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GREEN ICTS' AWARENESS AND ADOPTION: A CASE STUDY OF UNIVERSITY FRESHMEN IN THAILAND

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Abstract

'Green' is the word that both individuals and groups in the world focus. Green ICTs is also now stated to be one of strategic technologies because of their benefits in terms of decreasing expenses, creating good corporate image, and mitigating climate change from greenhouse gas emissions. However, the acceptance and use of green ICTs are still not prevalent, especially in the developing countries where poverty and growth problems have to be remedied first. Cooperation among all countries is important to perfectly solve the problems. Young generations in particular are important forces to cope these problems. Therefore, by using the case of university freshmen in Thailand, the study's objectives are to investigate the awareness and the acceptance of children on green ICTs, to explore the knowledge that they have regarding to the green ICTs, and, to search causes of green ICTs' acceptance or rejection. The results from the study are expected to support building the green ICTs usage in youths.

Keywords: Green ICTs, Awareness, Adoption.

1 Introduction

Currently, global warming is a problem that everyone has focused. The main cause of the issue is claimed to be greenhouse gas (GHG) emissions, especially carbon emissions. While other industries release 98 per cent of total pollution, the ICTs industry, which possesses 2 per cent of carbon emissions (Woodhead 2007), faces big challenges in terms of reducing carbon emissions. Green ICTs are ranked by Gartner to be one of top ten strategic technologies for 2010 (Gartner 2009). They cover broad activities not only product acquisitions but also product designs, product usages, and product disposals (Murugesan 2008). Many green products, technologies, cooperative actions, models, and solutions are introduced by both public and private sectors (ACS, 2007; Elliot, 2007; Eric, 2008; Forge, 2007; Griffith University, 2006; Murugesan, 2008; Harris, 2008; OECD and Danish Ministry of Science, Technology and Innovation, 2008; UCSU Environmental Center, 2009). Nevertheless, these green ICTs are not yet prevalent in developing countries which are not directly forced to implement the green ICTs ideas. Actions of individuals, especially youths, are the most important to solve problems because people are the key to make every green solution succeed (Pauw and Petegem, 2010; Diamantopoulos et al., 2003; Wesley, 2011; Connell et al., 1999). However, only few researches study how to make them aware and adopt the green ICTs. Thus, this paper is aimed to assess the awareness of university freshmen on green ICTs, to find that how do they think about their importance, to explore applications of the green ICTs by children, and to explain the reason whether they adopt the green ICTs or they do not, using qualitative study.

2 Literature Review

2.1 Green ICTs Products and Technologies

Considering *green products*, many leading international companies present innovative products and projects; for instance; Samsung creates Blue Earth cell phones, IBM initiates Big green project, HP introduces green line products, Sun Micro Systems builds energy-saving data centres, 3Com sells green networking equipment, etc. (Murugesan 2008; ThaiPR.NET 2009a, ThaiPR.NET 2009b). Considering *green technologies*, innovative technologies e.g. eco-hardware, automated power control programs, server virtualization, thin clients, integrated telephony, efficient storage systems, paperless office, fiber-based broadband infrastructures, etc. are provided and applied by many organizations (ACS, 2007; Forge, 2007; Griffith University, 2006; Harris, 2008; Lloyd, 2008).

2.2 Green ICTs Cooperative Actions

Considering *green collaborations*, United Nations play an important role in solving global warming (UN, 1997; UNEP, 1972; UNEP, 2005). Various organizations increase their focuses on searching for or supporting green solutions (ACS, 2007; Greenpeace, 2005; Greenpeace, 2006; Harris, 2008; OECD and Danish Ministry of Science, Technology and Innovation, 2008; TGO, 2009). Considering *international agreements*, the Basel Convention was signed in 1992, to be an international concordat among 150 countries that agree to reduce the transportation of hazardous waste (UNEP, 2007a; UNEP, 2007b). Five years later, the Kyoto Protocol was introduced to conclude obligations of developed countries, 37 industrialized countries and the European community (UN, 1997). Recently, 192 countries participated in the United Nations Climate Change Conference (COP15) on December 7 to December 18, 2009 to discuss about another agreement to replace the Kyoto Protocol which will be ended in 2012 (OECD and Danish Ministry of Science, Technology and Innovation, 2008; UN 2009). Considering *regulations*, the Waste Electrical and Electronic Equipment (WEEE) and the Reduction of Hazardous Substances (RoHS) regulations are enforced by the European Union (Forge, 2007;

Murugesan, 2008). Considering *standards and guidelines*, the ISO 14000 family addresses the important issues of environmental managements which are supporting systems, requirements, and general guidelines (NCC, 2008; ISO, 1996). ITIL implicitly supports the green issues by taking environmental costs into IT value (Rick, 2008). Triple bottom line (TBL) is an accounting system which is considered in aspects of social and environmental in addition to financial perspective (Brown et al., 2006; Old Mutual, 2009). The Leadership in Energy & Environmental Design (LEED) is an international certification system which categorizes the levels of environmental support. The Electronic Product Environmental Assessment Tool (EPEAT) is the rating standard ranking electronic products based on toxics reduction, recycled content, energy efficiency, ease of recycling, etc. (Murugesan, 2008).

2.3 Proposed Solutions and Models

Considering *models*, Eric (2008) introduces the model to set up enterprise-level green strategy. The model specifies that the green strategy should influence decisions on all strategies. Molla et al. (2009) proposed the green IT readiness model to express an organization's capability for green ICTs in five dimensions: attitude, policy, practice, technology and governance. Considering *frameworks and roadmaps*, Cooper and Molla (2010) create a GITOL framework to describe the capability of enterprise wide sustainability management spreading from individuals to groups and organizations. Thongmak (2010) also presents a framework for implementing green ICTs in developing countries. The framework guides systematic collaborations and actions among the developed world, the public sector, the private sector, and individuals within those countries. The roadmap for green ICTs for environmental sustainability is defined by Ahola et al. (2010). It is divided into 3 themes along with sub-roadmaps that are empowering people, extending natural resources, and optimizing systems.

2.4 Youth and Environments

Considering *environmental attitudes and behaviours*, Pauw and Petegem (2010) studied the environmental attitudes of youth according to Inglehart's 'objective problems, subjective values'. The results at the individual level are similar to the literature such as the influence of gender, socio-economic background, cultural and educational resources, etc. on environmental attitudes. At the country level, the results show that both natural richness of country and its environmental problems positively affect youth environmental attitudes. Hicks and Holden (2007) conducted a survey to find out young people's needs for a future perspective. Primary children aged 11-years-old demanded more amenities, affordable housing, better relationships between people, less crime and violence in their local community. Secondary school students aged 14- and 18-years-old were concerned by poverty, unemployment, and environmental problems. Meinhold and Malkus (2005) pointed the significance of pro-environmental attitudes towards pro-environmental behaviours. Environmental knowledge was indicted as a significant moderating variable. Blanchet-Cohen et al. (2003) did an action research using visual maps to examine children's viewpoints on environmental issues. Ten themes reflecting children's understanding and behaviours are classified: initiatives, value statement, thinking, affective, doing, policing, lifestyle choices, education awareness, stop doing, and bad. Connell et al. (1999) studied the environmental attitudes of young people in Melbourne and Brisbane. The results showed the conflict between environmental concern and pessimism, along with some minor differences in students' attitudes of two cities. Worsley and Skrzypiec (1998) explored the environmental attitudes of senior secondary school students across 32 countries. Most students were concerned about environmental issues.

2.5 Various Technology Acceptance and Adoption Models

Theory of reasoned action (TRA) was presented by Fishbein and Ajzen (1975). The theory indicates that a person's intention to perform behaviour is determined by the *person's attitude* and *subjective*

norm. Theory of planned behaviour (TPB) was extended by Ajzen (1985). It describes that a person's behavioural intention is influenced by the *person's attitude, subjective norm, and perceived behavioural control. Technology acceptance model (TAM)*, the most widely used extension of TRA, was proposed by Davis (1989). It specifies that attitude toward using technology is impacted by *perceived ease of use* and *perceived usefulness*. *Theory of Consumption Values* was conceptualized by Sheth et al. (1991a, 1991b). It specified five categories of perceived value to comprehend how customers make market choices. Five categories are *functional values, social values, emotional values, epistemic values, and conditional values*. *Innovation Diffusion Theory (IDT)* was introduced by Rogers (1995). It classifies individuals into five segments according to individuals' innovativeness: innovators, early adopters, early majority, late majority, laggards. The adoption rate of innovations depends on *relative advantage, compatibility, trialability, observability, and complexity*. Unified *Theory of Acceptance and Use of Technology (UTAUT)* was developed by Venkatesh et al. (2003). It unifies constructs from TRA, TPB, TAM, IDT, Motivational Model, Model of PC Utilization, and Social Cognition Theory. Key constructs are *performance expectancy, effort expectancy, social influence, and facilitating conditions*. Gender, age, experience, and voluntariness of use moderate the impact of key constructs on a person's behavioural intention. *Green IT Adoption Model (GITAM)* was presented by Molla (2008). It identifies 3 drivers of green ICTs for organizations: economic driver, regulatory driver, and ethical driver. *Economic driver* refers to the need for greater IT efficiency and the pursuit of tangible cost savings from IT operations. *Regulatory driver* refers to the pursuit of legitimacy within the wider social context. *Ethical driver* refers to the pursuit of socially responsible business practices and good corporate citizenship.

3 Questions and Data Collection Methods

The qualitative data was collected from freshman students who registered the Management Information Systems course during June to September. This course is a required course for undergraduate students. Respondents came from all fields of study, not only from MIS field. Firstly, students were asked to write (in Thai) about their understanding of green ICTs without searching the green ICTs ideas elsewhere. Secondly, they were assigned to study more about the green ICTs concepts from paper or electronic sources. Lastly, they were asked to give facts and opinions about their awareness and adoption of green ICTs as follows:

- In your point of views, the green ICTs are important or not, how, and why?
- Please specify practical applications or your behaviors that support the green ICTs concepts.
- As answered above, why did you agree with the green ICTs concepts?
- Moreover, why did you disagree with the concepts?

4 Findings

Of the 64 students, 57 students participate on the set up topics (89% of all respondents), 35 females and 22 males. According to Hsieh and Shannon (2005), the conventional content analysis is suitable when existing theory or research literature is limited. Although there is some literature on youth and environments, theory or research about the green ICTs awareness and adoption is rare. So, this research applied the conventional content analysis to reveal the results. Burke-Johnson (1997) listed strategies used to promote validity in qualitative research. Triangulation is a strategy that cross-checks information and conclusions through the use of multiple procedures of sources. Theory triangulation is the use of multiple theories and perspectives to help interpret and explain the data. This work applied theory triangulation to do the validation.

4.1 Understanding about Green ICTs

Firstly, the university freshman awareness of green ICTs was surveyed based on various *green ICTs' definitions*. In the aspect of *green computing*, it is about reducing, reusing and recycling. It involves not only hardware but people as well. Green computing is basically the analysis and efficient use of organization's computer resources (Harris 2008). In the aspect of *green IT*, it is loosely defined as "the collective representation of IT products and practices that reduce environmental impacts by either leading to lower net emissions or reducing waste by-products" (Trepant et al. 2010). In the aspect of *green ICTs*, Gartner defined Green ICT as "Encompassing environmentally sustainable IT and the use of IT in order to contribute to environment preservation" (Popovski et al. 2009). OECD defined Green ICT as "the use of ICT to reduce environmental loads and the use ICT as a promoter to relieve social environment influences," and Ministry of Economy, Trade and Industry in Japan defined it as "Saving in ICT-related energy consumption and energy conservation through the use of ICT" (Forge et al. 2009). Shim et al. (2009) defined Green ICT as "reduction of energy consumption and environmental pollution through the use of IT". According to above definitions, almost all students (50 of 57 students) correctly explained what green ICTs are. However, some students (7 students) misunderstood the green ICTs meanings. Four of them took the view that the green ICTs are *harmless uses of ICTs*. Two students thought the green ICTs are *secured ICTs*. One respondent defined the green ICTs as *the preventive technology*.

4.2 Recognizing the Importance of Green ICTs

All respondents realize the green ICTs importance. Most people (41 persons) believe that the green ICTs are *very important*. The rest (16 persons) also agree that the green ICTs are *important*. *The reason of environmental problems* is in line with the influence of environmental problems on the environmental attitudes of Pauw and Petegem (2010), the benefit of responding to social and environmental responsibility requirements for a firm which enters green marketing (Simula et al., 2009), the green IT motivation about environmental consideration of the green IT motivation grid (Molla, 2009), and the benefit from reducing environmental impact (T-Systems, 2009). *The reason of pollution reduction* supports a reduction in infrastructure requirements due to green technology which leads to the environmental benefits (Accenture, 2009). *The reason of efficient energy consumption* correlates with improvements to the energy efficiency of IT facilities because of green technology (Accenture, 2009). *The reason of cost cuttings* is in line with the green IT motivation about IT cost reduction consideration of the green IT motivation grid (2009), economic benefits of green technology (Accenture, 2009), and cost savings from green ICT (T-Systems, 2009). *The reason of users or organizations' images* supports the benefit of better brand image and reputation for a firm which enters green marketing (Simula et al., 2009), the impact of a greener ICT in terms of good marketing (Hodges and White, 2008), and the benefit of appealing to all stakeholder groups from green ICT (T-Systems, 2009).

Reasons for specifying green ICTs to be important/ very important	Examples	Supporting respondents
Supporting environmental concepts, environmental friendliness/ concerning global environmental problems	"I think green ICTs are very important concepts because they manage and apply the technologies which are environmental friendly." [Boy#2]	Girl#2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32 Boy#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22 (Girls = 29 Boys = 21 Total = 50)
Reducing pollution from e-waste by recycling/ lowering greenhouse gas emission by not applying hazardous substances in ICTs production	"Green ICTs are very important to the world and environments in the aspect of e-resource recycling. A decreased content of greenhouse gases is attributed to a lower amount of	Girl#1, 2, 3, 5, 6, 9, 10, 12, 14, 15, 16, 17, 18, 20, 21, 22, 25, 28, 29, 30, 34 Boys#2, 3, 5, 6, 8, 10, 11, 13, 14, 15, 17, 18, 19, 20, 21 (Girls

Reasons for specifying green ICTs to be important/ very important	Examples	Supporting respondents
	<i>waste, easing up the global warming situation” [Girl#2]</i>	= 21 Boys = 15 Total = 36)
Diminishing energy consumption/ Increasing the efficiency of energy consumption	<i>“Adopting the technologies that consume less power in organizations, such as video conferencing, helps reduce the use of oil or natural gases for transportation purposes.” [Girl#24]</i>	Girl#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 20, 22, 23, 24, 25, 28 Boy#1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 14, 15, 18, 19, 20 (Girls = 23 Boys = 16 Total = 39)
Cutting costs of using traditional technologies/ Removing unnecessary costs by using energy-saving devices, software, or solutions/ lowering electricity charges/ cutting down expenditures by reuse or recycling	<i>“Green ICTs diminish unnecessary expenses by applying software or hardware solutions to save energy or to reduce energy loss.” [Girl#4]</i>	Girl#2, 3, 7, 8, 9, 11, 13, 14, 15, 22, 24, 29, 35 Boy#1, 6 (Girls = 13 Boys = 2 Total = 15)
Showing good appearances of users or organizations	<i>“It shows a good image of the user because it is an environmental-concerned technology.” [Boy#1]</i>	Girl#13, 15 Boy#1, 6, 16 (Girls = 2 Boys = 3 Total = 5)

Table 1. Reasons for giving importance to green ICTs

4.3 How and Why Applying or Not Applying Green ICTs

Applications of green ICTs ideas specified by respondents are grouped in two categories: product/ service selection and usage behaviour, as shown in Table 2. In addition to applying green ICTs concepts, many students stated that they apply other green concepts that are choosing reuse/ recycle papers, selecting green products such as paper bags, cotton bags, etc., walking/ biking/ carpooling/ using public transportation instead of driving or taking the stairs instead of elevators, reusing/ recycling unused products e.g. old clothes, computer boxes, and using renewable energy respectively.

Applications of green ICTs	Examples	Supporting respondents
Products/ Services selection:		
Choosing energy-efficient equipment or technologies e.g. LCD monitors, wireless networks, printers with double-side printing functions, multifunction devices, rechargeable devices, equipment complying with energy safe mode standards etc.	<i>“I choose a notebook with separated display adapters, which can switch back and forth between two cards. For normal usage, without the need of high graphic resolutions, I use an onboard video card. However, if I want to use a high quality mode, such as playing games and editing videos, my notebook will automatically switch to another card, which are more effective but consume more power as well.” [Boy#7]</i>	Girl#1, 3, 4, 6, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20, 22, 24, 25, 27, 28, 29, 31, 34, 35 Boy#1, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 16, 18, 19 (Girls = 23 Boys = 14 Total = 37)
Selecting electronic means to take notes, to communicate, and to store documents over traditional means e.g. word processing software, sticky notes software, e-mail, facebook, conference calls, hard disks, etc.	<i>“I use word processing software to create documents and hand them on to my teachers via e-mail or upload those documents for others to be used as working resources because I do not want to consume papers and to be beneficial for others too.” [Boy#1]</i>	Girl#1, 2, 3, 5, 7, 8, 9, 11, 13, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 29, 35 Boy#1, 5, 7, 8, 10, 12, 18, 19, 21, 22 (Girls = 22 Boys = 10 Total = 32)
Choosing old operable hardware/ software and replacing them only when necessary	<i>“I worthily use devices and not often change them, and I rarely buy fashionable items.” [Girl#2]</i>	Girl#2, 16, 23, 29, 35 Boy#10, 11, 18 (Girls = 5 Boys = 3 Total = 8)
Selecting new electronic appliances when they consume excessive power	<i>“I stop using obsolete appliances and turn to use other appliances, which consume less electrical powers.” [Girl#18]</i>	Girl# 19 Boy# - (Girls = 1 Boys = 0 Total = 1)
Usage behavior		
Unplugging or shutting down	<i>“I turn off electrical appliances that are not in use to</i>	Girl#1, 2, 4, 6, 8, 9, 10, 11,

Applications of green ICTs	Examples	Supporting respondents
continuously inactive equipment e.g. computers, screens, air-conditioners, batteries, etc.	<i>reduce the power consumption</i> ” [Boy#20]	12, 13, 14, 15, 16, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35 Boy#1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20 (Girls = 27 Boys = 17 Total = 44)
Activating power management features or adjusting the properties of electronic devices to save energy e.g. setting hibernate mode, applying blank screensaver, reducing screen brightness, configuring air-conditioner to be at 25 degrees Celsius	<i>“I set energy saving mode for my notebook to automatically enter the sleep mode whenever it is not in use for a period of time.”</i> [Boy#7]	Girl#1, 2, 6, 13, 20, 21, 22, 26, 27, 28, 29, 30, 32, 33 Boy#3, 4, 6, 7, 10, 11, 12 (Girls = 14 Boys = 7 Total = 21)
Reducing unnecessary electronic device usage	<i>“I use devices as much as necessary. For instance, I do not using cell phone to talk too much.”</i> [Girl#35]	Girl#4, 13, 14, 15, 18, 28, 30, 31, 32, 33, 35 Boy#1, 8, 17, 20 (Girls = 11 Boys = 4 Total = 15)
Separating e-waste to be easily managed or recycled garbage	<i>“I dump electronic equipment to the right place to lessen toxics contamination to nature and to reduce natural resources and energy loss from producing new ones.”</i> [Boy#2]	Girl#16, 27, 28 Boy#2, 15 (Girls = 3 Boys = 2 Total = 5)
Reusing electronic devices e.g. donating computers to rural areas or using them in other places	<i>“After acquiring a new computer, I did not throw my old computer away immediately. I reuse it at my office, to produce order forms, shipping documents, etc. because it still works properly for such purpose.”</i> [Boy#3]	Girl#13, 18 Boy#3 (Girls = 2 Boys = 1 Total = 3)
Promoting or telling others about green ICTs concept	<i>“I study further about the green ICTs concepts to tell the people around me.”</i> [Boy#12]	Girl#19 Boy#12 (Girls = 1 Boys = 1 Total = 2)

Table 1. Applications of green ICTs

The reasons why university freshmen adopt or refuse the implementation of green ICTs are summarized in Table 3 and Table 4 consecutively. *The reason of environmental concern* is in line with attitude on behaviour intention of TRE (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985), perceived of usefulness of TAM (Davis, 1989), relative advantage of IDT (Rogers, 1995), adolescents’ pro-environmental attitudes affecting adolescents’ pro-environmental behaviours (Meinhold and Malkus, 2005), environmental concern relating to environmental behaviours (Olli et al., 2001), environmental attitudes predicting the intention to take action for the environment (Chawla and Flanders, 2007), ethical driver for adopting green IT of GITAM (Molla, 2008), and emotional value of a theory of consumption values (Sheth et al., 1991a, Sheth et al., 1991b). *The reason of cost* supports attitude on behaviour intention of TRE (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985), perceived of usefulness of TAM (Davis, 1989), relative advantage of IDT (Rogers, 1995), and economic driver for adopting green IT of GITAM (Molla, 2008). *The reason of increasing devices’ lifetime* correlates with attitude on behaviour intention of TRE (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985), perceived of usefulness of TAM (Davis, 1989), relative advantage of IDT (Rogers, 1995). *The reason of convenience* is in line with attitude on behaviour intention of TRE (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985), perceived ease of use of TAM (Davis, 1989), relative advantage of IDT (Rogers, 1995), and functional value of a theory of consumption values (Sheth et al., 1991a, Sheth et al., 1991b) *The reason of following the green ICTs trends* supports attitude on behaviour intention of TRE (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1985), perceived of usefulness of TAM (Davis, 1989), observation ability of IDT (Rogers, 1995), injunctive norms affecting environmentally-friendly behaviour (Mintz, 2011), and social value of a theory of consumption values (Sheth et al., 1991a, Sheth et al., 1991b).

Reasons for applying green	Examples	Supporting respondents
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ICTs		
Concerning environmental impacts from not adopting the concept/ helping in environmental problem reduction e.g. excessively power consumption, natural resource depletion, etc.	<i>"The indirect benefits that will happen are good impacts on the world. It helps delay the global warming, reduce toxic emissions, from production processes, and diminish resource usage. Those things will be beneficial for human in several aspects e.g. good health, better weather, and so on."</i> [Girl#3]	Girl#1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35 Boy#1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 (Girls = 30 Boys = 22 Total = 52)
Reducing costs e.g. electricity, paper, new equipment, travel expenses, etc.	<i>"I apply the green ICTs ideas because of their cost savings; for example, using a laptop, I do not have to pay electricity bills as much as I have to do so for PC; using a sticky note program, I do not have to buy paper notes."</i> [Boy#1]	Girl#1, 2, 3, 4, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 29, 30, 31, 32, 33, 35 Boy#1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20 (Girls = 28 Boys = 17 Total = 45)
Increasing devices' lifetime by lowering usage	<i>"In terms of batteries, if they are used continuously without breaks or off periods, their lifetimes will be shorten because of consecutive being in high temperatures."</i> [Girl#1]	Girl#1, 4, 5, 22, 28, 30 Boy#6, 7 (Girls = 6 Boys = 2 Total = 8)
Convenience in producing outputs or speed in communications e.g. using e-mails instead of papers	<i>"I use the technologies because of their convenience; they save both time and money. I do not have to print all documents, so I do not waste inks or papers. However, I save them in a computer. When I want to talk to friends, I have no need to catch a car to see them, but I use MSN chat or Skype instead."</i> [Girl#7]	Girl#7, 17, 21, 25, 26 Boy#1, 22 (Girls = 5 Boys = 2 Total = 7)
Following the green ICTs trend/ maintaining good images	<i>"Green ICTs encourage good looking of both user and company in the sense of preserving the world"</i> [Boy#16]	Girl#5, 8, 11 Boy#16 (Girls = 3 Boys = 1 Total = 4)

Table 3. Reasons for adopting green ICTs

The reason of lacking of knowledge or not clearly understanding the green ICTs is in line with the effect of knowledge about environments on environmental attitudes (Pauw and Petegem, 2010), environmental knowledge which moderates adolescents' levels of pro-environmental attitudes (Meinhold and Malkus, 2005), the relation between environmental knowledge and environmental behaviours (Olli et al., 2001), environmental knowledge predicting the intention to take action for the environment (Chawla and Flanders, 2007), the importance of support for scientific solutions to environmental problems (Worsley and Skrzypiec, 1998), the importance of better environmental education systems (Wesley, 2011), the problem of the limited amount of green product groups (Mintz, 2011). *The reason of Ignorance or not realizing consequences from not using* is supported by effort expectancy of UTAUT (Venkatesh et al, 2003), people being hesitant to make environmental changes due to the belief that certain environmental issues may sacrifice freedom (Wesley, 2011), young people feeling powerless to do very much about environmental problems (Connell et al., 1999). *The reason of perceived high costs of acquiring green ICTs devices/ too few green ICTs products or too little variety* correlates with people being hesitant to make environmental changes due to the belief that certain environmental issues may sacrifice economic stability (Wesley, 2011), young people believing that it is often too hard or expensive for people to do more than they are already doing unless government and industry provided economically viable alternatives (Connell et al., 1999), consumer's attitudes depending on the current economic climate (Mintz, 2011), financial being the obstacle of engaging in environmental behaviours (Evans et al., 2007). *The reason of papers better suit for some works* are in line with complexity of IDT (Rogers, 1995), time commitments being the obstacle of engaging in environmental behaviours (Evans et al., 2007), conditional value of a theory of consumption values (Sheth et al., 1991a, Sheth et al., 1991b). *The reason of low performance of some green ICTs technologies* supports performance expectancy of UTAUT (Venkatesh et al, 2003), the expectation that environmentally friendly products must also perform competitively in other dimensions (Diamantopoulos et al., 2003), the expectation that organizations in the process of developing new green product offerings should ensure their products perform competitively in other dimensions (Schlegelmilch et al., 1996), and functional value of a theory of consumption values

(Sheth et al., 1991a, Sheth et al., 1991b). *The reason of social values* correlates with social influence of UTAUT (Venkatesh et al, 2003) and social value of a theory of consumption values (Sheth et al., 1991a, Sheth et al., 1991b). *Other reasons* are in line with facilitating conditions of UTAUT (Venkatesh et al, 2003).

Reasons for not applying green ICTs	Examples	Supporting respondents
Lacking of knowledge or not clearly understanding the green ICTs concepts, advantages, or supported technologies, etc.	<i>“Green ICTs may have not been sufficiently publicized or narrowly advertised. Many people have never heard of Green ICTs. I have just heard of it for the first time from the requirement to answer your questions. Formerly, not only did I understand what green ICTs are, but I also did-not know what behaviors conforming to the green ICTs.” [Boy#3]</i>	Girl#3, 5, 6, 8, 13, 14, 15, 16, 18, 19, 21, 23, 24, 27, 28, 31, 32, 33, 34, 35 Boy#3, 4, 7, 9, 11, 12, 14, 20 (Girls = 20 Boys = 8 Total = 28)
Ignorance or not realizing consequences from not using	<i>“I have never thought about it, or I fail to realize the effects of not applying green ICTs ideas, such as the shorter lifetime of hardware, additional energy costs and maintenance costs, etc.” [Girl#4]</i>	Girl#3, 7, 9, 10, 11, 13, 14, 15, 16, 17, 19, 20, 27, 28, 29, 30, 33, 35 Boy#4, 5, 8, 10, 11, 13, 14, 16, 17, 20 (Girls = 18 Boys = 10 Total = 28)
Perceiving that costs of acquiring green ICTs devices are expensive	<i>“There is a small amount of electronic devices complied with the green ICTs ideas. Moreover, they are too expensive, so I cannot afford them.” [Boy#2]</i>	Girl#5, 8, 10, 11, 12, 13, 18, 19, 22, 26, 27, 31 Boy#1, 2, 4, 5, 6, 7, 10, 13, 17, 18, 19, 20 (Girls = 12 Boys = 12 Total = 24)
Old equipment is still functioning.	<i>“Sometimes devices without energy-saving features are still operable. Although they consume so much energy, I would feel regret if I left devices which are still usable.” [Girl#1]</i>	Girl#1, 2, 11, 12, 20, 22, 26, 30 Boy#2, 5, 6, 7, 8, 9, 12, 13, 15, 18, 19 (Girls = 8 Boys = 11 Total = 19)
Papers better suit for some works e.g. taking notes something immediately, reading long articles, etc.	<i>“Sometimes it is inconvenient; for example, if I want to write something now, I will take the paper to write, as this is faster than keying into computers or mobile phones.” [Boy#1]</i>	Girl#2, 25, 26 Boy#1, 7, 10 (Girls = 3 Boys = 3 Total = 6)
Performance of some green ICTs technologies are not as good as old technologies e.g. laptops vs. PCs.	<i>“Some green-supported technologies are still incomparable to existing technologies. For example, some laptops do not perform as fast as PCs.” [Boy#1]</i>	Girl#2, 8, 13, 31 Boy#1, 19, 21 (Girls = 4 Boys = 3 Total = 7)
Social values, such as modernization, increase needs for buying new devices	<i>“The popularity of new versions of cell phones in the modern society points that my phone is outdated. This is a reason that I need to change. In addition, the influences of marketing and promotions dominate my thought to follow trends, such as changing the mobile phones and buying-new computers. This is because they support a variety of programs, or they facilitate us more. In fact, after replacing them, I do not use anything more than the previous version at all.” [Girl#3]</i>	Girl#3, 16 Boy# - (Girls = 2 Boys = 0 Total = 2)
Other reasons e.g. lack of e-resources, unsupported assignments, etc.	<i>“Some people or some assignments do not support to use this kind of technology; for instance, teachers want me to send printed reports rather than to deliver the reports by e-mails.” [Boy#1]</i>	Girl# - Boy#1, 22 (Girls = 0 Boys = 2 Total = 2)

Table 4. Reasons for refusing green ICTs

5 Research Limitations

This paper contributes to theory and practices in terms of green ICTs adoption factors. However, the sample size is quite small and is selected mainly from the student of a single Thammasat business school, Thammasat University. Also, all of respondents in the study are university freshmen, so the

sample limitations and generalization should be concerned. Conclusion from this study to the green consumer population should be made only in the tentative view.

6 Conclusion and Implications

This research explores the awareness and the acceptance of university freshmen on the green ICTs. The results demonstrate that most freshmen understand the meaning of the green ICTs, but they did not have a deep comprehension on their application. However, young generations pay much attention on socials and environments, which is reflected in the answers why focusing on green ICTs and the reasons to choose green ICTs solutions. Therefore, public and private sectors should provide them the green campaigns which highlight environmental safe objectives, helps in reducing pollutions, and resources consumption reduction. In terms of green ICTs application, adolescents do quite well in their product/ service selection and usage behaviour. However, many actions that they can involve more are still ignored. Those actions are requesting environmental responsibility from their country, asking organizations to act green, voting for political parties with environmental concern policies, giving creative ideas, suggestions, or opinions to communities, sharing the green ICTs practices among their colleagues, etc. Also, since university freshmen are not able to earn much money, so they should be encouraged to adopt green ICTs more by selling green products at low prices and promoting the cost saving benefits. Many people point out that they are not enough educated about the green ICTs. Thus, both public and private sectors should communicate more in terms of green ICTs overview, received benefits, and enabling technologies.

References

- Accenture (2009). Green Technology: Driving Economic and Environmental Benefits from ICT. World Economic Forum, Geneva.
- ACS. (2007). Australian Computer Society Policy Statement on Green ICT. Policy Statement, Australian Computer Society, Sydney, Australia.
- Ahola, J., Ahlqvist, T., Ermes, M., Myllyoja, J., and Savola, J. (2010). ICT for Environmental Sustainability: Green ICT Roadmap. VTT Tiedotteita - Research Notes 2532.
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action control: From cognition to behavior*. Springer-Verlag, Berlin, Heidelberg, New York.
- Blanchet-Cohen, N., R. Doug and J. Amsden (2003). Children Becoming Social Actors: Using Visual Maps to Understand Children's Views Environmental Change. *Environments*, 13 (2).
- Brown, D., J. Dillard, S. Marshall. (2006). Triple bottom line: a business metaphor for a social construct, Document de Treball núm. 06/2, Departament d'Economia de l'Empresa, Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès), Spain.
- Burke-Johnson, R. (1997). Examining the Validity Structure of Qualitative Research. *Education*, 118 (2), 282-286.
- Chawla, L. and Flanders, D. (2007). Education for strategic environmental behavior. *Environmental Education Research*, 13 (4), 437-452.
- Connell, S., Fien, J., Lee, J., Sykes, H., and Yencken, D. (1999). If It Doesn't Directly Affect You, You Don't Think About It': a qualitative study of young people's environmental attitudes in two Australian cities. *Environmental Education Research*, 5 (1), 95-113.
- Cooper, V. A. and Molla, A. (2010). Conceptualizing Green IT Organizational Learning (GITOL), RMIT School of Business IT Working Paper Series, 3.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13 (3), 319-340.
- Diamantopoulos, A., Schlegelmilch, B.B., Sinkovics, R.R., Bohlen, G.M. (2003). Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business Research*, 56, 465-480.

- Eric, G. (2008). Creating an enterprise-level “green” strategy. *Journal of Business Strategy*, 29(2), 22 – 30.
- Elliot, S. (2007). Environmentally Sustainable ICT: A Critical Topic for IS Research?. In *Proceedings of Pacific Asia Conference on Information Systems*, Auckland.
- Evans, G.W., Brauchle, G., Haq, A., Stecker, R., Wong, K., and Shapiro, E. (2007). Young Children's Environmental Attitudes and Behaviors. *Environment and Behavior*, 39, 635.
- Fishbein, M. and I. Ajzen (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Addison-Wesley, Reading, MA.
- Forge, S. (2007). Powering down: remedies for unsustainable ICT. *Foresight*, 9(4), 3 – 21.
- Forge, S., Blackman, C., Bohlin, E., and Cave, M. (2009). *A Green Knowledge Society: An ICT policy agenda to 2015 for Europe’s future knowledge society*. Final Report, September 2009.
- Gartner. (2009). *Gartner Identifies the Top 10 Strategic Technologies for 2010*, Gartner Press Releases, viewed 1 November 2009, <<http://www.gartner.com/it/page.jsp?id=1210613>>
- Greenpeace. (2005). *Toxic tech: pulling the plug on dirty electronics*. Full Report, Greenpeace International, Amsterdam, Netherlands.
- Greenpeace. (2006). *Hi-Tech: Highly toxic*. Full Report, Greenpeace International, Amsterdam, Netherlands.
- Griffith University. (2006). *Green Computing Guide*. Griffith University, Queensland.
- Harris, J. (2008). *Green Computing and Green IT Best Practices on Regulations and Industry Initiatives, Virtualization, Power Management, Materials Recycling and Telecommuting*. Emereo Pty Ltd, Brisbane.
- Simula, H., Lehtimaki, T., and Salo, J. (2009). Managing greenness in technology marketing. *Journal of Systems and Information Technology*, 11 (4), 331-346.
- Hicks, D. and Holden, C. (2007). Remembering the future: what do children think?. *Environmental Education Research*, 13 (4), 501-512.
- Hodges, R. and White, W. (2008). *Go green in ICT*, tech. rep., GreenTech News, 2008.
- Hsieh, H.F. and Shannon, S. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, 15 (9), 1277-1288.
- ISO. (1996). *ISO 14000 essentials, ISO 14000 – Environmental management*, International Organization for Standardization, Geneva.
- Llyod, C. (2008). *Environmental benefits of broadband*. In the *Workshop on ICTs and Environmental Challenges*, Copenhagen.
- Meinhold, J.L. and Malkus, A.J. (2005). Adolescent Environmental Behaviors : Can Knowledge, Attitudes, and Self-Efficacy Make a Difference?. *Environment and Behavior*, 37, 511.
- Mintz, T. M. (2011). *Profiling Green Consumers: A Descriptive Study*. Thesis, Walker College of Business, Appalachian State University, Boone, North Carolina.
- Molla, A. (2008). *GITAM: A Model for the Adoption of Green IT*. In *Proceedings of Australasian Conference on Information Systems*, p. 658-668, Queensland, Australia.
- Molla, A. (2009). *Organizational Motivations for Green IT: Exploring Green IT Matrix and Motivation Models*. In *Proceedings of Pacific Asia Conference on Information Systems (PACIS)*, Hyderabad, India.
- Molla, A., Cooper, V.A., and Pittayachawan, S. (2009). *IT and Eco-sustainability: Developing and Validating a Green IT Readiness Model*. In *Proceedings of the International Conference on Computer and Information Science (ICIS 2009)*, paper 141, Phoenix, Arizona, USA.
- Murugesan, S. (2007). *Going Green with IT: Your Responsibility toward Environmental Sustainability*. *Cutter Business—IT Strategies Executive Report* 10(8).
- OECD and Danish Ministry of Science, Technology and Innovation. (2008). *Workshop summary*. In the *Workshop on ICTs and Environmental Challenges*, Copenhagen.
- Olli, E., Grendstad, G., and Wollebaek, D. (2001). Correlates of Environmental Behaviors : Bringing Back Social Context. *Environment and Behavior*, 33, 181-208.
- Old Mutual. (2009). *Corporate responsibility: Frameworks and indices*. Old Mutual plc, London, viewed 30 March 2009, <http://www.oldmutual.com/vpage.jsp?vpage_id=2746>.

- Pauw, J.B. and Petegem, P.V. (2010). A cross-national perspective on youth environmental attitudes. *Environmentalist*, 30, 133–144.
- Popovski, P., Krigslund, R., Manev, B., and Pedersen, G. F. (2009). Green Communication: Where Can It Really Help and How It Is Related to RFID. In the 12th International Symposium on Wireless Personal Multimedia Communications, Sendai, Japan.
- Rick, F. (2008). How green is ITIL?. *ITadviser*, 54.
- Rogers, E. M. (1995). *Diffusion of Innovations*. Free Press, New York.
- Schlegelmilch, B.B., Bohlen, G. M., and Diamantopoulos, A. (1996). The link between green purchasing decisions and measures of environmental consciousness. *European Journal of Marketing*, 30 (5), 35-55.
- Sheth, J. N., Newman, B. I., and Gross, B. L. (1991a). *Consumption values and market choice: Theory and applications*. Cincinnati, OH: South-Western Publishing Co.
- Sheth, J. N., Newman, B. I., and Gross, B. L. (1991b). Why we buy what we buy: A theory of consumption values. *Journal of Business Research*. 22, 150-170.
- Shim, Y. H., Kim, K. Y., Cho, J. Y., Park, J. K., and Lee, B. G. (2009). Strategic Priority of Green ICT Policy in Korea: Applying Analytic Hierarchy Process. In *Proceedings of WASET International Conference on Environmental Systems Engineering*, Venice, Italy, 58, 584 – 588.
- TGO. (2009). CDM in Thailand. Thailand Greenhouse Gas Management Organization, Bangkok, viewed 1 September 2009, <http://www.tgo.or.th/index.php?option=com_content&task=category§ionid=4&id=15&Itemid=26>.
- ThaiPR.NET. (2009a). Sun opens new green data center. ThaiPR.NET , InfoQuest Limited, Bangkok, viewed 28 February 2009, <<http://www.thaipr.net/nc/readnews.aspx?newsid=722ECED1FB9F0755B93E2A12E7A1728A&query=IqvRuSDkweKkw6vUyuC158HK7CI=>>>.
- ThaiPR.NET. (2009b). ASUS Announces Halogen-free Product. ThaiPR.NET , InfoQuest Limited, Bangkok, viewed 28 February 2009, <<http://www.thaipr.net/nc/readnews.aspx?newsid=95BA165B3C28BC73CE523C28AB0E5285>>.
- Thongmak, M. (2010). Green ICTs for Developing Countries: A Holistic Framework and Research Directions. In *Proceedings of the 3rd Technology and Innovation for Sustainable Development Conference (TISD2010)*, Nong Khai, Thailand.
- Trepant, H., Shehadi, R. and Karam, D. (2010). *Demystifying Green IT: Seeding Advantage*. White Paper: Booz & Company.
- T-Systems, (2009). *Green ICT: The Greening of Business*, T-Systems White Paper, Bonn.
- UCSU Environmental Center. (2009). *Green Computing Guide*. University of Colorado-Boulder, Colorado.
- UN. (1997). *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. Kyoto Protocol, United Nations, New York, USA.
- UN. (2009). *The United Nations Climate Change Conference in Copenhagen, 7-19 December 2009*. The United Nations Climate Change Conference, viewed 28 February 2010, <http://unfccc.int/meetings/cop_15/items/5257.php>
- UNEP. (1972). *Rio Declaration on Environment and Development*. Rio Declaration, United Nations Environmental Program, Rio de Janeiro, Brazil.
- UNEP. (2005). *GEO Year Book 2004-2005: An Overview of Our Changing Environment*. United Nations Publications, New York.
- UNEP. (2007a). *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*. Basel Convention, Geneva, Switzerland.
- UNEP. (2007b). *Parties to the Basel Convention*. Basel Convention, Geneva, Switzerland.
- Venkatesh, V., Morris, M., Davis, G. B. and Davis, F.D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, 27(3), 425–478.

- Wesley, M. (2011). Environmental opinion in today's society. Environmental Science Senior Thesis, Kenosha, WI Exelby, HRA 1997, 'Aspects of gold and mineral liberation', PhD thesis, University of Queensland, Brisbane.
- Woodhead, B. (2007). Industry feels heat on global warming. Australian newspaper, viewed 30 May 2007, <<http://australianit.news.com.au/articles/0,7204,21633909%5E16681%5E%5Enbv%5E,00.html>>
- Worsley, A. and Skrzypiec, G. (1998). Environmental attitudes of senior secondary school students in South Australia. *Global Environmental Change*, 8 (3), 209-225.
- Zelezny, J. C., Chua, P. P., Aldrich, C. (2000). Elaborating on Gender Differences in Environmentalism. *Journal of Social Issues*, 56 (3), 443-457.