INITIATIVES OF GREEN ICT IN EDUCATION : CHALLENGES AND RECOMMENDATIONS FOR E-GOVERNANCE

* Divya Singh, **Vidhu Shekhar Pandey

*, ** (Junior Research Fellow)

Department of Education,

University of Allahabad, Allahabad, U.P., India

Abstract

This paper makes a compact view of challenges and recommendations for e-governance by initiatives of green ICT in education. This study is a personal point of view that is speculative and limited to initiatives of green ICT, challenges and recommendations for e-governance with implications for the role of education in green ICT within the prospective contribution of the   e-governance in education to the study and practice of green ICT. Green ICT is comprised of initiatives and strategies that reduce the environmental foot print of technology. This arises from reductions in energy use and consumables, including hardware, electricity and papers, and because of these reductions green ICT initiatives also produce cost savings in energy use in addition to the environmental benefits. The amount of IT equipments and electricity footprints needing future recycling are simultaneously reduced. Green ICT initiative is the appropriate measure to reduce power consumption and it insures that it is effectively managed. The researchers focused on some initiatives/policies that pursued, enhance, current outreach campaigns to ensure that Green ICT considerations are embedded into management and awareness-raising to procurement of the ICT estate. Green ICT initiatives are reported to the appropriate university body and e-governance or plans for new or refurbished server hosting facilities; it will work with procurement services on changes to the university purchasing procedures to require purchases to seek approval from ISS for IT equipments that does not meet the Green ICT specification. The researchers have taken major initiatives in the field of e-governance by delivering various IT services like web and mobile based e-governance and online management and monitoring system in education.

Keywords: Green ICT, e-governance, Education

Introduction

In the last few years global warming and climate change was catapulted to the front of society and become a common subject of discussion in global society. In this context, the impact of ICT on ecological sustainability usually coined as GREEN ICT has emerged as one of the key management issues. Green ICT is comprised of initiatives and strategies that reduce the environmental footprint of technology. Green ICT means Green by ICT and Green of ICT. Gartner defines Green ICT as "Encompassing Environmentally sustainable IT and the use of IT to contribute to environment preservation". The Danish Ministry of Science

Technology and Innovation defines it as "more environmentally friendly utilization of IT and the use of sustainable IT". Organization of economic cooperation and development (OECD) defines Green ICT as "ICT to reduce environmental load and ICT for using as a promoter to relieve social environment influence", and ministry defined it as "Saving in ICT-related energy consumption and energy conservation through the use of ICT". As shown above, the definitions of this concept are different. However, this study defines Green ICT as "Reduction of energy consumption and pollution of environment through IT". This arises from reductions in energy use and consumables, including hardware, electricity and papers. Because of these reductions, Green ICT initiatives also produce cost savings in energy use in addition to environmental benefits. Electricity foot prints and the amount of equipment needing future recycling are simultaneously reduced.

Green ICT aims to minimize carbon foot print, minimize hazards ICT waste, reduce energy cost, achieve corporate social responsibility (CSR) and finally comply with government regulations. Yasuyuki Sugiyam described Green Research and development activities for reducing environment impact of society by reducing the impact of society as a whole by providing various kinds of ICT services (Green by ICT).

Evolution of Green ICT:

Today one of the most important anxieties in ICT is how to maintain environment where as keep running our operation, the rising boom of ICTs today is also concurrently witnessing an increasing impact on the environment and climate change. The study analyzed the evolution of Green ICT practice in U.K. Higher Education Institutions based on web based data collection in 2009 and 2011. The survey conducted by Riaz, M.T., Gutierrez, J.M., Pedersen J.N. on the challenges face of global warming by Co2 emission related in global ICT infrastructure. The article provided a number of strategies for greening ICT lead by discussion and overall analysis.

The study, reported by Mann H., Gerald G., Singh M., provides academics and manager with clearly defined concepts reduced to green information technology (IT) and have devised a true step implementation framework with a unique sustainability based feedback mechanism. The preliminary analysis on green IT awareness among Australian IT professionals based on a survey of 322 members of the Australian Computer Society have provided by Molla A., Vanessa C., Hepu D., Stars L., the findings of the study indicated that 51% of ICT professionals in Australia are concerned about climate change and only 30% of Australian IT professionals are aware about Australian Computer Society's Green ICT Policy. Shin-ichi Kuribayashi, Yasunori osana have identifies the need of collaboration among end systems, the communication network and the power network in order to reduce the total power consumption by the entire ICT system. The work has suggested the fundamental policies for the collaboration and energy consumption as green practices.

ICT Equipments: The list includes items such as :

✓ Desktop and Laptop PCs;

✓ Printers, Scanners, Copiers, Projectors;

✓ Smart phones, PDAs, desktop phones;

- ✓ Wireless and connected routers, hubs and other networking equipment;
- ✓ Mail servers, file servers, firewalls, databases etc.;
- ✓ Data centers and the equipment in them.

E-Governance:

Efficient execution of e-governance is highly important for the government in their respective area to align their services with the changing needs of citizens. The rise of information and communication technology ever the years has made the e-governance initiative common in most countries. It enables government departments to function in a more efficient and transparent manners, but still it is an evolving concept and practice due to various challenges in its implementation.

Literature Review:

- **A**lthough Green IT is becoming more common in discussion, there   is little academic research about this topic. The existing literature related to environmental sustainability is dominated by industry research groups, environmental groups, governmental bodies and international organizations. However; academics have only recently begun to take into account Green IT. Form the review of the literature, there are three main factors, these are motivational factors, organizational factors and technological constraints. (Kuo, 2010)

- After we look the broader concepts of sustainability innovation, it is the time for the Green IT to analyze very exhaustively. Murugesan (2008. pp. 25-26) suggest that Green IT is: "The study and practice of designing, manufacturing, using and disposing of computers, servers and associated sub-systems – such as monitors, printers, storage devices, and networking and communication systems – effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus Green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling….It is the study and practice of using computing resources efficiently."

Key studies:

Green ICT initiatives in US and other Countries

Governments and businesses have a wide range of initiatives dealing with the impacts of information and communication technologies (ICTs) on the environment and climate change.

Initiatives concentrate on greening ICTs rather than tackling global warning and environmental degradation through the use of ICT application.

Reducing the direct environmental impacts of ICTs is the most frequent objective of governments and businesses. Of 92 initiatives surveyed by the OECD, over two third focus on Greening ICT. Standers and labels such as U.S. Environmental Protection Agency's *ENERGY STAR* or the *Electronic Product Environment Assessment Tool* are examples. Encouraging R&D on resource efficient ICTs also rank high (e.g. Japan's *Green IT Project* and the *Climate Savers Computing Initiatives*). In many cases, governments

are taking the lead by greening their ICTs and implementing green procurement strategies (e.g. Denmark's *Action Plan for Green IT and the United Kingdom's Green ICT Strategy).*

Most initiatives aim at reducing energy consumption and increasing energy efficiency of ICTs or by using ICT applications. The aim of reducing energy consumption has been driven by high energy prices as well as environmental consideration. However, energy prices have fallen sharply (in may 2009, oil prices were less than 40% of July 2008 prices), and capital and credit have tightened to choking point. Furthermore, venture capital investments in clean technologies in the United States were down by 87% in first quarter of 2009 compared with the same quarter in 2008.

Most policies aim at reducing environmental impacts during use, for example by reducing energy consumption. Very few target reducing environmental impacts over the complete life-cycle, even though manufacturing, distribution and disposal can have higher environmental impacts. One half of initiatives focus on reducing energy consumption during ICT use, in contrast to only one tenth targeting emerging reduction during ICT manufacturing.

Many government economic stimulus packages are promoting green technologies and green growth to boost investment and support the recovery. "Smart" urban systems, transport systems and electricity grids all relay on ICTs. Korea has focused its KRW 50 trillion (EUR 26 billion) stimulus package almost entirely on development and use of green technologies, many with an ICT component, for example using ICTs in green transportation systems. The US *American Recovery and Reinvestment Act of 2009* provides USD 59 billion (EUR $% billion)for green technologies, including USD 11 billion (EUR 8 billion) for a smart electricity grid. This new interest partly makes up for the previously low frequency of policies to support Green ICTs applications.

Major Challenges:

The environmental impacts come in much the same way the impacts come from any equipments-manufacture, use and disposal. Green ICT has some specific major challenges in all the areas of:

- Rapid Technological change
- Privacy and security concerns
- Scale complexity
- Legislative and regulatory barriers
- Internal challenges to e-government implementation

We have taken major initiatives in the field of e-governance by delivering various IT services. Some of them are described below:

- Web and mobile based e-governance solutions.
- Employee appraisal system across multiple states/departments.
- Online management and monitoring solution (OMMS).
- Performance tracking and management solution.
- Development of data base driven systems.

- Data warehousing and data mining solutions.
- Budget allocation; monitoring and reporting tools.
- Property monitoring and management systems for Muncipal Corporations.
- Financial Planning and forecasting solutions.
- Centralized hospital information system.
- Workflow management system.
- Disaster recovery management solutions.

Initiatives of Green ICT: There are the five main goals of the initiatives of green ICT. Priorities for establishment of Green ICT Policy are:-

1. Eco-friendliness -   Reduction of Greenhouse gases.

    Reducing uncontrolled Resource Development.

2. Technology Evolution - Establishment of strategies for the development of Green ICT.

    Development of related technology.

3. Economic efficiency -   Job creation.

    Stability of National Economy.

4. Energy Efficiency -   Reduction of Energy consumption.

    Increase the benefits of Energy Services.

5. Stable supply of energy - Steady supply of energy.

    Reduce the concentration of the specified energy.

Strategy:

➢ To enhance current outreach campaigns and awareness–raising to ensure that Green ICT considerations are embedded into management and procurement of the ICT estate.

➢ To act as a reporting hub to ensure that Green ICT initiatives are reported to the appropriate institution body.

➢ All plans for new or refurbished server hosting facilities.

➢ To organize procurement workshops to highlight the need to embed green considerations in the procurement process.

➢ To use increased reporting capability to identify priority areas and focus Green ICT initiatives where they will achieve most impact in particular desktop/laptop, network and server provision.

➢ To work with the schools of computing sciences and civil engineering.

➢ To replace less power efficient network edge equipment.

The Green ICT initiatives is underpinned by a drive to acquire better management information to measure the benefits of green initiatives and to shape future green ICT strategies.

Implementation of Green ICT:

List of immediate steps has been developed to encourage the early implementation of some simple but high impact actions. Examples of areas where immediate savings can be made include:

➢ Running a long life asset campaign to increase lifespan where appropriate;

➢ Turning off PCs overnight, at weekends and during holiday periods;

➢ Ensuring that all printers are either purchased with automatic duplexing functionality or default to duplex and gray scale to reduce the amount of maintenance and transport required and electricity, paper and toner used;

➢ Removing active screen savers and utilizing power management functionality to put monitors in low power modes after specified periods of inactivity to reduce energy consumption of the equipment;

➢ Ensuring peripheral equipment is switched off overnight;

➢ Putting PCs into low power modes after specified periods of inactivity;

➢ Re-using or re-distributing legacy ICT and related goods to ensure assets are fully utilized for their whole life via a credible, traceable provider.

Departments should consider sharing ICT services with other departments which increase energy savings.

USES:

a) **Practices of green ICT –** It encourages and supports greener behavior by the faculties, staff members, students and admin people.

b) **Recycling of IT equipments –** It reduces carbon footprint through proper disposal of hardware and its hazardous elements through a responsible recycle.

c) **Performance and consolidation of printers –** These practices of online communication need to be follow rather than printed hard copies and printing only when it is necessary.

d) **Power management –** the personal computer power management has to be monitored by various practices like personal computer's router, Wi-Fi access points when not in used, remove active screen savers used thin-film-transistor liquid-crystal display instead of CRT monitors, used of next generation processors which are energy efficient.

e) **Improvement of telecommunication –** in the national and international conferences, the institutions should prrefer4 video conferencing to reduce travel and at the end carbon footprint will be reduce.

f) **Committee formation for green ICT –** the green ICT committee is responsible for sustainable ICT practices and motivation for all stalk holders to go green in their approach of using ICT.

g) **Use of cloud computing for energy conservation –** cloud computing reduce the effort required for setting up computer lab updating and maintained hardware and software.

h) **Purchase of energy certified equipments –** in purchasing of energy star rating hardware reduces future energy consumption by setting baselines and work towards reduction of energy cost.

Benefits of Green ICT to Organizations:

The solution to averting the disaster is likely to occur since the climatic change and increased costs of doing business lie in green ICT and its application within itself and in other sectors. Green ICT extends other less commonly considered aspects of the entire life cycle. This includes eco-friendly procurement, employee behavior, running data centers on sustainably generated power, and environmentally sound disposal of used ICT equipment. According to Herman et al (2010), ICT is not intrinsically green because it

consumes energy and raw materials; however, it can be leveraged to make business processes more energy efficient. The greatest benefit of green ICT to the universe and any nation is the reduced environmental impact and costs of doing business. This is so when seen against the background of energy consumption in developing countries.

Benefits from green ICT for different stakeholder groups:

1. Environment/society – lower carbon emissions, Reduce resource consumption, Compliance with legal requirements

2. Companies – Reduce energy costs, Reduce operating costs of data centers, Less hardware needed

3. Employees – Increased employee satisfaction, Greater loyalty, Easier recruitment

4. Capital market – Improved ratings, Higher share price, Greater company value

5. Customers – Greater customer loyalty, Appeal to new customer groups, Greater consumer satisfaction

6. Public – Improved image, Rounded out CSR strategy, Greater brand value

Hurdles of Green ICT:

- Lack of adequate funding and support from top management.
- Lack of participation from necessary students/staff/faculties.
- Environmentally unconcerned institutional culture.
- Lack of awareness of Green ICT.
- Lack of education or training from institutes.
- ICT's environmental impacts are not considered as significant.
- Lack of motivation among faculty/staff/students of institutes.
- Lack of government strict regulation.
- Lack of good procurement practice at education institutes.
- Inadequate research and development activities.

Recommendations for e-governance:

- Promote energy awareness – The biggest contributors to climate change are us and the way we conduct our everyday lives. People need advice and feedback to encourage appropriate changes to their behavior.

- Provide managers with information about their service – Provide energy and paper consumption information so managers can compare their service with others and assess the impact of any changes they make.

- Shut down PCs after office hours – For the default working day of 8 hours the overnight period lasts 16 hours. When weekends and holidays are taken into account we could be wasting up to four times as much energy as consumed during the working day.

- Remove active screensavers – A monitor left running with an active screen saver uses the same amount of energy as when the screen is in full use. The PC also consumes needless power in sustaining the screensaver.

- Switch monitor to standby after 5 minutes of inactivity (no active screensavers) – if nothing on the screen has changed for a long time it is likely that it is no longer being used. Standby mode prevents a longer period of wasted power. The display can quickly be resumed if it is indeed in use.

- Enable active power management on desktops (standby / hibernate after a defined period of inactivity) – Having active power management enabled will be more closely match the consumption of energy with use, reducing wasted energy. PCs can be put into a low energy mode when the user is away from the desk, e.g. during lunch or at a meeting.

- Ensure re-use of equipment that is no longer required but is still serviceable. If re-use is not possible recycle or ensure green disposal. – The majority of energy in the life of a PC or laptop is consumed in its manufacture, delivery and disposal. Extending its use or seeking its re-use elsewhere will save energy and materials (manufacturing stage) as well as purchase and disposal costs.

- Specify computers with high-efficiency Power Supply Units ((80% conversion or better) – Power supply unit convert mains AC power to the DC power needed by computers. More efficient units minimize the loss of energy from this conversion ion the form of heat.

- PC consolidation – Reducing the number of electronic devices an individual has will reduce indirect energy requirements e.g. less support and maintenance.

- Apply timer switches to non-networked technology and printers – Not all ICT equipment can be networked and/or automatically shut down or put into standby mode-typically printers, photocopiers and scanners. Neither do all such devices have automatic facilities to switch to a standby mode after a pre-set time. Timer switches can be used to turn off such equipments automatically outside office hours saving up to 67% of its daily energy consumption if currently left on 24 hours a day.

- Set default green printing including duplex and grey scale – By reducing the amount you print you will save paper and energy. Further savings can be made by presetting duplex, booklet and grayscale defaults and using a "Print on collect" facility where provided.

- Optimize power-saving sleep mode on printers – Printers are typically only active for 263 hours per year or 12r days; so if on permanently they waste energy 97% of the time. If power saving is already in place, reduce the amount of time before sleep is activated.

- Printer consolidation – Reducing the number of printers and replacing those left with networked multi-function devices (MFDs) e.g. Combined Printers/Copiers, can significantly reduce energy consumption. Fewer printers should also lower maintenance and management costs.

- Device consolidation – Reducing the number of electronic devices an individual has will reduce indirect energy requirements e.g. less support and maintenance. Instead of having separate PCs in the office and at home use a single laptop and carry it between the two. Rather than a mobile phone

and a PDA (e.g. Blackberry), use a single integrated device and "follow-me" services. Rather than having separate video conferencing equipment consolidating it into desktop devices may reduce energy consumption.

- Reduce cooling in the data center to appropriate levels and increase the ambient room temperature – Research has shown that increasing temperatures in data centers does not lead to a higher failure rate as was previously thought. Over 50% of the power associated with the data center is used for cooling the ICT equipments.

- Identify servers and data disks in the data center that are running but not providing any services and decommission – A server which is switched on but idle still uses 50-7-% of the power used when running at maximum load.

- Specify low-power consumption, low voltage servers with high efficiency power supply units (80% conversion or better) – Do not over specify system requirements. The higher the specification the more mains power is drawn. Power supply units convert mains AC power to the DC power needed by computers. More efficient units minimize the loss of energy from this conversion in the form of heat.

- Ensure re-use of equipment that is no longer required but is still serviceable – Energy is require to manufacture , distribute and recycle equipments as well as to use it. Extending its use or seeking its re-use elsewhere will save energy as well as purchases and disposal costs.

- Data center audit – as identifies mismatches between the current physical layout and the layout that would maximize the effectiveness of cooling from air conditioning units. Up to a 20% reduction in cooling could be achieved.

Conclusion:

Green ICT is of crucial importance for a sustainable economic development. The domains where ICT can help are vast. Reduction of carbon emissions is only one example. Equally important are issues like reducing waste and maximizing the use of raw materials. Collaboration between the different related sectors is paramount for achieving the goal.

Due to global warming, Green ICT is necessary to find solutions to environment and energy issues. Therefore, this study emphasized the priority of goals which need to be achieved for Green ICTC policy making in India.

This study adopt 5 main initiatives which are in this order of priority for policy making eco-friendliness, technology evolution, economic efficiency, energy efficiency, and stable supply of energy. The main reason for eco-friendliness was on the top priority in policy making for the solution to pollution and international competitiveness is necessary in order to develop the technology of Green ICT policy. This can bring growth in the IT and energy industries and the national economy too. Moreover, current awareness of Green ICT in pollution has many sources, no single effort will be sufficient in making an actual effect in improving the situation. In order to achieve sustainable and more environmental friendly use of ICT, there is

a strong need for more sustainable collaboration and cooperation between government policy makers, ICT manufacturers, ICT technologist and academic researchers. To conclude India has made an important first step to a long way, towards developing a green ICT industry.

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