CHAPTER - 1

INTRODUCTION

1.1 Overview

Individual and organizational demands for technological services are increasing rapidly. This demand is being generated from an increased dependency on information technology to provide solutions for both our business and personal challenges. IT has, without doubt, substantially improved business productivity and enhanced the overall quality of our lives. However, but this increasing growth is placing a tremendous burden on our environment. Information technology is an essential component of every organization's infrastructure, but it is also becoming an area with significant environmental impacts.

Improving environmental performance, tackling global warming and enhancing resource management are high on the list of global challenges that must be addressed urgently. According to a study by McKinsey, IT related production and consumption accounted for about 2% of overall carbon emissions in 2007 (about 0.86 gigatons of emissions a year) which is likely to go up to about 3% by 2020 (about 1.54 gigatons of emissions a year), an increase of about 80% from the current levels (Mithas et al., 2010: 2). In 2012, close to 4.7 percent of the world's electrical energy was consumed by ICT, releasing into the atmosphere roughly 1.7 percent of the total CO_2 emissions. These numbers are growing, although the improving energy efficiency of ICT equipment leads to a slower growth of these metrics than the increase of ICT's usage worldwide. It is estimated that the total amount e-waste generated in 2014 was 41.8 million metric tonnes (Mt). It is forecasted to increase to 50 Mt of e-waste in 2018 (Balde et al., 2015: 24). According to 'Global E-Waste Monitor 2014', compiled by UN's think tank United Nations University (UNU), US and China produced the most e-waste overall in 2014 (Balde et al., 2015: 42). India is the fifth biggest producer of e-waste in the world and has discarded 1.7 million tonnes (Mt) of electronic and electrical equipment in 2014 (The Hindu, 2015; http://www.thehindu.com/todays-paper/tp-national/india-fifth-biggest-generator-of-ewaste-in-2014-un-report/article7120245.ece).

Thus fast pace growth of IT has created a need to look for environmental sustainability of IT.

Rising energy consumption, fast growing e-waste together with government-imposed levies on carbon production, are increasingly impacting on the cost of doing business, making many current business practices economically unsustainable. It is becoming progressively more important for all businesses to act in an environmentally responsible manner, both to fulfill their legal and moral obligations, and also to enhance the brand and improve corporate image.

Fortunately, offsetting this concern, IT has a potential to help curb the carbon emissions in the general economy by about 7.8 gigatons (i.e. 1.5% of the global emissions in 2007), thereby potentially contributing on the whole, to sustainable growth. Forrester estimated Green IT service market to reach nearly $ 5 billion by 2013. It also lays a lead role in supporting a business's sustainability initiatives (Mithas et al., 2010: 2).

1.2 Concept of Green IT

The concept of Green IT emerged in 1992 when the U.S. Environmental Protection Agency launched Energy Star[1]. It has gained attention in the past decade. It is defined as "Collection of strategic and tactical initiatives that directly reduces the carbon footprint of an organization's computing operation". However, Green IT is not just focused on reducing the impact of the ICT industry. It is also focused on using the services of ICT to help reduce the organization's overall carbon footprint." (Neil, 2011: 4). Thus, Green IT aims at managing all IT operations to reduce the environmental impact.

[1] An international standard which is efficient ratings used to measure energy. Products bearing the 'ENERGY STAR' label are deemed to be more energy-efficient than those that don't meet the grade, according to the ENERGY STAR specifications.

1.3 Importance of Green IT and its Management

Green IT is now becoming more compelling for IT organizations. It has become imperative to adopt Green IT culture for sustainable future. Rapid growth of IT industry has made it essential to look in to growing problems of power consumptions, e-waste, unsustainable work practices like leaving PCs, laptops switched on when not in use, keeping screen savers on, excessive use of printers, etc. Gartner predicted that in 2009, more than one-third of all IT organizations would place environmental concerns among their top six buying criteria. By 2010, three-quarters of companies would be using carbon-footprint considerations in calculating their hardware-buying strategy, and by 2011, large companies would be developing policies requiring their suppliers to prove their green credentials through an auditing process. (Lamb John, 2009: 10)

Most companies are talking a good game but not actually going green where it counts. According to a survey of 124 IT operations by Forrester Research in May 2007, some 85 percent of respondents said environmental factors are important in planning IT operations. But only one-fourth of survey respondents have actually written green criteria into their company's purchasing processes (Lamb John, 2009: 10).

Green IT management requires a well-defined closed loop management system. It is not just simply adoption of certain practices that reduce impact of IT on environment but requires integration of governance, policy, practices, measuring and evaluating the outcomes of Green IT implementation.

Despite emerging as an important concern for business organizations, Green IT still lacks systematic approach towards adoption of sustainable Green IT culture in terms of governance, policy, and practices. Green IT adoption so far is observed to be more of ad-hoc basis. Initiatives are taken in terms on Green IT practices but as such there is no closed loop system or mechanism which can help an organization to assess its Green IT initiatives and manage its overall Green IT implementation in a proper manner. Overall, though an emerging area Green IT research, is still by far at nascent stage.

1.4 World Scenario of Green IT

Germany, U.S., Australia, and Japan are some of the countries which are taking initiatives in Green IT. Although the initiatives, rules and regulations vary from country to country, all address impact of IT on environment. Solving the E-Waste Program **(StEP)** by United Nations (initiated in 2004), is a program that tries to solve the e-waste problem by initiating and facilitating policies, legislations & design of e-waste management models (Pinto, 2008: 68). Waste Electrical and Electronic Equipment **(WEEE)** directive initiated by the European Union (started in Feb 2003) places the responsibility for the disposal of equipment on the manufacturers (Webber & Wallace, 2009: 26) and Restriction on Hazardous Substance **(RoHS)** directive (initiated in Feb 2003) restricts the use of six hazardous materials in the manufacture of certain types of electronic equipment (Webber & Wallace, 2009: 25).

Japanese laws make it mandatory to consider dismantling, and reuse of materials has become an integral part of the supply chain to create new products. The Chinese regulation is normally referred to as China RoHS. Products shipped to China must be marked as to whether the items are regulation compliant or noncompliant.

Basel Action Network **(BAN)** is a nonprofit worldwide organization that focuses on reducing the environmental impacts of e-waste by promoting Green, toxin-free design of consumer products (Pinto, 2008: 67-68). **ENERGY STAR** is an international standard created in 1992 by the US EPA, which is used to measure energy-efficient ratings. Electronic Product Environmental Assessment Tool **(EPEAT)** is developed by the Green Electronics Council in Portland, Oregon (originated in Dec 2007), which awards a gold, silver, or bronze certification, based on how well organizations meet benchmarked 51 criteria, some of which include ease of disassembly, chemical content, end-of-life design, etc. Products must meet at least 23 of the criteria for the bronze-level certification (Webber & Wallace, 2009: 66).

The importance of Green IT has also being realized by the research community all over the world. To date, apart from few researchers, Alemayehu Molla has done a significant

contribution in knowledge creation for GREEN IT. Information Systems conferences, such as Australasian Conference on Information Systems (ACIS), Pacific Asia conference on Information Systems (PACIS), and American conference on Information Systems (AMCIS) and International Journal of Green Computing (IJGC) have provided a platform for research in Green IT. Green IT research has yet to make it in IT Journals as most of the research papers are coming through conferences. A large volume of publications is initiated from IBM, Fujitsu, Wipro, TCS and research organizations like Green Peace, Info~Tech research group, Forrester research, Gartner Inc. etc. The academic research so far done in this area is mostly by other countries and not much looked into by Indian researchers.

1.5 Green IT and IT Industry in India

India is now one of the biggest IT capitals in the modern world. Accenture, Infosys BPO, Wipro Ltd, TCS, HCL Technologies, Mahindra Satyam are all global IT giants. Various international organizations have set up their offices here in India like Google, IBM, Accenture, Microsoft etc. It has helped in changing Indian economy from a agricultural based economy to a knowledge driven economy. As per NASSCOM's (National Association of Software and Services Companies) research, the IT sector was likely to generate revenues worth USD 130 billion by the end of 2015 which would result in a positive metamorphosis of the Indian economy, pushing it towards high growth rates.

With this rapid development of IT sector, it is posed with one of the biggest challenge i.e. environmental sustainability of IT. According to the statement from IT committee, MCCIA (Mahratta Chamber of Commerce Industries & Agriculture), computing resource costs are reducing but the power costs are increasing substantially. Around 40% energy consumption in the corporate sector is due to the use of IT and related devices. IT users in India are large consumers of electricity (DNA, 2013; http://www.dnaindia.com/pune/report-green-computing-is-fast-becoming-a-compulsion-1873213).

According to Gartner Research Director Ganesh Ramamoorthy, majority of the Indian organizations still lack the strategic focus that comes with a clear understanding of the core issues and key technologies that bring about real change in the vision for sustainability and Green IT in an organization. Gartner predicted that India's spending on green IT and sustainability initiatives would reach $34 billion in 2014 a 14.1 percent increase from $29.2 billion that was spent in 2013. ("Gartner Says India Green IT and sustainability spending to reach $34 Billion in 2014", http://www.gartner.com/ newsroom /id/2944818).

1.6 Motivation of the Research

Awareness among Indian organizations about climate change and Green IT issues is growing, however there is still a lot to be achieved. They are slowly integrating Green IT initiatives into their core business operations but it is observed that many Indian organizations have no clear understanding of the core issues involved in Green IT and there appears to be less recognition towards the need of Green IT. This is because there is no structured and sustainable Green IT ecosystem established in the IT organizations. India is still at nascent stage with respect to Green IT despite a rapid growth in IT. On the research front, this area seems to be largely disregarded so far. Looking to the significance of Green IT going forward and its equal criticalness in Indian perspective, this area is chosen for the research work. The current research has been conducted in Pune city, being one of largest IT hub in India.

1.7 Organization of Thesis

The thesis is organized as follows:

Chapter 1 presents an overview of Green IT and its high level state of the art worldwide. It illustrates the status of Green IT in India and finally provides the motivations of the current research.

Chapter 2 extensively reviews the literature relating to Green IT. The literature review covers various dimensions of Green IT such as definition, issues, drivers, governance,

policy, practices, and adoption models. It also covers Green IT initiatives taken worldwide and in India. The chapter concludes with summarizing the state of the research in this area.

Chapter 3 discusses the research methodology aspects of the present research. It provides information about research problem identified followed by objectives of the study. Various other aspects like target population, sampling technique, data collection methods, questionnaire designing, validity and reliability of the research instrument with statistical method of data analysis are presented in depth. It also notes the limitations experienced while carrying out the research.

Chapter 4 details out the data analysis and hypothesis testing pertaining to the current research on Green IT management. Variety of statistical tools such as frequency tables, bar charts, cross tabulations and radar charts have been presented for interpreting the data collected through questionnaires. It also includes the in-depth analysis of the interviews conducted. For hypothesis testing, it brings out the details of different tests like Friedman test, Chi-square test and Kruskal Wallis test.

Chapter 5 essentially provides the interpretation of the findings obtained from data analysis and hypothesis testing presented. Towards the end, recommendations are provided based on the findings.

Chapter 6 proposes a conceptual framework of Green IT management. It gives a high level overview of Green IT management ecosystem and the actors acting on the ecosystem. It shows how a Green IT ecosystem works in a closed loop manner. It subsequently proposes a tool to assess the Green IT maturity of an IT organization.

Chapter 7 presents two illustrative case studies to show the efficacy of the proposed Green IT maturity model.

Chapter 8 provides the concluding remark on research work on Green IT presented in the thesis. It brings out contributions made by the present research and potential directions in which further research can be conducted.