Green IT: The Perspective of IT Professionals

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Abstract
Public awareness about environmental issues has risen as a result of scientific research and reports published in the field. Discussions are ongoing mostly on global warming, greenhouse gas emissions and increasing energy consumption. Information Technology (IT) plays a key role among these discussions due to its negative impact on environment. Within this context, Green IT becomes essential to return these negative impacts into positive by focusing on hardware, software and process dimensions of the challenge. Producing with renewable energy and less harmful materials, utilizing green data centers and smart management of disposal processes will directly reduce total carbon footprint of an organization. In recent years, organizations' consciousness on environmental problems has increased steadily, besides, IT professionals' role on environmental sustainability, through Green Transformation, gains importance. In this study, our concentration is primarily on the investigation of Green IT from the perspective of IT professionals. The awareness level and beliefs of IT professionals about Green IT were examined via an online survey. We have collected data from 257 IT professionals, who work at different sectors of an emerging market. The initial findings reveal that IT professionals have low levels of awareness. Furthermore, they suggest that green IT/IS usage is associated with eco-friendly devices & systems, and believe that green IT/IS usage reduces electronic waste and hazardous materials. The great majority of the respondents also assume that companies' green IT/IS device and application usage improves their corporate images. In addition, IT professionals indicate that green IT/IS can be used to reduce a business's total carbon foot print. It has been also declared that green IT/IS involves making efficient use of natural and company resources in order to reduce negative environmental impacts. Moreover, it is believed that companies utilize green IT/IS in order to improve corporate sustainability & social responsibility.

Keywords: sustainability, environment, green IT, IT professionals, beliefs, awareness level.

JEL classification: Q56.

1. Introduction

In recent years, there has been an increasing emphasis on sustainability and particularly greening of information technology (IT) in the business world. According to Time (2015), Apple declared that it would spend 1.7 billion euros ($1.9 billion) to build two data centers in Europe that would be entirely powered by renewable energy. Reportedly, the new centers are intended to meet what is expected to be a massive rise in demand for remote data storage in the medium-term, as both consumers and businesses come to depend more and more on Cloud-based technology (Time, 2015). Another technology giant Google stated that it's been using renewable energy to power 35% of its operations, and it's made agreements to fund over $2 billion in renewable energy projects (GoogleGreen, 2015). Likewise, global IT company Microsoft announced carbon neutrality through which it will offset emissions from all its direct operations by running up a multi-million dollar bill in the process (Murray, 2012). According to the report of Thinkprogress (2015), Apple, Google, and Microsoft are among the thirteen of the world's biggest and most powerful companies committed $140 billion in low-carbon investments and joined the U.S. Administration's "Act on Climate" initiative. Allegedly, Apple will build 140 MW of renewable energy whereas Google will continue on its path to 100 %

renewable energy (Thinkprogress, 2015). All these news and reports literally demonstrate that the big players of the IT industry take heed of the IT's impact on environment and human health. Admittedly, the IT industry does not consist of only these companies, and the efforts of these leading IT companies for a better environment is merely a small step for the welfare of future generations. Despite the increased importance of green IT from the governmental and practitioner perspectives, there is still scarcity of research in the academic world. Therefore, in this study it is aimed to have a comprehensive understanding of IT professionals' perspective about green IT. Hence, this research aims to shed light to the following questions:
a) What is the awareness level of IT professionals about green IT?
b) What are the beliefs of IT professionals about green IT?

2. Literature Review

Today, the business world has witnessed to the fast-paced evolution of technology, particularly information technology. Nevertheless, IT's impact has a yin-yang characteristic by nature; that is to say, on the one hand it inspires many industries and even changes our daily lives in an unpredictable way. On the other hand, it is accused of its negative consequences both on the environment and social life. IT has been criticized because of creating alienation and de-humanization, loss of privacy, leading to unemployment, and threating human health and damaging environment. The scope of our study is limited to the IT's impact on environmental sustainability. At this point, it will be beneficial to refer to the study of Chow and Chen (2009), in which the authors claimed that the sustainability of a green environment can be accomplished through three main approaches; social responsibility, environmental protection, and economic progress. Chow and Chen (2009) considered green computing as a crucial contributing factor to green environment. In his prominent study, Murugesan (2008, p. 25) defined green IT as "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". Bose and Luo (2012) agreed with Murugesan's (2008) green IT definition and asserted that this definition of green IT includes hardware assets, software assets, tools, strategies, and practices that help improve and enrich environmental sustainability. According to Murugesan (2008), green IT is composed of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling.

Former studies including both exploratory and empirical, looked into Green IT/IS awareness level and beliefs from different perspectives. One of the investigation areas of Green IT/IS is beliefs, attitudes, motivations and behaviors of individuals to achieve a more sustaining environment. Molla, Abareshi and Cooper (2014) focused on IT professionals in their study and found that their Green IT beliefs, attitudes, information acquisition capabilities and organizations fields influence their behavior. The authors concluded that the majority of the IT professionals are concerned about climate change and Green IT belief is a strong predictor of attitude toward Green IT, which can lead to pro-environmental IT practice (Molla, Abareshi and Cooper, 2014). Widjaja, Mariani, and Imam (2011) looked into the awareness level of IT professionals in Indonesia in order to fulfill the lack of research about Green IT in stated region. They mentioned that IT professionals in Indonesia have already some concerns about climate change and power consumption of IT however; there is still a lack of implementation and action dimensions (Widjaja, Mariani, and Imam, 2011). Another study conducted by Chou and Chou (2012) identifies the components that influence how organizations evaluates the value of Green IT and proposes a Green IT value model. The authors suggested three components that contribute to Green IT value process, including awareness, translation, and comprehension.

This value model clearly presents the dynamics of green value configuration in the IT industry (Chou and Chou, 2012). In another research, Chow and Chen (2009) examined the belief and behavior of IT users in green computing in Hong Kong. The authors concluded that the attitude toward Green IT is the main factor to practice and perceived behavior control has the most influence on IT users to actual green IT behavior (Chow and Chen, 2009).

Coffey, Tate and Toland (2013) utilized institutional theory to frame a study of the factors which influence small and medium sized businesses (SMEs) to adopt Green IS/IT practices. The authors found a diversity of viewpoints that suggest that adopting a "one size fits all" approach for encouraging organizations to adopt Green IT/IS is unlikely to be successful. Since SMEs are the dominant form of business around the world and they are estimated to have total contribution of around 70% in terms of global pollution, understanding the issues affecting the adoption of Green IS/IT by SMEs has widespread significance for the global environment. It is suggested that a clear message is needed to be sent to SMEs by governments, larger players in the market-place, societies and consumers in order to express the expectation about Green IT/IS adoption (Coffey, Tate and Toland, 2013). In their recent study, Bisoyi and Das (2018) stated that green computing aims in attaining sustainable future by implementation of practices that uses computing resources economically and eco-friendly manner. According to Bisoyi and Das (2018), rise in usage of Internet, mounting power density of equipments, escalation in requirement of energy for maintenance of data center, precincts of power supply and access, low rate of server utilization, emerging consciousness about impact of it on atmosphere were among the factors motivating to adopt green computing. In another research, Leung et al. (2018) have investigated the Green IT (GIT) behavior of young consumers including their day-to-day GIT practices, and buying behavior of computer devices and streaming services. The findings of their study demonstrate that: understanding of GIT knowledge has a positive influence on PBC.

3. Research Methodology

Since Green IT/IS has a role to revert the negative impacts of technology, transforming business and adopting green IT/IS becomes essential. During this transformation, IT professionals play a key role, hence this paper mainly concentrated on the awareness level and beliefs of IT professionals about Green IT/S. As stated above in the introduction part, we attempted to explore the awareness level of IT professionals about Green IT/IS, and the beliefs of IT professionals about Green IT/IS. In this research, the data were collected from 257 participants who were working at the IT departments of both national and international corporates. Both an online and paper based questionnaires were generated and they're either delivered to the IT departments via e-mail or in-person. The online version of the survey was formed through Google Forms application, and the survey was displayed for three weeks and was distributed to online groups, and invitations for filling the form were sent to email addresses of IT departments of companies. The survey link was also shared on Facebook and LinkedIn accounts of the authors and displayed at some IT related web pages as well. The survey consisted of different questions which were intended to measure the IT professionals' awareness level of and beliefs about Green IT. At the end, we've reached to 257 usable and fulfilled questionnaires. The participants were from companies in distinct sectors including telecommunications, banking, consumer electronics, retailing, health, and etc. The respondents had different levels of experience in their occupations so that some were senior level IT professionals whereas some were junior. On top of the questionnaire, a brief description of Green IT was given by referring to the study of Murugesan (2008) as follows: "the practice of designing, manufacturing, using, and disposing of computers, servers, related devices and

software & processes running on these hardware products and practices with minimal or no impact on the environment".

3.1. Research constructs and measurement

The first part of the questionnaire included questions that are aimed to measure the awareness level of respondents, six items were utilized in this section from different sources (Widjaja, Mariani, and Imam 2011; Molla, Abareshi and Cooper 2014; Murugesan 2008). Second part of the survey contained questions regarding respondents' beliefs about Green IT, and we've used 28 belief items, which were generated or adapted from several sources in the literature (Koo, Chung and Nam 2015; Molla, Abareshi and Cooper 2014; Elliot and Binney 2008). Both awareness and belief scales were measured by using five-point Likert Scale (5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree). Last part of the survey was composed of demographic questions that profile the respondents in terms of age, gender, education, and experience.

4. Results

The demographic profile of the respondents in terms of gender, age, education and experience in IT sector is illustrated in Table 1. As it is seen, 57% of the sample is composed of males, and 67% of the respondents belongs to the age group of 25-34. In terms of education, 57% of the participants has at least university degree. Finally, in terms of work experience, it can be asserted that the majority of the respondents have somewhat experience in the field.

Table 1. Demographic profile of the respondents

Demographics (n: 257)				
Gender	**Male**	**Female**		
	146 (57%)	111 (43%)		
Age	**18-24**	**25-34**	**≥35**	
	26 (10%)	173 (67%)	58 (23%)	
Education	**Univ. Students**	**University Degree**	**Graduate Level (MA/MS/PhD)**	
	13 (5%)	147 (57%)	97 (33%)	
Experience	**< 2 years**	**2-5 years**	**6-10 years**	**> 11 years**
	65 (25%)	72 (28%)	70 (27%)	50 (20%)

4.1. IT professionals' green IT awareness level

IT professionals' green IT awareness level was measured by asking them to indicate their agreement or disagreement with a total of 6 statements on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). The Cronbach's α value of awareness scale is 0,890 which is above the prevalently accepted threshold level of 0,70. As seen in Table 2, "I know exact meaning of "Green IT/IS"." statement received the highest mean value among six awareness statements. However, the statement about subscribing to Green IT/IS e-mail distribution lists got the lowest mean value. This result can be inferred that the IT professionals have somewhat knowledge about green IT, however, they were not active in following the trends or improving their opinions on this topic.

Table 2. IT professionals' green IT awareness level

	Mean (x̄)	Std. Dev. (σ)
I know exact meaning of "Green IT/IS".	**2,97**	1,385
I purposely attend seminars/events about Green IT/IS.	1,90	1,089
I follow product announcements about Green IT/IS.	2,05	1,145
I regularly read articles/news about Green IT/IS.	1,76	1,005
I participate in Green IT/IS discussion forums.	1,51	,853
I subscribe to Green IT/IS e-mail distribution lists.	**1,47**	,862

4.2. IT professionals' beliefs about green IT

IT professionals' beliefs about green IT was measured by asking them to indicate their agreement or disagreement with a total of 28 statements on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). As it can be seen from Table 3, among the 28 statements, "senior management commitment is necessary for prevalence of Green IT/IS" has the highest mean value (4,19) and it is followed by "green IT/IS usage is associated with eco-friendly devices & systems" (4,18). The statement referring to exaggeration of Green IT benefits for building a positive image got the lowest mean value (2,55). Actually, this means that IT professionals have a strong belief in the role of senior IT managers' dedication for the adoption of green IT/IS in their organizations. In addition, what they understand from green IT/IS usage is related to eco-friendly devices and systems. In this sense, they may overlooked their personal consumption patterns, such as printing to both sides of the paper or turning off their computers.

Table 3. IT professionals' beliefs about green IT

	Mean ($\bar{X}$)	Std. Dev. (σ)
companies' green IT usage is highly related with governments' energy efficiency regulations.	3,51	1,166
green IT/IS penetration needs enforcement from industry associations	3,85	1,029
companies' green IT/IS usage is related with universal greenhouse gas regulations.	3,44	1,137
green IT/IS adoption is dependent on regulations on discarding e-waste.	3,46	1,057
government incentives are necessary for green IT/IS adoption.	4,14	1,016
green IT/IS can be used to reduce a business's total carbon foot print.	4,11	1,031
green IT/IS usage reduces electronic waste and hazardous materials.	4,14	,976
green IT/IS usage is associated with eco-friendly devices & systems.	**4,18**	,908
green IT/IS involves making efficient use of natural and company resources in order to reduce negative environmental impacts.	4,07	,935
economic value of using Green IT/IS is unclear for the companies.	3,30	1,098
green IT/IS solutions and products are expensive to purchase.	3,21	,937
green IT/IS solutions leads to energy cost reduction.	3,75	,923
cost of server energy consumption decreases through green IT/IS usage.	3,62	,973
green IT/IS products & solutions increases efficiency of powering IT/IS infrastructure.	3,76	,938
having sustainability strategy within the company helps the Green IT/IS penetration.	3,90	,907
senior management commitment is necessary for prevalence of Green IT/IS.	**4,19**	,947
IT management's role is very important for reducing IT's greenhouse gas emission.	3,92	,981
IT professionals play significant roles in helping businesses tackle their carbon foot print.	3,67	,981
green IT/IS adoption in a company is influenced by the actions of competitors.	3,79	,976
pressure or marketing from ICT vendors has an impact on green IT/IS usage in a company.	3,66	,984
clients' demand and pressure has an impact on applying Green IT/IS products & practices in a company.	3,86	,961
companies' green IT/IS device and application usage improves corporate image.	4,14	,958
benefits of green IT/IS are exaggerated for the purpose of building a positive image.	**2,55**	1,142
companies making investment in green IT/IS are more credible and trustworthy.	3,41	1,000
environmental leadership is obtained by companies making investment in green IT/IS.	3,86	,928
media (newspaper, TV, news) exposure about being green influences people about Green IT/IS usage.	3,75	1,028
what people have heard and seen in the Media (newspaper, TV, news) have an impact on green IT/IS usage.	3,85	,912
companies utilize green IT/IS in order to corporate sustainability and social responsibility.	4,01	,919

5. Conclusions and Managerial Implications

In the last decade, green IT has become one of the most essential issue for the businesses and governments around the world as computing becomes progressively pervasive. Green IT, which is also called as green computing, is assumed as the practice and study of environmentally sustainable computing. In this study, we particularly focused on the

perspective IT professionals since mostly they either demand an adoption to green IT/IS if they've less experience in their profession or decide to transform the whole system into green computing due to their seniority in their occupation.

The results of this study have pointed out that IT professionals mostly know the meaning of green IT, however, when other statements are examined it is found that IT professionals' awareness level is quite low. It's also seen that there's a high tendency among the IT professionals in terms of senior managers' commitment to convert the business system into the green computing. It is also believed that green IT usage is associated with eco-friendly devices & systems. Findings have highlighted that benefits of Green IT, such as its impact on reducing electronic waste and hazardous materials or decreasing a business's total carbon foot print, have been recognized by IT professionals. Furthermore, IT professionals believe that government incentives are necessary for prevalence of green IT. On the other hand, the statement of "benefits of green IT/IS are exaggerated for the purpose of building a positive image" has received the lowest mean value. Actually, this is something exciting, since this means that professionals really believe in the benefits of green IT and they are not inclined to think that all the attempts are just for green-washing. Similarly, the second lowest mean value belongs to the statement of "green IT/IS solutions and products are expensive to purchase". IT professionals may perceive that although green products have relatively higher prices than traditional IT products, it really worth to choose the green option, since in the long run not only the company but also the society as a whole may take advantage of this choice.

6. Limitations and Suggestions for Future Research

This study is limited to understand the general motives of IT professionals from different sectors and different seniority levels. In the upcoming papers, we plan to group these motives under major factors by utilizing factor analysis, however, to do this we expect to increase the sample size of the current study. In addition, further research is needed to explore the effect of beliefs to determine the attitudes toward Green IT, and behaviors that are related to the attitudes need to be studied. Moreover, relationship between experience level and beliefs can also be examined. That is to say, we try to analyze whether seniority of the professionals has an impact on their attitudes towards green IT. In addition, it is equally crucial to investigate the personality traits of IT professionals who have tendency to actualize the transformation of green computing.

Since this study is the preliminary part of our research, we plan to increase the number of respondents to our survey and utilize detailed multivariate analysis techniques in order to group the factors that identify the motives of IT professionals about green IT. We'll also examine whether there's a relation between experience level of IT professionals and their attitude toward green IT/IS. In addition, willingness to pay more for green IT devices and systems will be also explored. Finally, it will be beneficial to inspect whether there're differences between IT professionals who adopt and who do not adopt green computing in their organizations in terms of their personality traits.

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