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The Determinants of Green ICT Adoption in Foreign Multinational Organizations in Malaysia

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Abstract

In the wake of increased need for business processes that promote environmental sustainability, many organizations have adopted Green ICT as way to promote environmentally friendly agenda. However, there is scanty information on Green ICT adoption in Malaysia especially by multinationals. More specifically, the existing research does not shed light on the factors that facilitate Green ICT adoption by multinationals in Malaysia. Therefore, it is vital to examine the various factors that could contribute to success in Green ICT adoption efforts by MNCs in Malaysia. The independent variables in this research comprise technology, environment, attitude and perceived usefulness of Green ICT. The theories that underlined this research consist of the Diffusion of Innovation (DOI), Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Stakeholder Theory (ST) and Institutional Theory (IT). In order to test the relationship between the theories and to establish the measurement model validity, the Confirmatory Factor Analysis (CFA) was used and Multiple Regression was used to test the hypotheses. The research design adopted for this research was explanatory and the target population was employees of multinationals in Klang Valley, Malaysia. The researcher collected data from the employees through online self-administered questionnaires and by hand survey questionnaires between July and August 2017. A sample of 138 multinational employees responses were collected using a pre-designed survey questionnaire based on the 5-point Likert Scale. The data gathered from the field from the questionnaires was recorded and coded into SPSS and AMOS for analysis. The findings revealed that environment, attitude and perceived usefulness have a positive

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significant impact on the adoption of Green ICT. Besides, the findings revealed that technology has no impact on Green ICT adoption. The outcome of the study will provide useful insights to Malaysian government to adjust the existing Green ICT policies at the national level and contributes to the growth of the future master plan.

Keywords: Green ICT Adoption, Technology, Multinationals, Malaysia

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Introduction

Researchers have explored Green ICT's reach in the world and its enablers and stumbling blocks have explored deeply in the western countries (OECD, 2010a) as well as in emerging economies (Shahin Dezdar, 2017). For instance, a study conducted by Cortmiglia (2012) sought to establish the ICT trends in Brazil and Green ICT was found to be a major trend in the country. Unlike prior studies which focused on single factors such as technological, organizational or environmental factors affecting Green ICT adoption (Bang-Ning Hwang *et al*., 2016), this study adopts a broader scope and focuses on all these factors as well as the impact of attitude and perceived usefulness towards Green ICT adoption.

The results of this research can be of use to the Malaysian government in adjusting the current Green ICT policies. Besides, the findings of this study would also be useful to multinational firms willing to contribute to ICT initiatives as it would give those guidelines on how to involve all stakeholders in Green ICT adoption in accordance with "*The 11th Malaysia Plan (2016-2020) - Communication, education and public awareness (CEPA)*" programme. The study will also provide a background and some new ideas to make the necessary changes to the existing Green ICT policies at the national level and at the same time contribute to the development of the future master plan.

The Specific Objectives of this paper are as follows;

1. To examine the impact of technology on green ICT adoption.
2. To examine the impact of environment on green ICT adoption.
3. To examine the impact of attitude on green ICT adoption.

To examine the impact of perceived usefulness on green ICT adoption.

Literature Review

Definitions of Key Concepts

Various researchers define Green ICT as actions aimed at protecting the environment (Lim Wei Ping, 2012 ; Laura-Diana Radu, 2016 ; Kavita *et al*., 2015; San Murugesan, 2008) by use of technology incorporating hardware, software and technology services (Molla, A, 2009) enabling companies to reduce energy consumption and costs of production.

Table 1: Definition of Key Concepts

Authors	Definition of Green ICT	Variable
Laura-Diana Radu, (2016)	"to reduce the negative effects of ICT usage on the environment and IT for green, ecological informatics, environmental informatics, and computational sustainability—for development and usage of applications dedicated to environmental protection"	Technology Environmental Sustainability Determinants Environmental Protection
Kavita Suryawanshia, Sameer Narkhedeb (2015)	"Green ICT is a pioneering way of using ICT that consists of policies and practices which deal with environment sustainability by minimizing carbon footprint, ICT waste and by optimizing energy consumption and by conserving natural resources for cost effectiveness, sustenance of ICT and to save planet"	Technology Environmental Sustainability Cost Effectiveness
Lim Wei Ping (2012)	"Sustainability in order to protect the economic, environment and social systems for the benefit of future generations"	Environmental Sustainability Economic Social systems
Molla, A (2009)	"an organization's ability to systematically apply environmental sustainability criteria (such as pollution prevention, product stewardship, use of clean technologies) 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."	Technology Environmental Sustainability Organization Human & Managerial
San Murugesan (2008)	"the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage	Technology Environmental Sustainability Organization Economic

	devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities."	Social Ethical

From the definition of Green ICT key concept above, researcher has extracted few key variables and provided its individual definitions in Table 3 below.

Table 2: Definition of Key Variables

Authors	Key Variables	Definition
Laura-Diana Radu (2016), Thongmak (2016), Hussain et. al. (2014), Wabwoba et.al. (2012), Weng and Lin (2011), David *et al*., (2011), Bachour & Chasteen (2010)	Technology	Green ICT adoption in an organization means using the available technology efficiently by considering the environmental impact, social responsibility and economic viability.
Laura-Diana Radu (2016), Hussain et. al. (2014), Chulmo Koo *et al*., (2013), Weng and Lin (2011), David *et al*., (2011)	Environment	Protecting the environment in terms of ICT involves the hardware and software development with very minimum influence towards the environment and/or improving the existing hardware and software to be more environmental friendly and using ICT to diagnose and solve environmental problems.
Thongmak (2016) Hussain et. al. (2014) Wabwoba et.al. (2012) Weng and Lin (2011) Molla, A (2009)	Attitude	Attitude states the extent of awareness and interest the leaders and professionals of an organization have on environmental sustainability. Whether the professionals have sufficient knowledge and skills to practice Green ICT.
Davis (1989)	Perceived Usefulness	Perceived usefulness acts as one of the determinants of Green ICT adoption by positively influencing people to accept and use the environmental friendly technologies. An individual will start accepting a technology when he/she believes that his/her job performance will get enhanced by using the technology and also when they realize the actual benefit of adopting the technology.

Conceptual Framework

Following the theories and empirical evidence above, it is prudent to state that technological, organizational and environmental factors play a vital role in influencing Green ICT adoption. Besides, an organization perception on a green technology's ease of use and relative usefulness affects the extent to which an organization will adopt environmentally sustainable operations (Chugh *et al*., 2016; Buchalcevova & Gala, 2013; Khor *et al*., 2015).

Figure 1: TOE Conceptual Framework

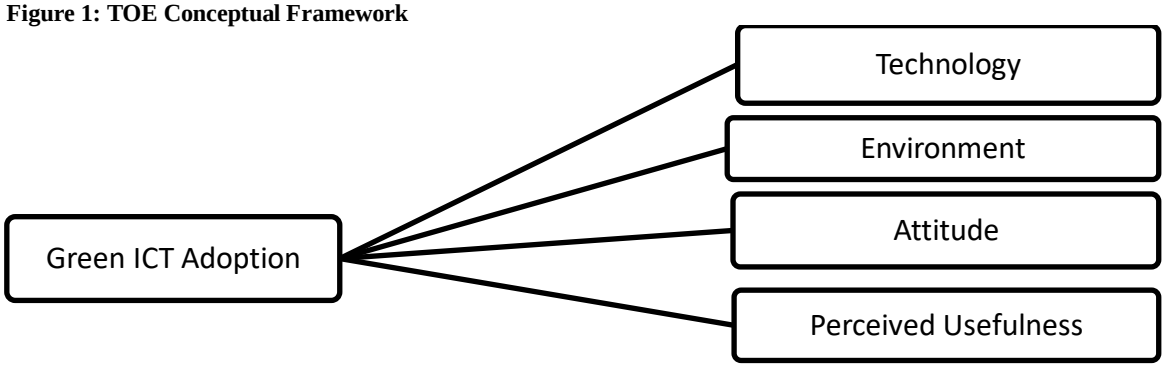

Figure 1: TOE Conceptual Framework

Adopted from Tornatzky & Fleischer (1990) and adjusted for the purpose of this research.

In the above conceptual framework, technology, organization environment, perceived usefulness and attitudes towards Green ICT by Multinationals are the sub-independent variables that affect adoption of the technology by international corporations.

Hypotheses

According to Tonartzky & Fleischer (1990), several characteristics of an innovation including ease of use and compatibility can influence Green ICT adoption since it is viewed as a complex practice to integrate in business operations. According to Wabwoba *et al*., (2012), an organization that is more technologically conscious is likely to adopt newer technologies compared to a conservative organization. Also, when the benefits of implementation and adoption are seemed to be less significant than the cost of technology implementation, most likely the ICT personnel would not consider the implementation (Wabwoba *et al*., 2012). This is further supported by Weng and Lin (2011) that there is high possibility for shareholders to discourage Green ICT adoption in view of the initial funds required to adopt and implement Green ICT. Besides, Alena, B & Libor, G (2013) found out that technology plays a key role in Green ICT adoption by companies and without it, implementation of Green ICT is not possible. According to Hussain *et al*., (2014) the advancement of new technologies such as cloud computing, thin client, rapid growth of internet do effects the data centre infrastructures, product design, power management, number of power and cooling equipment. Hence, it's obvious that technology factors do affect the adoption of Green ICT. Therefore, the researcher has formulated the following hypotheses.

H_1: Technology has a significant positive impact on Green ICT adoption

Several studies have been conducted to determine the effect of environmental factors such as stakeholder pressure, government support and type of industry on Green ICT adoption. For example, Weng and Lin (2011) concluded that shareholders could discourage Green ICT adoption considering the initial funds required to adopt and implement Green ICT. From the shareholders perspective, funds used in adopting Green ICT could be used in investing in other profit-making ventures (Weng and Lin, 2011). Besides, a research carried by David *et al*., (2011) revealed that government subsidies such as tax incentives encourages companies to adopt Green ICT. Besides, Wabwoba *et al*., (2012) found out that companies in high technology industries such as in banking and investments are likely to adopt Green ICT unlike companies in the manufacturing sector. What these findings reveal is that environmental factors such as government support and stakeholder pressure affects adoption of Green ICT by businesses. Therefore, the researcher has formulated the following hypotheses.

H_3: Environment has significant positive impact on green ICT adoption.

According to the Theory of Reasoned Action, a person's intent to perform an action is determined by that person's attitude. In light of this, several researchers have conducted studies to determine the impact of attitude on Green ICT adoption. For instance, Thongmak (2016) carried a research to determine whether a positive attitude towards an organization leads to a higher rate of adoption of an invention. The results revealed that a positive attitude is vital in the successful adoption and constant use of a Green ICT technology since positive attitudes support the green ICT innovation. Besides, Wabwoba *et al*., (2012) established the perceived ease of usefulness as a determining factor of whether a company will adopt Green ICT or not. Since perceived ease of use stems from ones attitudes and beliefs, it is prudent to state that attitude has a major impact on green ICT adoption (Wabwoba *et al*., 2012). Therefore, the researcher has formulated the following hypotheses.

H_4: Attitude has significant positive impact on green ICT adoption.

A study by Chulmo Koo *et al*., (2013) revealed that perceived usefulness determines whether an organization will adopt Green ICT or not. The researcher further concluded in the study that the sustainable use of green IT devices have positive effects on perceived usefulness (Chulmo Koo *et al*., 2013). In a similar way, Wabwoba *et al*., (2012) found out that the perception on the usefulness of Green ICT adoption to business processes and individuals are the major determinant of adoption and success of Green ICT. Additionally, Weng and Lin (2011) identified perceived usefulness as a major technological factor determining Green ICT adoption. Therefore, perceived usefulness has a significant impact on Green ICT adoption in a positive way. Therefore, the researcher has formulated the following hypotheses.

H_5: Perceived usefulness has significant positive impact on green ICT adoption.

Research Methodology

Research Design and Approach

For this study the researcher will use **explanatory** research design to establish the relationship between the dependent and independent variables (Saunders *et al*., 2009). Using this research design, the researcher will manipulate technological, organizational, environmental factors and attitude and perceived usefulness to determine how they affect adoption of Green ICT in the study locale. To do this, the researcher will collect empirical data from the multinationals under study and analyse it to establish the relationship between the dependent and independent variable and this will be crucial in coming up with a valid and reliable conclusion. Collection of data will be highly structured through the use of questionnaires to ensure that all the questions administered to the respondents are similar. This type of research design requires the researcher to have research hypothesis as it is the case in this study and this is in contrast with other research designs which require one to have research questions (Saunders *et al*., 2009). This research design assists a researcher in understanding the causal relationship of the variables, replication possible and it leads to greater confidence in the study due to internal validity and consistency. However, extraneous variables make it difficult to establish causal relationship and this one of the greatest challenges of the design.

The research approach involves theoretical testing of a research strategy explicitly designed to meet the purpose of the testing. The research approach selected for this study is **deductive** approach used to develop the Green ICT Adoption hypotheses using the existing theories then later these hypotheses will be tested through the empirical observation (Wilson, J., 2010). According to Saunders *et al*., (2009), research can be quickly completed using deductive approach if sufficient time is devoted to setup the study prior to data collection and data analysis. This approach makes it possible to forecast the time plans accurately and comes with lower risk strategy for instance; non-return of survey questionnaires. The deductive quantitative research used since it involves collection and conversion of data into numerical form so that statistical manipulation can be employed to make relevant and valid conclusions (Wilson, J., 2010). Also, quantitative research design is synonymous with positivist research. Quantitative research requires the researcher to develop two or more hypothesis to help in predicting the relationship between the research variables and presents them as P value (Saunders *et al*., 2009). Quantitative research also requires the researcher to be objective and to apply deductive reasoning to arrive at the relationship between the variables. For instance, the researcher will investigate the independent variables in multinationals in Klang Valley, Malaysia and then generalize the research findings to all multinationals in Malaysia. Besides, the reliability and the validity tests carried out by the researcher will preserve the objectivity of the study. Therefore, this research is purely quantitative in nature since it is based on deductive reasoning, emanates from positivism philosophy, has several research hypothesis under investigation and converts the collected data into numerical figures to aid in data analysis and interpretation.

Data Collection

The researcher will use **primary data** which involves collecting original data from the field and it has been chosen for this research since there is scarcity of secondary information on the research problem. As well, primary research is best suited for the variables under investigation such as attitude and perceived usefulness since it cannot be evaluated using secondary data as they are bound to change from time to time (Saunders *et al*., 2009). The primary data collected during the research will be vital in filling the existing literature gap in the field of Green ICT and therefore ease the work of future researchers. Besides, primary research resonates well with the research intention (Welman, C, 2012). This is because the researcher is fully in control of the data collection process and he or she ensures that only data that is relevant to the research is collected. Besides, primary data provides recent data which is vital in coming up with up to date research findings and conclusions that meet the needs of today.

The researcher in this study will use quantitative research approach to explore the relationship of the dependent and independent variables (Krauss, 2005; Looi Theam Choy, 2014) through the use of questionnaire **surveys** sent to respondents in targeted multinationals in Klang Valley electronically or through hand delivery to increase the response rate and therefore increase reliability of the findings. The researcher did not select a qualitative method for this study since it is time consuming and it works well with small populations (Looi Theam Choy, 2014). Besides, qualitative research is very difficult to replicate and given that Green ICT is relatively new in Malaysia, it is likely that more studies will be conducted on the topic and therefore the use of qualitative method would inhibit research replication (Krauss, 2005). Additionally, qualitative research has inbuilt researcher bias and this could adversely affect the reliability of the research findings and conclusions. However, there is a potential setback with quantitative method since it depends on respondents' participation and obtaining timely and accurate responses (Looi Theam Choy, 2014). Also, a quantitative design requires one to take a large sample size so as to improve statistical accuracy of the research findings and this complicates data collection and analysis.

Data for this research will be collected through self-administered online questionnaires and by hand survey questionnaires constructed in English for duration between July 2017 – August 2017. Likert's scaling will be used in the questionnaires to seek for agreement or disagreement. Before administering the questionnaire, the researcher will inform the respondents the purpose of the research and assure them that all information they reveal will be used for research purposes only. If the respondent agrees to answer the questions, the researcher will administer the tool and then thank them for their time.

Instrument Development

The research instrument is a device used to obtain relevant information related to the research. The survey questionnaire for this research has two sections.

Section 1	Socio - Demographics	11 questions	Using fixed options, avoiding unstructured responses. For Green ICT Awareness questions, using 5-point Likert Scale
Section 2	Research Instrument Questions	25 questions	Using 5-point Likert Scale, requiring respondents to assign a rating for each question.

Table 3: Socio-Demographics Questions on Green ICT Awareness

	Description	Measures	Reference
Green ICT Awareness	An organization's ability to implement and adopt environmentally, economically and socially sustainable solution in order to optimize the energy consumption.	How important are the following awareness for Green ICT adoption?	
		GICTA1: Green ICT awareness	Alok Mishra & Ibrahim Akman (2014)
		GICTA2: Aware of the ICT impact on environment	
		GICTA3: Aware that ICT contributes to CHG emission.	Mathupayas Thongmak (2016)
		GICTA4: Organization prioritize Green ICT Adoption	Franklin *et al*., (2012)
		GICTA5: The cost involved with Green ICT implementation	Franklin *et al*., (2012) Mathupayas Thongmak (2016)

Some earlier researches used the TOE conceptual model for IT adoption (Lacovou *et al*., 1995; Lin *et al*., 2008; Zhu, K. & Kraemer, K.L, 2005), and it provides a model for analysing various forms of innovations and their ultimate integration in the business processes. In this study, these models are introduced together with two additional models as the constructs to measure the determinants of green ICT adoption in multinational companies such as Technology, Organization, Environment, Attitude and Perceived Usefulness. There are 5 constructs and 25 items found to be relevant to the study. Most of these items are adapted from (Mathupayas Thongmak, 2016), (Franklin *et al.*, 2012), (Buchalcevova A & Gala Libor, 2013), (Molla, A, 2009), (Ming-Horng Weng and Chieh-Yu Lin, 2011) and (Mosharrof H. Masud and Noreha A. Malik, 2014).

Table 4: Instrument Table

Construct	Description	Measures	Reference
Green ICT Adoption (Organization)	The adoption and implementation of Green ICT largely depends on the leadership style, culture of organization and the organizations approach towards innovation and change	How important is the organisation preparedness to adopt and implement Green ICT?	
		GICT1: Green ICT strategy roadmap.	Mathupayas Thongmak (2016)
		GICT2: Promotion of recent initiatives	Mathupayas Thongmak (2016) Mosharrof H. Masud and Noreha A. Malik (2014)
		GICT3: Environmental friendly.	Mathupayas Thongmak (2016)
		GICT4: Environmental Policy.	Buchalcevova Alena & Gala Libor (2013) Chulmo Koo *et al.*, (2013)
		GICT5: Flexible working schedule	Ming-Horng Weng and Chieh-Yu Lin (2011)
Technology	The implementation of technology and practices whose main purpose is to improve IT stewardship and reduce energy consumed by the IT infrastructure and IT related pollution	How important is the following technology solution implementation for Green ICT adoption?	
		T1: Policy on managing the recycling of IT equipment	Buchalcevova Alena & Gala Libor (2013)
		T2: Environment friendly IT procurement policy	Buchalcevova Alena & Gala Libor (2013)
		T3: Server virtualization	Buchalcevova Alena & Gala Libor (2013) Molla, A (2009) Ming-Horng Weng and Chieh-Yu Lin (2011)
		T4: Storage virtualization	Buchalcevova Alena & Gala Libor (2013) Molla, A (2009) Ming-Horng Weng and Chieh-Yu Lin (2011)
		T5: Storage consolidation	Buchalcevova Alena & Gala Libor (2013) Molla, A (2009) Ming-Horng Weng and Chieh-Yu Lin (2011)

Environment	The environmental considerations applied by a business in its daily operations affect its preparedness to adopt Green ICT.	How important is organization action to promote environmental sustainability?	
		E1: Responsible waste disposal	Mathupayas Thongmak (2016)
		E2: Procurement policy.	Molla, A (2009)
		E3: Efficient Lighting and Cooling systems.	Mathupayas Thongmak (2016)
		E4: Shorter IT equipment refresh.	Mathupayas Thongmak (2016)
		E5: Responsible site infrastructure designing	Molla, A (2009)
Attitude	The attitude of employees towards Green ICT affects the success of adoption and implementation of Green ICT.	How important is attitude towards Green ICT adoption?	
		A1: Concern on climate change.	Mathupayas Thongmak (2016) Mosharrof H. M. and Noreha A. M. (2014)
		A2: Energy Saving Tactics.	Mathupayas Thongmak (2016) Mosharrof H. M. and Noreha A. M. (2014)
		A3: Attempts to reduce carbon emissions.	Mathupayas Thongmak (2016) Mosharrof H. M. and Noreha A. M. (2014)
		A4: Responsible use of printing materials.	Mathupayas Thongmak (2016) Mosharrof H. Masud and Noreha A. Malik (2014)
		A5: Perception on the role of IT professionals in promoting environmental sustainability	Buchalcevova Alena & Gala Libor (2013)
Perceived Usefulness	The extent to which users of Green ICT believe that the technology improves their job performance determines whether or not they will welcome Green ICT efforts.	How important is perception on the usefulness of Green ICT adoption?	
		PU1: Cost reduction.	Mathupayas Thongmak (2016)
		PU2: Long term benefits.	Chulmo Koo *et al.*, (2013)
		PU3: Vendor and supplier support of Green ICT efforts.	Molla, A (2009)

		PU4: Stakeholders view of Green ICT adoption.	Molla, A (2009)
		PU5: Green ICT is implemented as part of CSR policy	Molla, A (2009)

Population and Sample

The population of interest for this study is ICT personnel from multinational IT organizations in Klang Valley, Malaysia. As the study focuses on green ICT, target population would require a minimum ICT knowledge in order to understand ICT terminology being used in the questionnaires. Multinational organizations are targeted since green ICT initiatives are mainly implemented in large organizations in Malaysia and also since none of the previous researchers have conducted studies on the selected factors on green ICT in Malaysia.

Using the Krejcie & Morgan (1970) sample size formula for finite population, the sample size of 250 respondents to be collected to offer enough statistical strength for data analysis. The survey questionnaire was sent to 250 respondents via email and by hand and a total of 193 completed responses were received.

The sampling is carried out using the Non-Probability Convenient Sampling, where the employees of the intended organization meets the practical criteria of easy accessibility, availability at a given time, geographical proximity and the willingness to participate (Ilker Etikan *et al*., 2015; Creswell, 2014; Dörnyei, Z., 2007). This ease the research activities. Also, it is expected with convenient sampling, the participants of the intended population are similar (Ilker Etikan *et al*., 2015). However, the obvious disadvantages of this technique are it is likely to be biased and the problem of outliers due to high self-selection possibility (Ilker Etikan *et al*., 2015).

Data Analysis Plan

The data collected will be analysed using Statistical Package for the Social Science (SPSS) software version 22 and AMOS tool to analyse the variables to establish relationships between dependent and independent variables (Saunders *et al*., (2009). The data gathered from the field through administration of questionnaires will be recorded and coded into SPSS and AMOS tool and in analysing the data, the researcher will establish multiple analysis as follows.

Results, Analysis and Discussion

Analysis of the Demographic Profile of Respondents

Demographics are characteristic of a population (Roth and BeVier, 1998; Hair *et al*., 2010), which provides the information of the research participant and this is essential for the purpose of understanding if the participated individual is a descriptive sample of the

target population for generalization. Table 5 below shows the demographic profile of respondents for this study. Around 59% of respondents are male and 42% is female and majority of the respondents are aged between 30 to 50 years old, which could be associated with the level of maturity to adopt Green ICT. This can also be supported by the position and number of years working in an organization to have the visibility of the companies roadmap (Wairimu, N & Theuri, F, 2014). Out of the 49 cases removed earlier due to outliers, 43 of them are respondents holding junior position which shows that they might be lacking the knowledge of the organization's financial and strategic moves such as the implementation of Green ICT adoption (Wairimu, N & Theuri, F, 2014).

Table 5: Demographic Profile of Respondents

		Frequency	Percentage
Gender	Male	81	58.7
	Female	57	41.3
Age	20-29	10	7.2
	30-39	79	57.2
	40-49	45	32.6
	50-59	4	2.9
Industry	Oil & Gas	38	27.5
	Financial Institution	46	33.3
	Manufacturing	2	1.4
	Consulting	10	7.2
	Healthcare	2	1.4
	Others	40	29.0
Number of Employees	Below 1000	25	18.1
	1001 - 2000	20	14.5
	2001 - 3000	5	3.6
	3001 - 4000	11	8.0
	Above 4000	77	55.8
Years of Working	Less than 6 months	3	2.2
	6 months to 1 year	13	9.4
	1 year to 2 years	19	13.8
	2 years to 4 years	25	18.1
	Above 4 years	78	56.5
Position	Junior Management	29	21.0
	Middle Management	98	71.0
	Senior Management	11	8.0
Total Responses = 138			

Table 6 below shows demographic of Green ICT awareness among the respondents. 21% of the respondents are completely not aware of the term "Green ICT", however out of the 21%, some 10% of respondents are still aware that ICT impacts the environment. It's more evident to realize that around 91% of respondents do know that ICT contributes

to greenhouse gas emission and this could support the Green ICT adoption. Organization emphasizing on the importance of Green ICT does increases the awareness among employees which would ease the adoption.

Table 6: Demographic of Green ICT Awareness of Respondents

		Frequency	Percent
I have heard about Green ICT	Strongly Disagree	11	8.0
	Disagree	18	13.0
	Neutral	47	34.1
	Agree	33	23.9
	Strongly Agree	29	21.0
I'm aware that ICT impacts the environment	Strongly Disagree	8	5.8
	Disagree	7	5.1
	Neutral	39	28.3
	Agree	53	38.4
	Strongly Agree	31	22.5
I know that ICT contributes to Green House Gas (GHG) emission	Strongly Disagree	4	2.9
	Disagree	9	6.5
	Neutral	57	41.3
	Agree	44	31.9
	Strongly Agree	24	17.4
My organization emphasize on Green ICT importance	Strongly Disagree	6	4.3
	Disagree	20	14.5
	Neutral	49	35.5
	Agree	39	28.3
	Strongly Agree	24	17.4
I believe Green ICT implementation costs more than non-green ICT implementation	Strongly Disagree	2	1.4
	Disagree	9	6.5
	Neutral	64	46.4
	Agree	43	31.2
	Strongly Agree	20	14.5
Total Responses = 138			

Reliability Analysis

For this study, the most regularly used reliability measure of Cronbach's Alpha is performed (Hair et al., 2010). The table below displays the "*Cronbach's Alpha coefficients*" for all the variables and its individual constructs. From the table, the overall data reliability for internal consistency is excellent (0.95) together with the individual construct reliability achieving mostly excellent and good results. As the overall values are in a more than adequate level, there were no significant changes made to the survey questionnaires.

Table 7: Reliability Coefficient

Reliability Measurement	Research (138 cases)		Strength of Association
	Number of Items	Cronbach's Alpha	
All Variables	25	0.953	Excellent
Construct 1: Green ICT Adoption	5	0.840	Good
Construct 2: Technology	5	0.817	Good
Construct 3: Environment	5	0.907	Excellent
Construct 4: Attitude	5	0.785	Acceptable
Construct 5: Perceived Usefulness	5	0.916	Excellent

Validity Analysis

In the study, the face validity for the research was done using cross-referencing methods in which the instruments are given a secondary review by the supervisors (Saunders *et al*., 2009). Given this situation, the instrument was declared a valid measure for collection of information for the study. The supervisor based on a set scale of the reliability analysis recommended that there are amendments made to the instrument. The validation of the instrument is based on the theory as presented in the Literature Review of the study where the variable has since been derived.

The validation is performed using the Confirmatory Factor Analysis. The model estimates from variables was loaded in AMOS to validate the covariance and correlation matrix. The Rule of Thumb founds some fit measures that connect the approximation of the theoretical structure for the empirical data (Bryne, 2010). For the Chi- Square, the test of the HO-hypothesis [which founds the empirical covariance matrix in response to the theoretical matrix in the model] against the H1-hypotheses [which is the empirical covariance matrix in correspondence to any other matrix] it should be equal to or less than the degrees of freedom. For the study, the ratio of 2:1 is accepted; also it's showing below 3.0 which is a good fit (Kline, 2011). For the P-value, the test of exact fit involves an error probability of rejection of the HO-hypothesis where the P is 0.00. Given this condition, the value should be less than 0.05 in the current study. The study embraces an independence model where all the observed variables have a negative correlation founding the restricted model.

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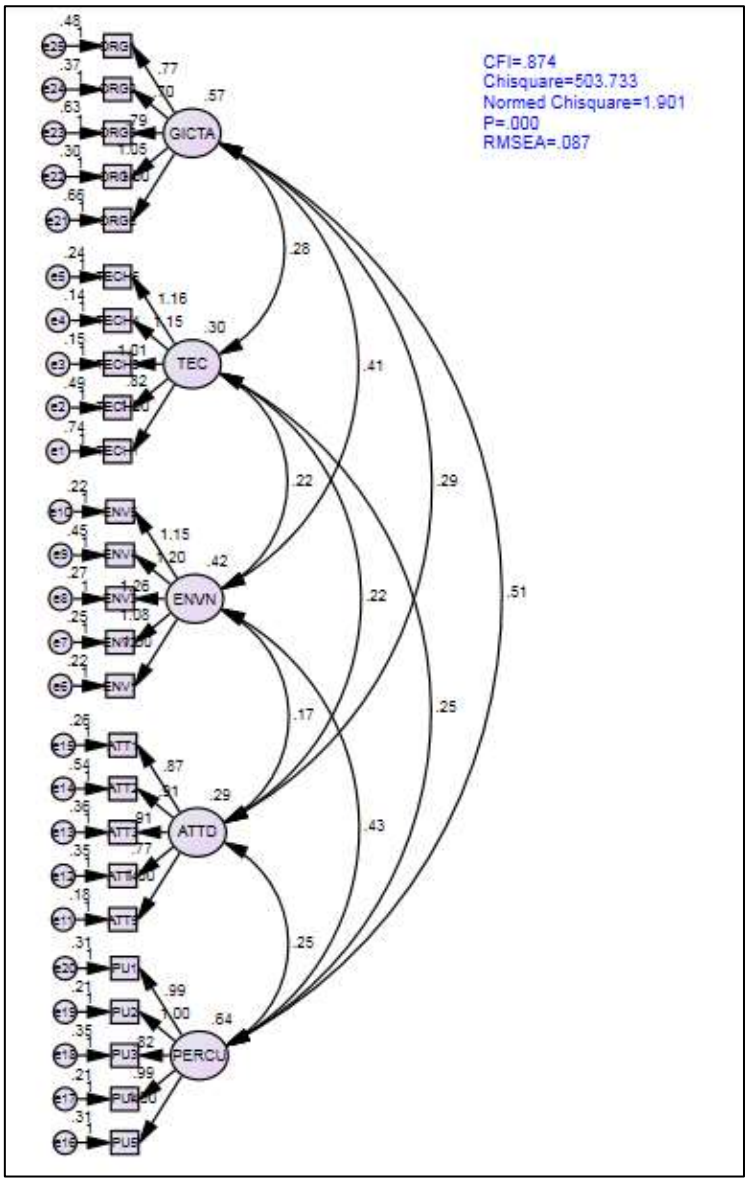

Figure 3: Original Model – CFA Model Fit

Original model had 5 constructs with 5 items each but CFI and RMSEA were not achieved so modification was made to the model by removing one item from each of the constructs which had cross loading and after modification the CFI and RMSEA achieved with each 0.923 and 0.074 (Hoyle, 1995). The CFI is based on the revision of the normed fit index, which takes into consideration the sample size. Considering that the RMSEA which stands at less than 0.08, and the CFI of approximately 1 in which the current range is acceptable the adjustments are conducted in an effort to provide reasonable results within an independence model.

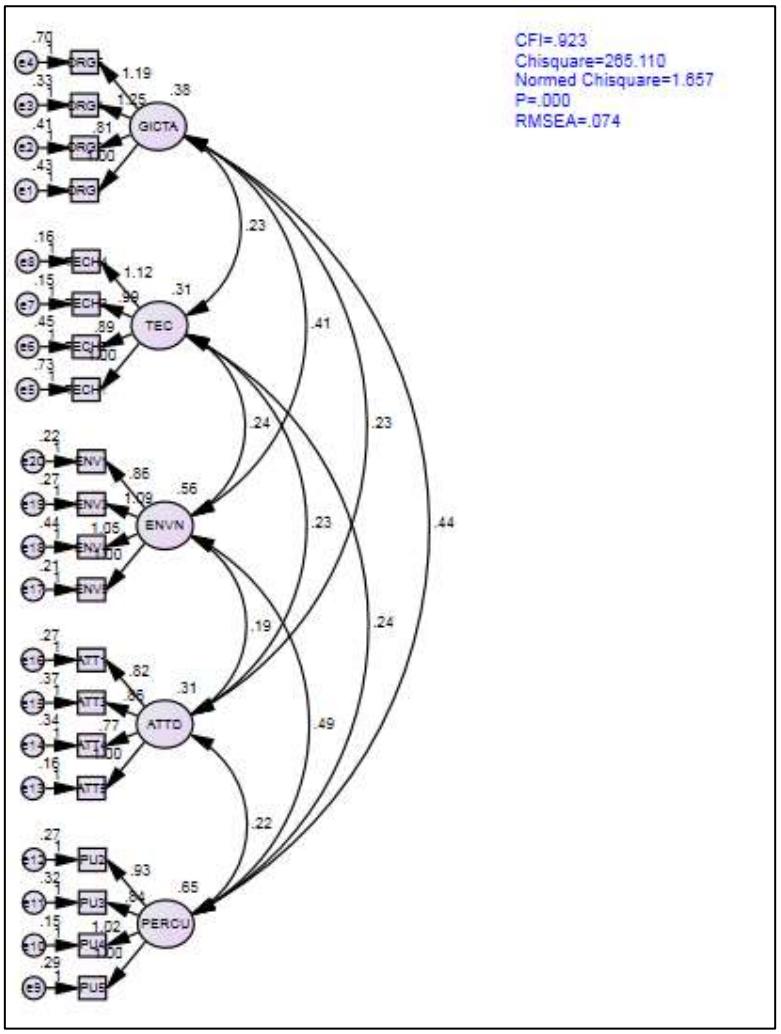

Figure 4: Modified Model – CFA Model Fit

Table 8: Outcome of CFA Model Fit Analysis

Measurement	Original Model	Modified Model
CFI	0.874	0.923
Chisquare	503.733	265.110
Normed Chisquare	1.901	1.657
RMSEA	0.087	0.074

Convergent validity is a subcategory of construct validity in which the measures of the constructs, which should be theoretically elated, are observed in correlation to each other. Thus, convergent validity, as proposed by Kline (2011), is the degree to which the operationalization is similar to (converges on) other operationalization to which it theoretically should be similar. In the study, the five items are reflective of the determinant of the green ICT adoption in multinational organizations. In the study, the analysis indicates intercorrelations of the five scale items based on the scale provided to

the respondents. The measures of constructs that are related to each other should be strongly correlated with the AVE > 0.5 to establish a valid construct and even better if it's 0.7 for a much better fit (Hair *et al.*, 2010). The item intercorrelations are ranging from 0.5-0.7, which indicates that the correlations is high with different constructs supported. Given this, we can assume the patterns of the correlations are converging on a similar item.

Table 9: Convergent Validity

Measurement Constructs	Green ICT Adoption (GICTA)	Technology (TECH)	Environment (ENV)	Attitude (ATT)	Perceived Usefulness (PU)
GICTA1	0.68				
GICTA2	0.62				
GICTA4	0.80				
GICTA5	0.66				
TECH1		0.84			
TECH2		0.82			
TECH3		0.60			
TECH4		0.54			
ENV1			0.81		
ENV3			0.84		
ENV4			0.76		
ENV5			0.85		
ATT1				0.66	
ATT3				0.62	
ATT4				0.59	
ATT5				0.81	
PU2					0.82
PU3					0.77
PU4					0.91
PU5					0.83
AVE	0.5	0.5	0.7	0.5	0.7

Nomological validity makes the comparison of two constructs to observe the possible correlation between these constructs without being directly associated to one another (Hair *et al.*, 2010). The data provides evidence of convergent validity. Given the current coefficients, the most highly correlated factors include GICTA-ENV and GICTA-PU. Other high coefficients are TECH-ATT, GICTA-ATT, GICTA-TECH and PU-ENV. However, the coefficients that are less than 0.48 are indicative of a methods factor [ATT-ENV and PU-ATT].

Table10: Nomological Validity Estimates

			Estimates
GICTA	<-->	TECH	0.67
GICTA	<-->	ENV	0.88
GICTA	<-->	ATT	0.67
GICTA	<-->	PU	0.88
TECH	<-->	ENV	0.59
TECH	<-->	ATT	0.74
TECH	<-->	PU	0.54
ATT	<-->	ENV	0.46
PU	<-->	ENV	0.80
PU	<-->	ATT	0.48

Discriminant validity is assessed by comparing the extracted variance of any two variables with the square of correlation of these two variables. According to Hair *et al*., (2010), this is a rigorous approach with rule stating that the Average Variance Extracted (AVE) should be higher than the Square of Correlation. The table below shows that there is a significant discriminant validity among the constructs except for Green ICT Adoption < > Environment, Green ICT Adoption < > Perceived Usefulness and Technology < > Attitude.

Table11: Discriminant Validity

Relationship			AVE	Square of Correlation	Discriminant Validity
Green ICT Adoption	<-->	Technology	0.49	0.45	Yes
Green ICT Adoption	<-->	Environment	0.57	0.78	No
Green ICT Adoption	<-->	Attitude	0.47	0.45	Yes
Green ICT Adoption Usefulness	<-->	Perceived	0.58	0.78	No
Technology	<-->	Environment	0.58	0.35	Yes
Technology	<-->	Attitude	0.48	0.55	No
Technology Usefulness	<-->	Perceived	0.59	0.29	Yes
Attitude	<-->	Environment	0.56	0.21	Yes
Perceived Usefulness	<-->	Environment	0.67	0.65	Yes
Perceived Usefulness	<-->	Attitude	0.57	0.23	Yes

Regression Analysis

The model fitness informs the good fit index in which the R, R square and the Adjusted R square are assessed. These provide an estimate of the strength of the correlation

between the response variable and the model while not providing a formal hypothesis test for the relationship (Hair *et al*., 2010). The higher the value goes, it increases the coefficient between the *observed value* and the *predicted value*. R Square is considered as substantial when it ranges above 0.75, moderate when it is 0.50 and weak for 0.25 values (Henseler, J., & Fassott, G. (2009).

The R Square value for this study is 0.742 which is closer to be in the substantial range for the endogenous latent variables, which indicates the data is 74.2% closer to the fitted regression line, also known as *coefficient of determination*. Further to that, the adjusted R Square value is 0.734 which indicates the significant model fitness for this study.

Table12: Model Summary[b]

Model	R	R Square	Adjuster R Square	Std. Error of the Estimate	Durbin-Watson
1	0.861[a]	0.742	0.734	0.41291	1.888

a.PU, ATT, TECH, ENV
b.Dependent Variable GICTA

Following the validity and reliability analysis, there is a need to identify the results of the test based on the measurement theory which offers a comparison for the theoretical measurement model against the reality presented by the sample of current research considering the estimates of the parameters and the key fit statistics. The rule of thumb is p value should be less than 0.05 for a statistically significant model (Hair *et al*., 2010) and the ANOVA table below shows Sig value as 0.00 which proves the model is extremely significant for this study. The F- Statistic is 95.686 indicating that there is 95% of chances to obtain similar result if this study is done elsewhere. Therefore, this indicated a regression model fit as indicated in the table below.

Table13: Model Significance – Anova[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	65.275	4	16.314	95.686	0.000[b]
	Residential	22.676	133	0.170		
	Total	87.933	137			

a.Dependent variable
b.Predictors: (Constant), PU, ATT, TECH, ENV

The measurement theory presumes a number of theories considering the hypotheses of the research. As advanced by Hair *et al*., (2010), the hypotheses make assumption of the contribution of the constructs to the measurement theory. The covariance matrix can be used in the examination to test the hypotheses. The sig value of each independent variable should be less than 0.05, if so the hypotheses is accepted otherwise the hypotheses is rejected. The other measurement of Standardized Beta Coefficient value assists to

measure how significantly the dependent variable is influenced by the independent variables (Hair *et al*., 2010). Strong correlation or significant impact will be realized when the value goes higher.

Given the results indicated in the coefficients table below, the measurement theory hypotheses of Environment, Attitude and Perceived Usefulness are accepted because of an existing type 1 error rate of 0.05 as presented. However, the Technology was rejected as indicated by the sig value of 0.07, which is greater than the 0.05 type 1, error rate.

Table 14: Hypotheses – Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.674	0.291		-2.312	0.22
	TECH	0.144	0.79	0.116	1.826	0.070
	ENV	0.407	0.069	0.420	5.872	0.000
	ATT	0.296	0.078	0.208	3.777	0.000
	PU	0.270	0.068	0.279	3.946	0.000

a.Dependent Variable GICTA

Table 15 Hypothesis resutls

Hypotheses	Sig. Value	Beta Coefficient	Result	Interpretation
H1: Technology has a significant positive impact on Green ICT adoption.	0.70	0.116	Rejected	The Beta coefficient of 0.116 indicates that Technology has an 11.6% positive impact on Green ICT adoption. However, as the p-value is more than 0.05, the hypothesis is not significant. Thus, rejected.
H2: Environment has a significant positive impact on Green ICT adoption.	0.00	0.420	Accepted	The Beta coefficient of 0.420 indicates that there is 42% positive impact of Environment on Green ICT adoption. As the p-value is less than 0.05, the hypothesis is accepted.
H3: Attitude has a significant positive impact on Green ICT adoption.	0.00	0.208	Accepted	The Beta coefficient of 0.208indicates that there is 20.8% positive impact of Attitude on Green ICT adoption. As the p-value is less than 0.05, the hypothesis is accepted.

H4: Perceived Usefulness has a significant positive impact on Green ICT adoption.	0.00	0.279	Accepted	The Beta coefficient of 0.279 indicates that there is 27.9% positive impact of Perceived Usefulness on Green ICT adoption. As the p-value is less than 0.05, the hypothesis is accepted.

Discussion

The CFA was conducted to accomplish two goals. First, it was aimed at presenting the hypothesized interrelations existent between the dependent and independent variables of Green ICT Adoption, Technology, Environment, Perceived Usefulness, and Attitude. According to the theory as advanced by Lacovou *et al.*, (1995) and operationalized by Linet *et al.*, (2008) and Zhu, K. & Kraemer, K.L, (2005), there is an actual interrelationship among these factors. The defence of any of the variables requires the preservation of all the others.

Secondly, the CFA has proven that some of the measurement variable advanced by Mathupayas Thongmak, (2016); Franklin et al., (2012); Buchalcevova, A & Libor, G (2013); Molla, A, (2009); Ming-Horng Weng and Chieh-Yu Lin, (2011) and Mosharrof H. Masud and Noreha A. Malik, (2014) under the five variables are appropriate to measure the respective implementation of green ICT. The factor loading of the measurement variables of each factor has aided in the identification of significant variables, which include the measurement of the dependent variable, Green ICT Adoption.

Green ICT Adoption

The coefficient of determination (R^2) of the endogenous variables indicates high explanatory power. The proposed model provides direction for the implementers and makers aimed at enforcing appropriate policy design and implementation to advance the implementation of Green ICT through adoption of a process oriented and systematic method. In accordance to the model, the Green ICT is designed to increase the use of Green ICT solutions while creating a better environment on which technology can be used to create adequate awareness of the impact it has on the environment. For example, adoption of Green CT will positively influence the environment by reducing the non-biodegradable waste. This would result in reduction of possible carbon emissions and decrease the carbon footprint of organisations in the world. The overall results has also provided suitable guidance to the policy development within an organisational setting as there is existing statistical evidence against irrelevant and isolated policies that focus on various dimensions of the socio-economic prosperity dimensions. The study has advanced the theory of Green ICT to a significant extent from a standard behaviour or norm to a positive behaviour with good disciplines observed through the evidence of the hypothesized associations.

Technology

Technology is the first objective drawn for this research. It is to examine the impact of technology on Green ICT adoption. Technology enables an organization to recognize the impact it has on environment and encourage its users to use it efficiently by considering the social responsibility and economic viability (Laura-Diana Radu, 2016; Thongmak. 2016; Hussain *et al*., 2014; Wabwoba *et al*., 2012; Weng and Lin, 2011; David *et al*., 2011; Bachour & Chasteen, 2010).

The overall reliability for Technology is good with .817. The descriptive statistic shows that majority of the respondents have agreed to Technology related questionnaires with Mean showing 4.17. The correlation between the constructs is 0.5 on AVE which indicates that Technology supports the theoretical framework. The level of correlation between Technology and Environment and Technology and Perceived Usefulness are low which indicates that the variables are distinct from one another except for Technology and Attitude in the discriminant validity. Multicollinearity analysis was done to further test the coefficient of the variable and VIF value of 2.08 shows that there is a considerable level of accuracy in the model.

However, the hypothesis is rejected with p value 0.70 indicating that Technology is insignificant to Green ICT Adoption. There was only a minority of respondents (11.6%) felt that Technology has a positive impact on Green ICT adoption. The information is instituting that in the theoretical logic Green ICT adoption is perceived as an administrative innovation. In this, technology is perceived as a design intervention aimed practicing a pro-environmental IT policy. Therefore, technology involves idea generation and diffusion through maturation of green IT policies, practices and IT governance. Further to that, it could also be that as doubted by Wabwoba *et al*., (2012), an organization might not consider Technology as a significant factor for Green ICT adoption if the cost of technology implementation is going to be more than the adoption and they might decide to improve the existing hardware or software to be environmental friendly. Wabwoba *et al*., (2012) also concluded in the research that technology is not perceived to be a barrier towards Green ICT implementation in Kenya.

Environment

Environment was tested as one of the determinant since Green ICT is all about protecting the environment and ensuring that ICT related hardware and software are built with very minimal influence towards the environment (Hussain *et al*., 2014; Chulmo Koo *et al*., 2013; Weng and Lin, 2011; David *et al*., 2011). As it shows the importance of this determinant to Green ICT Adoption, the hypotheses of environment has been accepted with significant value of .000. The beta coefficient of .420 explains that environment is perceived to be significantly impacting Green ICT Adoption. The significance is further supported with an excellent reliability of .907 and the multiple regression analysis. The factor analysis achieved substantial AVE of 0.7 indicating a strong support to the theoretical framework.

As the Institutional theory explains, the external factors to a company may place pressure to the organization to adopt Green ICT following the government policies (Lim Wei Ping, 2012). It's also supported by David *et al*., (2011) that multinational companies are standing in the competitive marketplaces and they will be directed to adopt the ecological initiatives as the companies will certainly face many social pressures.

Attitude

Attitude states the level of awareness and interest the leaders and professionals of an organization have on environmental sustainability. Whether the professionals have sufficient knowledge and skills to practice Green ICT (Thongmak , 2016; Hussain *et al*., 2014; Wabwoba *et al*., 2012; Weng and Lin, 2011). The significant value of the coefficients being .000 promotes the objective of attitude to have a significant positive impact on Green ICT adoption. This is established by the theoretical logic of the green economy normatively in current and traditional literature. Attitude has an acceptable reliability of .785 and the factor analysis also indicates good fit with average variance of 0.5.

In accordance to the regression model, the attitude of the individuals has the capacity to promote social wellbeing. For example, if the individuals have a positive attitude towards the use of Green ICT, it will be better for the environment and the organisation. As a result, people will have a positive perceived usefulness of the technology that may cause any potential problems in the environment to be avoided (Hussain *et al*., 2014; Weng and Lin, 2011). Therefore, the model identifies that policies designed in the promotion of environmental protection will also promote organisational advance.

Perceived Usefulness

The final hypothesis is also accepted. It is observed that perceived usefulness have a significant positive impact on Green ICT Adoption. Perceived usefulness to a great extent is seemed to positively influence people to accept and use environmental friendly technologies. The reliability of Perceived Usefulness is excellent with .916. The significant value is .000 and the beta coefficient value shows that 27.9% of respondents believe Perceived Usefulness has significant positive impact on Green ICT adoption, which increases the strength of the model. This variable is seen to be second strongest variable after environment. The factor analysis achieved AVE 0.7 showing a good fit.

Thongmak (2016). and Lee, (2010) found that perceived usefulness could support to increase the observed importance of being ecologically friendly, which is fundamental for Green ICT adoption.

Conclusion, Recommendations and Implication

The objective of the study was to investigate the determinants of Green ICT adoption in multinational organizations. This chapter presents a summary of the main findings and the conclusions that were drawn from the main findings. As well, this chapter offers

recommendations from the study and implications to existing knowledge, policy and the researcher.

Conclusions

At the heart of this study, the researcher sought to determine the impact of technology, environment, attitude and perceived usefulness on adoption of Green ICT by organizations. From the findings, it can be concluded that technology has no significant impact on Green ICT adoption. The technological infrastructure in an organization does not affect the Green ICT adoption since an organisation that is committed to Green ICT could choose to overhaul the existing ICT infrastructure in favour of Green ICT. This is in contrast with prior studies by David *et al*., (2011) and Chulmo Koo *et al*., (2013) who concluded technology has a significant impact on Green ICT adoption.

Secondly, the findings of this research have revealed that there is a direct positive relationship between environment (both internal and external) and Green ICT adoption. The multiple regression revealed a significant positive correlation of these two variables. Therefore, the actions of competitors in an industry can affect adoption of Green ICT by a company in that industry. For instance, if multinational organizations in a country are adopting Green ICT, then the other multinational organization might feel obliged to follow the trend to be at par with other international companies. As well, internal environment of a company such as corporate governance affects the adoption of Green ICT by an organization. If the leaders at the helm of a company are dedicated towards social, economic and environmental sustainability, they are likely to adopt ICT with a lot of ease. As well, a company which is committed to corporate social responsibility is likely to adopt Green ICT since it promotes a healthy environment. This conclusion agrees well by previous studies by Thongmak (2016) and Wabwoba *et al*., (2016) who concluded that environment has a positive significant impact on Green ICT adoption.

Thirdly, it is prudent to conclude that attitude has a positive impact on the adoption of Green ICT. The data analysis revealed that there is a significant positive correlation between attitude and Green ICT adoption and therefore it is right to deduct that attitude significantly affects the adoption of Green ICT. Thus, if the employees of a company have a positive attitude towards adoption of Green ICT, this is likely to increase chances of the program's success. As well, a positive attitude of the board members and top management towards adoption of Green ICT is likely to accelerate Green ICT adoption and set the pace for the other stakeholders such as employees and key partners. Previous studies by Wabwoba *et al* (2016) and Chulmo Koo *et al*., (2013) arrived at similar conclusion hence reinforcing the notion that attitude has a positive significant impact on Green ICT adoption.

Finally, the findings of this research revealed a significant positive correlation between Green ICT and perceived usefulness, concluding that perceived usefulness has a positive impact on Green ICT adoption. Therefore, if the organisation is well aware of the potential benefits of adopting Green ICT, they are likely to support Green ICT efforts. The potential benefits must include particulars of how each of the stakeholders will benefit from the adoption. For instance, the shareholders might want to know whether

Green ICT adoption will improve the stock value so that they can enjoy a capital gain. On their side, the employees may want to know how Green ICT will ease their tasks at the workplace. Similar studies conducted by Weng and Lin (2011); Chulmo Koo *et al.*, (2013) and Thongmak (2016) led to similar conclusions that perceived usefulness has a significant positive impact on Green ICT adoption.

Recommendation

Several recommendations can be drawn from the research findings which can be used to optimize Green ICT efforts by the private sector and the government. Based on the positive correlation of external environment and Green ICT adoption, the organization manager should understand that Green ICT adoption can only be successful in an organization whose corporate governance and culture is geared towards sustainability. Therefore, business leaders should strive to structure the vision and the mission of the company with sustainability in mind since this would lay the ground for adopting environmental conscious practices such as Green ICT. Besides, corporate governance on practices such as procurement and waste disposal should promote sustainability and with this, the organization will be more receptive to green activities. On the other side, the government has a responsibility to protect the environment for the benefit of the future generations. Therefore, legislators should come up with policies aimed at educating people on the usefulness of Green ICT adoption as then will facilitate change of business practices in the corporate landscape. When the business community understands the importance of Green ICT adoption, they are likely to have a positive attitude towards Green ICT adoption which is key in implementing a Green ICT strategy.

Implication

These study findings have several implications on the existing knowledge and policy as well as key lessons for the researcher. The study has filled a research gap where there was no information regarding the factors that affect adoption of Green ICT in multinational companies in the country. The knowledge generated will enable future researchers to conduct in-depth analysis of the topic. As well, the information generated from this study is reliable and therefore could be used by future researchers as background to the research and literature review on Green ICT adoption. Most of the policies on Green ICT do not explain on the need to adopt Green ICT by the business community and hence most companies are reluctant on Green ICT adoption. This situation could be improved using the findings from this research which revealed the significance of perceived usefulness on Green ICT adoption. Using these findings, the government could revisit Green ICT policies to ensure that they are clear on the benefits of Green ICT to all the stakeholders of the business community. Since attitude takes time to change, the government agencies responsible for implementing Green ICT efforts should support businesses to facilitate a smooth transition to Green ICT since harassing the business persons will only make the business community to resent Green ICT efforts. At a personal level, this research has revealed to the researcher that Green ICT adoption is not a one-time event. Instead, it is the culmination of many interrelated activities such as the attitude of employees, the actions of competitors and the corporate governance. Therefore, collaboration with all stakeholders is vital in the transition to Green ICT adoption.

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