

Waste disposal of electronic waste should also be of utmost importance to any organization. Unwanted computers should not be thrown away in rubbish bins as it will exacerbate the already existing landfill situation. Reuse an existing component or hardware as long it matches the functional requirement. Refurbish existing systems by replacing hardware of the old one. If either refurbishing or reusing won't serve the purpose then we need to ensure that the waste is properly disposed off. Care should be taken so as not burn as these might release toxic gases into the environment. Also over a period of time it can leak into the waterways and the environment. These wastes form a good source of raw materials for manufacturing newer components. Steps should be taken to ensure that the waste being collected is sent to authorized facilities

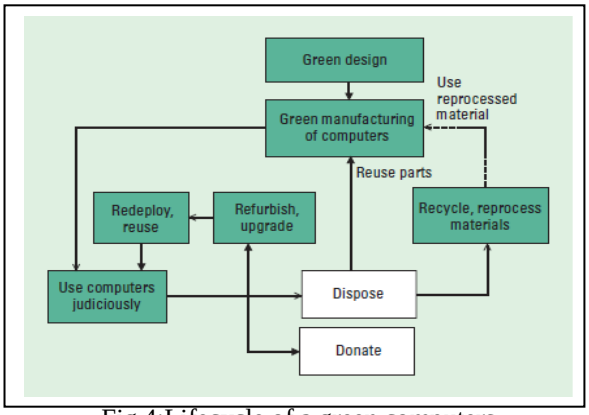

Fig 4:Lifecycle of a green computers
Source:
http://www.pitt.edu/~dtipper/2011/GreenPaper.pdf

VI. IT STANDARDS AND REGULATIONS

Addressing this problem is no longer a sole concern of the organization but the government itself. Regulations and enforcing standards therefore becomes vital in this regard. Some regulations as listed below can help the manufacturer in designing green computers and other hardware based on their environmental attributes.[2]

A. EPEAT:

The green electronic council has put forward EPEAT, Electronic Product Environmental Assessment Tool, an assessment tool to identify IT components on their environmental attributes. There are 23 required criteria and 28 optional criteria which the manufacturer can implement at the time of manufacturing. These criterions are grouped into eight performance groups. These groups are materials used in building the component, Elimination materials that might harm the environments, recycling, performance, packaging, longevity, energy conservation and end of life management At the time of manufacturing the company can choose which of the optional criteria they can apply to the product.
Based on the criterion selected and opted out the product will be given a rating of Bronze, Silver or Gold. Bronze means the product has only the 23 required criterions whereas the Silver would have implemented at least 14 additional criterions in addition to the 23 required ones. Gold would have implemented at least 21 of the optional criterion.The logo of the EPEAT is given in the figure 5.

B. ENERGY STAR:

This standard regulates energy performance of external and internal power supplies and provides detailed specifications for idle, sleep and standby modes of IT devices. Energy savings will be increased

in all modes of operation and will require an awareness drive required on part of the employment using the IT devices. The logo of the energy star is given as in figure 6.

Fig 5:Logo of EPEAT
Source:
http://thehobbeehive.files.wordpress.com/2011/05/epeat_logo.jpg

Fig 6: Energy star logo
Source:
http://blogs.rochester.edu/thegreendandelion/2011/09/anderson-wilder-receive-energy-star-certification/

C. ROHS DIRECTIVE:

The Restriction of Hazardous Substances (ROHS) directive aims to restrict the use of hazardous substances while manufacturing an IT Product. It also checks if a product has been manufactured with more than permitted amount of materials like lead, mercury, chromium or cadmium and enforces rules such that these products do not enter the market.

VII. CONCLUSION

With such an evident calamity in sight regarding the environmental impact the IT industry is making, it is essential that we as an individual, the organization and the government should understand and enforce the need for green computing. All the actors concerned should come forth and join forces to ensure that green computing, a set of principles and directives, are sufficiently incorporated into the overall IT ecosystem

REFERENCES

[1] Rouse, M. (2010, May). Search data Center. Retrieved April07,2014,.[Online].Available. http://searchdatacenter.techtarget.com/definition/green-computing.

[2] Murugesan, S. (2008).' Harnessing green IT: Principles and Practices'. Pittsburg: IEEE Computer society.

[3] Scumniotales, J. (2012, 11 06). Achieving Hard ROI with Verdiem Surveyor and Cisco EnergyWise. Retrieved April 07, 2014, from Verdiem Corporation: [Online], Available: http://www.verdiem.com/print/2391

[4] Jansen, C., Techopedia. Retrieved April 07, 2014,from 'GreenComputing:''[Online]. Availble: http://www.techopedia.com/definition/14753/green-computing [5] Pushtikant Malviya, ShailendraSingh. (2013). A Study about Green Computing. *International Journal of Advanced Research in Computer Science and Software Engineering*, 790-794