Green Information Technology Managerial Capabilities of IT Organizations in Sri Lanka

Thananjeyan .S
Dept. of Electrical and Electronic Engineering
University of Jaffna
Sri Lanka
thananji@jfn.ac.lk

Fernando, M.S.D.
Dept. of Computer Science and Engineering
University of Moratuwa
Sri Lanka
shantha@cse.mrt.ac.lk

***Abstract*- Green Information Technology is one of the emerging area of research that draws attention of both general public and business. It arises the awareness of conserving the environment for the future generations. Green IT concept evolves from preserving trees, reducing paper usage, recycling IT equipment and implementing power saving mechanisms to IT friendly business culture. Thus, it is important to study the current level of Green IT managerial capabilities of organizations before proposing any Green IT initiatives.**

This research analyzes the current level of Green IT managerial capabilities of IT organizations in Sri Lanka based on their IT policy and IT governance. This research is targeted to Chief Information Officers or equivalent officers. The results show that the organizations have adopted some of the state-of-the-art Green technologies. However, life-cycle approach that includes procurement, reuse, recycle and disposal of Green IT equipment was not followed and the steps to measure the carbon footprint of the organizations were also not considered as important.

This research recommends organizations should implement Green IT in each of the IT process of the organizations as life cycle approach. It should be a feedback driven continuous process that could lead behavioral changes in the organizational culture.

***Index Terms*— Green Information Technology, Green IT management, Green IT managerial capability, Green IT policy, Green IT governance**

I. Introduction

The importance of Green Information Technology (Green IT) was strongly recognized in the Chief Financial Officers (CFO) Research services report [1] and in information system research [2]. The increasing accumulation of greenhouse gases is affecting the climate and weather pattern. It increases the global temperature and causes global warming [3]. Electricity is a major cause of climate change, because the coal or oil that helps generate electricity also releases carbon dioxide, pollutants, and sulfur into the atmosphere [3]. Gartner estimated that IT industry accounts for approximately 2% of global carbon dioxide (CO2) gas emission [4].

The first wave of Green IT focused on virtualization, data center infrastructure, power management, and new technology on the desktop computers. But later it was realized that Green IT is not only with the servers and power management, but it should be a part of the business process and from the heart of the employees. So the next wave of Green IT focused on broader change in processes, behavior, and company culture [1]. There are a lot of challenges in investments, strategy, risk, and social commitments, as well as the efficiency and cost savings.

Business leaders, policy makers, IT professionals, researchers, students and the general public need useful guidance on Green IT. Government, enterprises and societies now started to think how to tackle environmental issues and adopt environmental sound practices. The impact of IT on ecological sustainability and its role in the sustainability has become one of the key management issue [2].

Thus studying the business insight and strategies behind Green initiatives helps to understand how well companies are preparing for future. Knowing the importance of environmental issues and the potential of IT in advancing ecological sustainability, it is sensible to investigate the current state of Green IT managerial capabilities. The topic is current and still somewhat lacking in research in Sri Lanka. To understand the Green IT implementations at organizational level, it is sensible to determine the IT professionals' understanding of Green IT.

In order to determine the current level of Green IT managerial capability of IT organizations in Sri Lanka, the following two objectives are defined for this research. They are;

(1) To identify factors affecting IT managerial capability - To lay the foundation for this research, it is important to identify the factors of Green IT readiness that affect IT managerial capability of the organizations;

(2) To identify the areas that need to be improved to raise the Green IT managerial capability in IT organizations in Sri Lanka - With the help of this research, identify the areas of IT managerial capabilities which need to be improved in the IT organizations in Sri Lanka. It will lead the organizations to be better environmental friendly organizations;

The significance of this research can be presented from a multifaceted perspectives such as;

(1) Healthy environment for the employees - Organizations should make sure that the employees enjoy the

satisfactory working environment. Green implementations witness better environment as it focuses on how to reduce the carbon footprint of an organization while reducing the operational costs. This research will suggest the Green IT areas that need to be improved to make the organization's environment to be natural and healthy.

(2) Environment preservations - Due to the scarcity of the resources, people have a challenge in using them. They need to think about the future and need to preserve the environment for the future generations. World has recognized this scarcity and damages to the environment as a serious issue. Even though Sri Lanka has started encouraging the organizations to implement Green practices, it is not considered as a serious issue. In this research, the cross analysis of the Green practices of IT organizations in various areas will be analyzed and it will help organizations to focus their weaker areas and give more focus on those areas to save the environment for the future.

II. THEORETICAL BACKGROUND

Sustainability is a development that meets the needs of the present world, without compromising the ability of future generations to meet their own needs [5]. Development is not a state, but it is a process of change. For development to be sustainable, the decisions of individuals, organizations, and institutions have to be consistent with future as well as present needs. Decisions on resource consumption, technological innovation, and institutional orientation have to be consistent [6]. As far as organizations are concerned, sustainability is defined as increasing their economic value with the responsibility towards the society and the environment. Sustainability is through its triadic nature that encompasses economic, social, and environmental dimensions [7]

A. Green IT

Lamb defines Green IT as the study and practice of using computing resources efficiently [8] and Webber and Wallace define Green IT as the reduced environmental impact from running an information technology (IT) department [9]. Some experts suggest that Green-IT is not only about reducing the environmental impact of IT use but also about using IT as an enabler for businesses to reduce their carbon footprint [10]. San Murugesan states that It's the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment. 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" [3]. Green IT is a systematic application of environmental sustainability criteria to the design, production, sourcing, use and disposal of the IT technical infrastructure as well as within the human and managerial components of the IT infrastructure in order to reduce IT, business process and supply chain related emissions and waste and improve energy efficiency [11] [12].

In general, it is said that there are two factors behind the motivations to go Green [13]. First, the scarcity of natural resources demands better solutions. Second, the stakeholders' environmental awareness, and thus demand for greener solutions, is increasing. It is noticeable that these two factors are intertwined. There are two challenges for IT managers [14]. First they need to reduce the IT related energy use, greenhouse gas emissions, inefficiency in equipment usage and wastes. Then they are expected to provide IT solutions to improve their environmental footprint in their business and supply chains.

B. Green IT framework

Green IT Framework developed by Connection Research has four aspects (pillars) of Green IT [15]. Green IT framework developed by Connection Research and Royal Melbourne Institute of Technology (RMIT) is shown in Figure 1. Equipment life cycle covers the procurement of ICT equipment, recycling or reusing and disposal at the end of its lifecycle in an environmentally friendly manner. ICT equipment, like all other equipment, passes through a lifecycle from manufacture, sale (if there is a sale, there is a purchase), usage and often reuse, and then disposal.

End user computing is the part of an IT process that is controlled by the end user. End user computing is especially important because it is the only part of IT that exists outside of the specialized IT function. There are four areas - desktop personal computing, mobile personal computing, departmental computing, and printing and consumables. Enterprise Computing is the part that is directly controlled by the IT department of an organization. It includes typically the data center, networking, software development and outsourcing. In organizations large enough to have a data center, the effective management of the data center equipment also be one of the most important aspects of Green IT. The real potential benefits of Green IT are in using ICT as an enabling technology to help the organization, and the wider community, reduce its carbon emissions.

C. Green IT readiness

Green IT readiness (G-readiness) as an organization's capability (and state of maturity) in applying environmental criteria to its IT technical infrastructure as well as within its IT human infrastructure and management across the key areas of IT sourcing, operations and disposal [4]. Green IT managerial capability of an organization is the management of all IT activities including strategic foresight concerning changes in the business, IT and wider environment [16]. It provides a basis for identifying and defining the IT managerial capability needed to transform toward a greener IT. The Green IT policy and Green IT governance are the components of IT managerial capability.

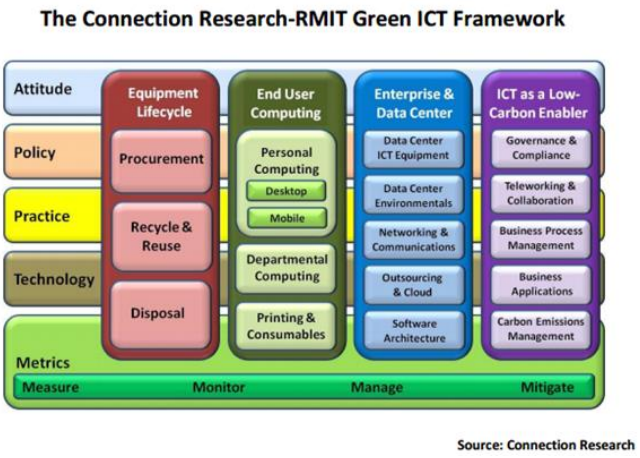

Figure 1Green ICT framework: Green ICT framework developed by Connection research and Royal Melbourne Institute of Technology

Green IT policy refers to the environmental criteria and frameworks an organization puts in place to guide the sourcing, use, and disposal of the IT technical infrastructure and the activities of IT people. There are many aspects to Green IT policy. There are lots of things we can do in employing energy efficient technologies and making effective usage of existing technologies, and there are many ways we can reduce the energy consumption and/or the carbon footprint of the organization. Any energy reduction policy needs to be holistic, coherent, and properly managed and monitored. A policy development framework includes the establishment of policies, the communication of those policies, the enforcement of those policies, and the measurement of policy effectiveness and mitigation strategies. A Green IT policy framework must be established to ensure Green IT becomes a business-endorsed program of work rather than a discreet IT project. It must take into account the required roles and responsibilities, skill-sets, commitments, targets, deliverables and methodologies used.

Green IT governance refers to the operating model that defines the administration of Green IT initiatives, the allocation of budget, and other resources and the metrics for assessing impacts. Roles, responsibilities, accountability, and control for Green IT initiatives need to be clearly established [17]. Businesses should determine whether the responsibility for Green IT initiatives should be assigned to Chief Information Officers (CIOs) or to environmental managers [18] [10]. Green IT governance also includes allocation of budget and other resources to Green IT initiatives and defining metrics for assessing the impacts of Green IT initiatives. Indeed, governance capability will require standard administrative processes for developing Green IT initiatives to be put in place.

D. Measuring Green IT

The Green IT Framework is a mature, tested and practical taxonomy which describes all aspects of Green IT. The next step is to apply metrics to each aspect of the framework to measure an organization's level of capability in that aspect. Organizations need to define the metrics in order to measure their Green IT readiness level. "You can't manage what you can't measure", says the old business maxim. An effective Green IT strategy should clearly identify reduction measures in such areas as achieving energy savings, reducing carbon emissions and improving recycling efforts.

III. METHODOLOGY

Literature review is the main source to structure the empirical model and methodology. It mainly discusses about the scope of the research, empirical model, research method and data collections

A. Scope

Green IT is applicable for all organizations that use IT in any of their business processes; however this research focuses on the IT organizations in Sri Lanka, because IT and IT equipment are heavily used in these type organizations when compared to other type of organizations. Mostly all of the employees are equipped with IT equipment in these types of organizations. In other organizations there may be IT departments and that may not heavily being used as in the IT organizations. In each IT organizations, IT managers are the target groups of this research as this research wants to explore the Green IT managerial capabilities of the organizations. IT Software industry and IT Business Process Outsourcing (BPO) organizations are considered IT organizations in this research as their core business is Information Technology.

B. Empirical model

Based on the literature review, Green IT managerial capability consists of Green IT policy and Green IT governance. Organizational sustainability and IT sustainability are considered in the Green IT policy and strategic foresight and green matrices for monitoring Green IT are considered in the Green IT governance as described in the Figure 2.

C. Methodology

In order to achieve the objectives of the research, a survey method is followed among the IT managers of the IT organizations in Sri Lanka. Likert scale survey is used to quantitatively determine the current level of Green IT managerial level.

To determine Green IT Readiness level, a survey is the best choice, because senior IT managers would not like to spend time with a long and time-taking questionnaire, and Likert scale based responses make it easier for them to answer a long questionnaire. Survey helps to capture a picture of a situation at a specific point of time and the possibility of large sample size allows making generalizations [19].

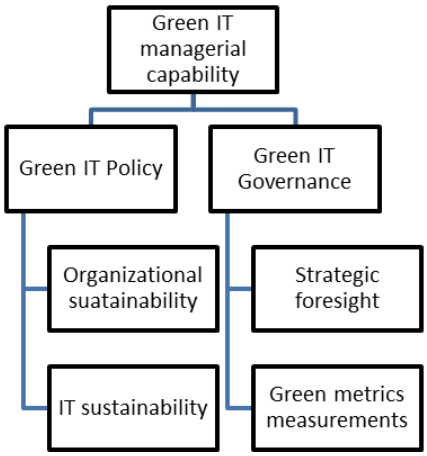

Figure 2 Empirical model: Empirical model of the Green IT managerial capability

Green IT readiness survey

Based on the above conceptual model, a survey was prepared in a way that all the components of the conceptual model were included in that questionnaire.

The survey is used to determine the actual level of Green IT Readiness level in IT organization in Sri Lanka. It was carried out in 2014 as a web based survey. The data was analyzed using XLSTAT. The questionnaire was created as an online questionnaire using Google form. The respondents were sent an e-mail with a short note introducing the study. Reminders were sent to those ones who did not respond to the questionnaire within some period. Most of the time telephone calls were made to remind the questionnaire. The questionnaire was targeted to reach CIOs or their equivalents to answer.

D. Data Sample and responses

As this research is focused on the IT organizations in Sri Lanka, the list of IT organizations data were collected from one of the IT organizations' associations in Sri Lanka. The database contained the details around 151 Sri Lankan IT organizations. IT organizations those have been considered in this research have two major categories; IT Companies and IT Business Process Outsourcing (BPO)/ IT Enabled Services Sector (ITES) Companies

A total of 32 responses were received. The responses from 18 IT software organizations and 14 IT BPO/ ITES organizations were received. The response rate is comparable to response rates of other studies targeting senior executives. The response rate of this research is 21%, which is lower than a suggested good response rate of 36% (+/-13%) [20]. However, the rate is in line with majority of research carried out with CIO level people [11] [14]. When compared to these results, the 21% response rate is better with earlier results carried out with CIO level people.

IV. RESULTS AND DISCUSSION

Current level of Green IT managerial capability can be calculated by calculating the average scores of each dimension, on a scale from one to four. This type of evaluation could be also done on company level if several administrative employees would rate the company and the scores would be then used to calculate the average scores and the managerial level.

A. Green IT policy

Green IT policy includes the policy level frameworks an organization puts in place in order to apply the Green IT concepts into the IT related activities. It defines the extent to which Green issues are encapsulated in organizational procedures that guide the life cycle of IT technical infrastructure and the activities of IT people.

Green IT Policy level is shown Figure 3. Engaging in social responsibility is the highest value (2.87) among other policy level measures. Especially BPO organizations have more interest in corporate social responsibilities. Organizations have concern about their environment and they are willing to contribute their society.

Other noticeable measure is that most of the organizations require their solutions to be web based solutions. It will cut down the packaging and transport related wastes. Packaging materials causes unfriendliness to the environment, the disposal of them may create problems. The amount of Carbon emitted to the environment will be reduced by cutting down travelling.

Most of the organizations (around 75 %) did not think about preparing a policy mechanism to measure their environmental performance of their IT suppliers as shown in Table 1. It implies that life cycle approach of IT equipment is not considered in the organizations. Procurement, recycle & reuse and disposal of IT equipment has the major effect on Green IT readiness.

B. Green IT governance

Green IT governance is the operating model that defines the administration of Green IT initiatives and it is closely related to the policy. Roles, responsibility, accountability and control for Green IT initiatives need to be clearly established.

All of the factors that affect Green IT governance are less than the value of 2 as shown in the Figure 4. Even though IT management discusses Green IT issues as priority, they did not give the high priority to Green IT. It is not implemented or considered as best practices in the organizations. Organizations did not show interest in making Green IT practices into their daily business processes and employees' day to day life. BPO organizations have little greater concern in following ISO 14000 (environmental management) framework than the other types of organizations.

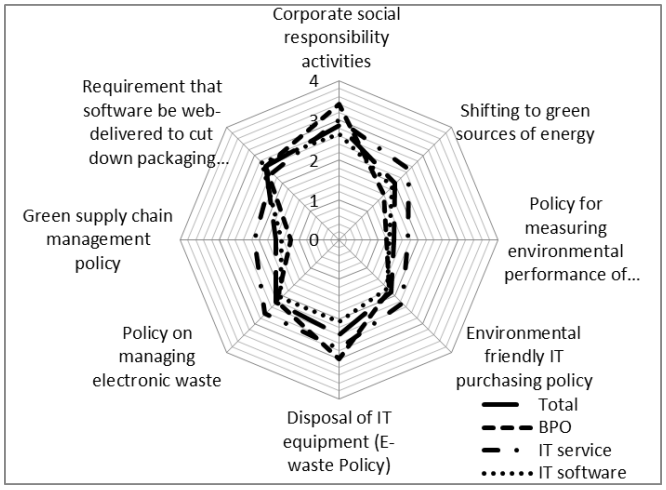

Figure 3 Green IT policy level: Green IT policy level of IT organizations in Sri Lanka

Table 1 Green IT policy responses: Responses for the question organizations who have a policy to measure IT supplier's environmental performance.

	Frequency	Percentage (%)	Cumulative Percentage (%)
1= Has not considered	23	74.3	74.3
2= considering, but not adopted	5	16.1	90.4
3= adopted, but not implemented	2	6.4	96.8
4=adopted, implemented	1	3.2	100

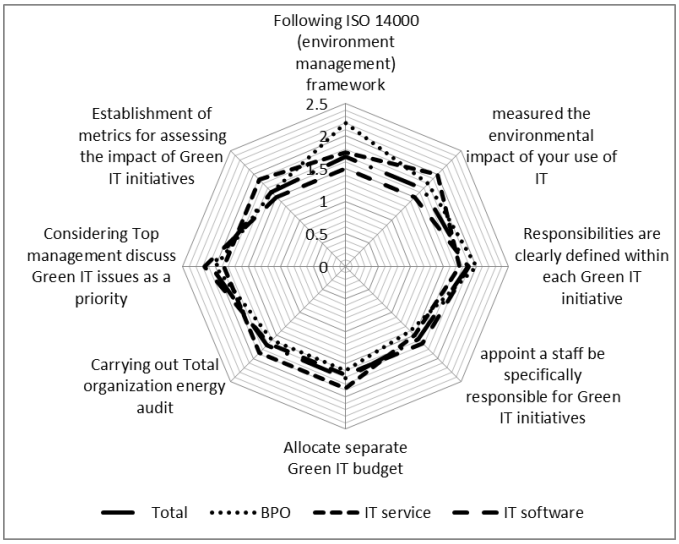

Figure 4 Green IT governance level: Green IT governance level of IT organizations in Sri Lanka

C. Implications of the study

Organizations in Sri Lanka started focusing on implementing Green IT practices. It is important to analyze the current level of Green IT managerial capabilities of the organizations before initiating Green IT practices. Organizations should first start with the policy level design of the Green IT. It should form a Green IT governance body of the organizations to handle the Green IT issues. Roles and responsibilities should be define clearly.

This study first identifies the factors affecting Green IT managerial capabilities based on the Green IT framework developed by Connection research and RMIT University. We have developed a conceptual model for Green IT managerial capabilities from the literature reviews and validated it. Those factors and the conceptual model can be used for the future researches of Green IT managerial capabilities. Then it identifies the areas that need to be improved to raise the Green IT management capabilities in IT organizations in Sri Lanka. Finally it suggests some guidelines for the IT organizations to improve their Green IT managerial capabilities.

The Green IT managerial capabilities survey was mainly limited due to the small sample size. The results of the current operationalization of the model do not represent IT organizations comprehensively. So the generalization was not made in the conclusion of the research. This research made the recommendations for the IT organizations in Sri Lanka.

V. CONCLUSION AND RECOMMENDATIONS

The factors affecting the Green IT managerial capabilities are identified in the literature review. They are equipment lifecycle, end user computing, enterprise & data center and ICT as low carbon enabler. Equipment life cycle includes procurement, recycle and reuse, disposal of ICT system and end user computing that includes personal computing (desktop & mobile), departmental computing, printing and consumable. Enterprise computing contains data center equipment, data center environment, networking and communication, outsourcing and cloud computing. ICT as a low-Carbon enabler includes governance and compliance, tele-working and collaborating, business process management and carbon emissions management.

A. Green IT policy

Green source of energy policy, environmental friendly IT purchasing policy and policy for measuring environmental performance of IT suppliers are in lower level as shown in the result. Organizations should think of total cost of ownership rather than looking at the lowest price of products. This mentality needs to be changed in the Sri Lankan IT organizations. They should go for purchasing or implementing sustainable long term solutions.

Organizations have concerned on disposal of IT equipment and on managing electronic wastes, but lacking in looking for Green sources of energy. They should focus on changing to sustainable energy sources like solar power and reduce the total cost of ownership and bad effect to the environment caused by the electricity generation.

B. Green IT governance

Based on the analysis in the result section, IT organizations have adapted environmental management framework (ISO 14000) for some extend. But top management is not interested in allocating separate Green budget, carrying out total energy audit and measuring the environmental impact of IT usage.

Organizations did not have a proper framework to define the responsibilities for the Green IT initiatives. They did not have a separate staff especially responsible for Green IT initiatives. They do not establish metrics for assessing the impact of Green IT initiatives. The Green IT governance is in lower level in Sri Lankan IT organizations. They should think of establishing a management structure for Green IT initiatives, measure the environmental impact and they should emphasis the energy audit to improve energy efficiency.

VI. RECOMMENDATIONS

The Green IT readiness model offers a common platform for practitioners to assess and benchmark their Green IT initiatives and progress. Assessment of a current state is an essential step in any strategy development. The Green IT readiness model offers both a framework and an assessment tool to strategize for Green IT. The instrument serves as a means for organizations to benchmark themselves against other

organizations and in particular against firms in the same industry.

A. Green IT as life cycle approach

Based on the analysis in results section, and the conclusion in the discussion section, organizations do not follow a life cycle approach. IT organizations should adapt some proven energy saving practices such as virtualization, print optimization, rightsizing IT equipment and equipment recycling.

IT organizations should focus on total cost of ownership of a product. Total cost of ownership is the total costs that involved from the point of purchasing the item to the disposal of that item. Total cost of ownership includes the cost involved in disposal of the item also [3]. Then the requirement for take back the equipment at the end of the lifetime of that equipment should be considered. Green track record of suppliers and clients should be considered in the business process of IT organizations.

B. Green IT as a continuous process

Continuous observations on Green IT are required for an organization. Green IT implementation should not be a onetime process. It should be a repetitive and feedback driven process. Organizations need to define the key performance indicators of their own value and measure the indicators similar to the one Connection Research identified. They might not be a unique unit for the measurements, but they should be measureable.

The Green IT readiness model will allow IT managers to approach Green IT not only from the IT technical infrastructure perspectives but also from the IT human infrastructure and IT managerial capability perspectives. Further, the Green IT readiness model is based on the lifecycle approach covering IT sourcing, operation, and disposal, rather than viewing Green IT.

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