

A PROCESS OF ADOPTING GREEN INFORMATION TECHNOLOGY IN MALAYSIA

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Abstract

The process of adopting Green IT needs more attention and awareness to implement well in the organization. However, there are limited studies discusses details in Malaysia context. The importance of this study is to investigate how far Malaysia public organization adopting Green IT compares to a private company and whether public organization Malaysia could implement as well as a private company. Thus, this study brings us to identify how far the organization adopting Green IT in their company. To identify the adoption level in the organization, the study emphasizes on four processes: plan, design, implementation and measure phases. Therefore, this study applies a qualitative method, with interviewing 23 respondents from the public sector (KeTTHA, MAMPU and GreenTech) and two private IT manufacturing companies. The results show that Malaysia companies performing Green IT adoption in those three areas: asset management, energy efficiency and green practices. Thus, the results potentially can guide public organization (particularly) to evaluate and improvise the Green IT implementation.

Keywords: Green Practices, Green IT, Green Organization, Adopting Green, Malaysia

Introduction

According to Murugesan and Gangadharan (2012) Green IT or green computing divides into three perspectives: i) designing and manufacturing ii) IT supports and iii) creating awareness. The designing and manufacturing Green IT refers to using computers, servers, storage devices communication efficiently with minimal environmental impact. IT supports refer to assists and leveraging the information systems initiatives and creating awareness refers to green initiatives among stakeholders. From this definition, the benefits of implementing Green IT in the

organization can be explained in three situations: environment, economy and social aspects. In the environmental aspect, Murugesan and Gangadharan (2012) state that Green IT benefits in improving energy efficiency, lowering GHG emissions, use less harmful materials and encourage reuse and recycling. In economics, Green IT benefits in the organization in terms of the total cost of ownership (cost of disposal and recycling); whilst in social aspects, the demand for Green IT is not only coming from customer, but studies show that it comes from the workers that prefer to work at healthy and fresh

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workplace environment. Cardoso *et al.* (2019) clarifies that society is now concerned with sustainability, environmental care, clean environment and green job. Plus, Chief Executive Officer of GreenTech Malaysia mentions that the government encourages the participant from the private company to implement Green IT in their organization to avoid being left behind (Zainul, 2019).

However, previous studies reveal that Green IT design is fragile and rigid to implement by the employee (Zaman and Sedera, 2015). Lack of studies on Green IT adoption and depth information in the organization is one of the reasons why we need to conduct this study (Azmi *et al.*, 2017). Beside few studies in Green IT in the organization, the scenario in implementing Green IT in developing countries is still low including the local industry in Malaysia (Ghazilla *et al.*, 2015) even though numerous government incentives were provided to adopt the Green IT in Malaysia (Al-Rejal *et al.*, 2019). According to Yang (2020) organization interested in adopting Green IT if the package of implementation comes with cost reduction and economic benefits. However, CEO of GreenTech stated that even though there is still a lack of awareness among the corporate company in Malaysia, there is a potential for Green IT to be implemented (Zainul, 2019).

Thus, this study focuses on the adoption of Green IT management through asset management, energy efficiency and utilizing green practices in a selected public and private organization in Malaysia. These three areas were selected due to this study conducted in public and private organization as Murugesan and Gangadharan (2012) illustrate that the extend studies on Green IT research and practices have signified that three different yet critical areas need organizations' participant. Besides, as this study involves participation of five organizations which is the policy maker, IT coordinator, IT producer and at the same time IT users, Bose and Luo (2012) state the current literature on Green IT research and practices additionally suggest that organization able to become involved in shaping Green IT policies and reducing their organizations' carbon footprint in these three critical areas which comprise several activities which are design of Green IT by manufacturer, procurement, end-of-life management of IT equipment and others (asset management), developing optimizations, data center, cloud computing, utilization, reducing the use of imaging devices, virtualization and other technology (energy efficiency), and teleworking, wireless, email, e-services and others (enabling green practices). Therefore, these three areas are

significant to investigate how far public organizations adopting Green IT compare to private organizations as those organizations cover on Green IT lifecycle which is manufacturing, using, and disposing of all related IT (hardware and software) concerning eco-friendly issues (Dalvi-Esfahani *et al.*, 2017).

In addition, from three areas discussed earlier, there are several studies conducted in Malaysia in some areas such as the current situation of practices on using IT (Aghasian *et al.*, 2013; Selyamani and Ahmad, 2015; Alla and Chen, 2016), disposing of IT (Bello *et al.*, 2013; Kasbun *et al.*, 2016) and the findings are more toward green practices of using IT in the education sector (Aghasian *et al.*, 2013; Bello *et al.*, 2013; Din *et al.*, 2013; Selyamani and Ahmad, 2015; Alla and Chen, 2016) and only some studies conducted in organizations sides (Uddin *et al.*, 2012; Rahim and Rahman, 2013; Esfahani *et al.*, 2015; Kasbun *et al.*, 2016; Dalvi-Esfahani *et al.*, 2017; Dalvi-Esfahani *et al.*, 2020). Therefore, from the previous study, it can be seen that several studies only discuss on one or two mentioned areas rather than discuss on every area in adoption of Green IT. Besides those three areas focuses on this study, this study also discuss more on the process of adoption of Green IT including the comparison of Green IT adoption between the public and private sector and whether public organization Malaysia could implement as well as a private company. The objectives of this study are to identify the organization stage in implementing green IT through four processes: plan, design, implementation and measuring the plan Green IT.

The Development of Green IT in Malaysia

Many scholars express Green IT terminologies with green computing, environmentally, sustainable computing, and energy efficiency based on their perspective of business concern and organization operation. Cai *et al.* (2013) explain Green IT as IT lifecycle. It refers from design, manufacture, uses to disposal of IT hardware and software including its technologies which is data centre, virtualization and electronic waste. The scholar perspectives refer to all four activities where the government sector encompasses design, use and disposal, whereas as a private sector that comes from IT producer encompasses all four activities. Therefore, this study focus on the definition of Green IT as practices in designing, manufacturing, using and disposing of IT technologies to reduce the energy consumption, carbon emission and electronic waste.

In July 2009, the National Green Technology Policy (NGTP) established with policy statement which is "green technology shall be a driver to accelerate the national economy and promote

sustainable development” (GreenTech, 2013). For the period year of 2010-2015, Malaysia strengthening the green policy with the establishment of the National Green Technology Policy (NGTP). The NGTP focuses on four economic developments: minimizing the growth of energy consumption, the growth of Green Tech industry and innovation and public awareness (Ministry of Energy Green Technology and Water, 2017). Then, the NGTP has expanded the scope into the Green Tech Master Plan for 2017-2030. In the Green Tech Master Plan, the scope is holistic with five strategic thrusts and focuses on six sectors. Five strategic thrusts are strengthening the institutional framework; provide a conducive environment for green technology development; intensify human capital development in green technology; intensify green technology research and innovations; and promotion and public awareness for six key sectors which is energy, manufacturing, transportation, building, waste and water and attempts to harmonize the policy directions of each sector towards a common goal of sustainable utilization of natural resources (Ministry of Energy Green Technology and Water, 2017). GreenTech (2011) justifies that Green IT was adopted in Malaysia with the three waves of implementation approach planning. Wave 1 period is from 2011 to 2015, focuses on developing green data standards, telecommunicating and teleworking, promoting local companies to provide business services related to Green ICT and enhancement of e-Government initiatives. Wave 2 is starting from 2016 until 2020 which emphasized on enabling SMEs or consumers with eServices, enabling organization with Green ICT practices and legalizing e-documents. Last, wave 3 which from 2021 to 2025 which focuses on the consolidation of data centres for governments and enabling increased participation of local players. Through the wave of implementation approach, it can be concluded that this approach is not only for the government sector, it is also in the private sectors such as SMEs and local companies. Among incentives offered by Malaysia government for Green IT is in investment tax allowance energy through the use of efficient devices in the company and recycling initiatives in the managing asset company to reduce waste (Myers, 2018), jointly formulated the proposed Data Hijau Lestari (DAHLIA) program with the Green Computing Initiative to spearhead the development and management of Green IT facilities beginning with the public sector by encouraging government ministries and agencies to adopt best practices, construct energy-efficient IT facilities, and educate energy managers and information technology professionals (KeTTTHA, and Green Computing

Initiative, 2012) and provide financing scheme on project eligibility criteria for the energy sector by producing energy-efficient equipment (GreenTech, 2016). Thus, it is crucial to get data through interviewing as not many companies prefer to share their thoughts about the Green IT organization implementation.

In discussing about Green IT, there are many countries such as Japan, United Kingdom, Korea and others country have taken strive in the adoption and implementation of Green IT. Japan government promotes Green IT data center consolidation, innovative use through information platform integration and adaptation Cloud Computing with expectation a reduction of 130 million tons of CO₂ by 2025 (MAMPU, 2010) after Green IT initiative was established through the initiative of Ministry of Economy, Trade and Industry (METI) in December 2007 and both governmental bodies and industrial enterprises joined this initiative (Majima *et al.*, 2017). Besides, Cabinet Office (2011) state that The United Kingdom (UK) is one of the governments the first to launch a deep carbon reduction plan ICT in July 2008 which has been able to reduce 12,000 tons carbon with savings of 6.8 million pounds. In addition, Taruna *et al.* (2014) illustrate that developed countries such as Ministry of Science, Technology and Innovation of Denmark's efforts for the establishment of Green IT whereas Green IT Department, National Information Society Agency (NIA), Korea is targeting for a reduction in CO₂ emissions (MAMPU, 2010) with a reduction of carbon emission concentrations to 37% by the end of 2030 and ICT is one of the sectors included in the green technology adoption agenda for the South Korean economy (Batoool *et al.*, 2019). Thus, it is crucial to look at the other countries which more success in the adoption of Green IT as a benchmark in order to become more successful in the adoption and implementation of Green IT in the country in supporting NGTP.

The Process Involved in Green IT Adoption

According to Bose and Luo (2012), there are four phases to adopt green IT in the organisation. There is plan phase, design phase, implement phase and measure the performance phase. The Green IT adoption process suggests three critical areas in asset management, energy efficiency, and green practices where it will bring to the reduction of energy usage, carbon footprint and electronic waste in the organisation. Below explain the details.

Plan Phase

Plan phases needed the organisation to develop strategic thinking and innovative capability and translated into actionable activities (Unhelkar,

2016). According to Bose and Luo (2012), plan phase must include determining the current organisation position of green implementation; defining the Green IT objectives and developing Green IT organisational assessment. It includes cataloguing asset management and utilising Green IT practices among employees. The procedure needs to be implemented by identifying the recycle (assets) process and action by employee (through awareness of the Green IT understanding and trained with Green IT concept).

Design Phase

Design phase elaborates on developing a Green IT blueprint to achieve the goals in the planning phase. Bose and Luo (2012) suggest the design phase channel to whether technology use or green policies. Whether the design plan is to specify the technology use or green policies, it needs to present to asset management, energy efficiency and/or green practices. This is proved where design alternatives to minimise the impact on environmental necessary to be considered, design changes require to be developed and the prototype must be measured again for environmental impact (Murugesan and Gangadharan, 2012).

Implementation Phase

Bose and Luo (2012) explained that in this phase involved placing the design into practices with a few activities to implement the chosen technology. Bose and Luo (2012) suggest that green practices by utilising of IT through consolidation. If an organisation is currently using a number of servers that are not being utilised to their storage and performance capacity, they would be consolidated to a fewer number. Cresswell and Sheikh (2013) listed that important factor includes the system demands to fit, training, must have a good relationship with suppliers, communication and feedback, support, the necessity to address subject surrounding confidentiality and security. Besides, Unhelkar (2016) demonstrated that implementation phase includes identification risk and how to solve, interrelationship amongst work areas and their priority on management, monitoring of progress, measure for comparison and reporting to stakeholders and handling their expectation.

Measure the Performance Phase

Bose and Luo (2012) stated that measuring and monitoring the performance of Green IT that has been implemented against the organisation's environmental metrics to access whether the target goals and objective are met. Moreover, Unhelkar (2016) also added that measured, including what they do, how to change and how to bring about the

change are measured in term of the numbers of activities within the process, asset value measured, the contributing organisation make to business units and business processes and the carbon footprint. Hence, if the implementation does not fully pass the effectiveness, the Green IT adoption process would back to the planning phase and adjust.

Theoretical Framework

Figure 1 shows the theoretical framework of Green IT adoption based on secondary data that leads to the research objectives. This study listed rendered the Green IT adoption process.

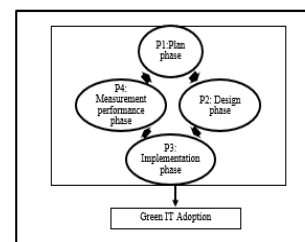


Figure 1. Shows the process involved in Green IT adoption.

Materials and Methods

The method used in this study is a combination of primary and secondary data. The primary data is collected through interviewing respondents from a policymaker, ICT coordinator, execution of Green Technology Policy and IT producers. The respondents shared their expert and experience of adopting Green IT in organizations. Five organizations are from MAMPU, KeTTHA, GreenTech, and two from 20 years establish manufacturing IT company (Company A and Company B). Semi-structured interviews and purposive sampling were conducted guided by open-ended questions with 23 respondents (six respondents from KeTTHA, six respondents from MAMPU, one respondent from GreenTech Malaysia, six respondents from Company A and four respondents from Company B) to answer the research objectives about the process involved in Green IT adoption. The secondary data is from the official website of the company to strengthen the study area.

Results and Discussion

The result shows based on the discussion of the four processes: plan phase, design phase,

implementation phase and measuring the performance phase. The public company is from KeTTHA, MAMPU and GreenTech, while private companies represent Company A and Company B.

Plan Phase

The result in the planning phase is divided into three sections: i) determine the current position of the organization; ii) defining the organization objectives and iii) developing organizational environmental metrics. In the public company (KeTTHA, MAMPU, GreenTech), the result shows that the respondents are intended to discuss on green practices in the organization compare to asset management and energy efficiency. It is agreed by 9 out of 10 respondents from the public sector. To determine the current position of the organization, respondents explain that the Green IT practices are on latest technology practices (cloud, green data centre, and virtualization) and new green technologies (server, storage, network, security and others). In defining the organization objectives, the public companies emphasize the involvement from the stakeholder to meet the social responsibility. It includes visiting local and overseas company as proof of the Green IT concept. Plus, management, professionals, IT executives will be responsible and involved in the planning, on-going process, approved project time in terms of budget and others.

A respondent from GreenTech shares his opinion regarding on Green IT in Malaysia: *"...First of all, I have run an analysis where I have studied the ICT industry in Malaysia. If we can see, there are 23 big data centre and if we viewed from the industry angle, the amount of energy used by ICT same with the airline industry which is producing a lot of carbon emissions. In the analysis, I have looked at the size, rating, and calculate the energy consumption and I have listed how much carbon footprint, how much data centre is under-perform, how much data centre over-perform and how much ICT under usage. Besides, on that calculation, I can see that which part is contributed lots in energy consumption and carbon footprint. The analysis of energy consumption took about four months and a report called as Barometer Report was released and distributed to all government agencies. The report aims to provide awareness to all agencies about the energy consumption of ICT in the public sector"*.

Contradict with the private company (Company A and B) results. In the planning phase, both private companies emphasized on asset management and green efficiency. In determining the current position, the top management contributes to ideas what should change after

coming the environmental well-being of the world, including the change of organizational culture and production sides. There are three approaches both companies defining the organization objectives. First, diagnose and research and internal audit which held research and diagnostic the energy consumption and internal energy audit on its IT equipment to understand actual areas that most energy demand including overall operation in manufacturing IT products. Second, responsible of research and development team by in the research stage, it takes the longest timeframe where the company should think and consider many aspects such the commitment of employees, potential to address human needs, launch markets and value to the customer, and many others and third conducted the lab test first for the development of products.

On the side of the private sector, 8 respondents were agreed towards this phase. One of the respondents from private sector stated that: *"... Chief Information Officer of ICT Producer A is responsible in deciding to adopt Green IT as initiative and corporate how to be better manage of energy consumption, carbon footprint and electronic waste"*. HP (2017) indicated that they set up the goal with 25% of carbon emission reduction from operation by 2025 compared to 2015.

Thus, the results indicate that that public focus on green practices and private company adopt the Green IT through diagnosing the asset management and green practices. Both public and private company shows that they use the latest technology use in data management. For instance, computing cloud, green data centre, and virtualization. Plus, results also show that they use new green technologies such as a server, storage, network, security and others. To define the organization green IT objectives, both public and private company visits to several agencies including overseas organizations. At the same time, they plan that their employee management, professionals, IT executives will be responsible and involved in the planning, on-going process, approved project time in terms of budget and others. Whereas the differences can be seen among them where the suggestions and ideas come, challenges that they need to face, visited the technologies inside or outside the country, focuses on products as the private sector are the producer of IT hardware and software, details diagnose with internal audit and research development that conducted by the overseas. However, there is no details explanation of how public organizations develop environmental metrics. Table 1 simplified of plan phase in Green IT Adoption.

Design Phase

As literature mentions that the organization may choose whether to designing the technology used or designing a blueprint for green policies, the result shows that the respondents from the public company (KeTTHA, MAMPU, GreenTech) implement both technologies used and green policies. These translated into energy efficiency and green practices. Energy efficiency includes revised the technologies, collaboration with agencies, procurement ICT products, provide a guideline/module for Green IT and person in charge. According to the respondents, revised the technology refers to the organisation has to look more detailed in the technical specifications in the range of five to six specifications. Collaboration with agencies refers to collaborate with a technology partner to obtained consultation to examine the design according to the specification provided in adopted green data centre tier 2 of institute uptime which core technology is virtualization which means servers and storage combined into one, adopted cloud, and thin client. For the green practices, disposal activities refer to the organisation also adopted disposal activities where the organisation will follow the government's standards and disposal rules under government asset 2007. Procurement ICT Products refer to ICT division responsible in making an option regarding how much price required and the

approval amount including the green requirement needed for the contractor to supply their products so that company which meets all the requirements and who supply the ICTs equipment needs to follow the take-back program and in purchasing schedules, recycle materials such as boxes, plastic need to encounter the requirements that can be recycled, Energy Star labelled RoHS and others. Provide guideline/module for Green IT refers to MAMPU produced the standards, guideline and rules for all public sectors to explain the way of adopting and activities involved in the adoption of this Green IT. And Person In-charge refers to Officers in the asset unit responsible to safeguard all the equipment. MAMPU (2010) indicated that MAMPU as an agency that pursues on the ICT modernization in the public sector was taking initiative with provided the guideline to support the Green Technology Policy. One of the public sectors highlighted: "...Design phase is the second stage of adopting Green IT after planning. In this stage, the organisation will revise the technologies to be adopted as many latest technologies regarding ICT equipment in the market. At this stage, it has allowed the organisation to re-plan the design of the structure and position in the data centre". However, the differences can be stated that the public sector is focused on the technologies that they need to adopt, such as green data centre technologies, cloud and many others. Therefore, the design phase is the phase that detailed

Table 1. The summarize of plan phase in Green IT adoption

Plan phase for Public Sector : KeTTHA, MAMPU, GreenTech	Asset Management	Energy efficiency	Green practices- utilise IT
Determining current position of the organization			Analysis of energy and carbon: Latest technology practices new green technologies
Defining the organization's green IT objectives			Employee involvement: Subordinates ideas Details study Visit to local and overseas company Proof of concept
Developing an organisational environmental metrics Plan phase for Private Sector: Company A Company B			
Determining current position of the organization	Idea contribution from top management in adopting changes in environmental		
Defining the organization's green IT objectives Developing an organizational environmental metrics			Team management participation - Producing green products

monitor is needed to ensure that it will be no risk in the implementation phase. Thus, the design phase is the second phase in the adoption of Green IT.

Whereas for the private sector, focus on designing technology used. It represents three factors: asset management, energy efficiency and green practices. For asset management, the company will investigate the raw material in manufacturing product, which is eliminating the plumbum, lead, cadmium in the product to achieve the level of magnetic. The expert will guide the implementation of standards to improve the intelligent of products, policies and protocol to secure the right to privacy of employees and customers. For energy efficiency, first designing including building, updating and operating facilities, and product development which combating to optimize the use of energy and materials, and minimize carbon emission. Second, redesign products follow green specification is in every development new Green IT product, the company will follow the rules and specification that comes from the global and meets with Malaysia's standard. Implement standard is the company has practised eco-friendly disposal which helps the movement of greener equipment and ensuring compliance with regulation and removing data before disposal. In this phase, 10 out of 13 respondents from the public sector and 9 out of 12 respondents from the private sector agreed design phase is the second phase in the adoption of Green IT.

Thus, the results indicate that the public and a private company are recognizing the technologies,

disposal activities and procurement activities, the however private sector is focused on the development new Green IT technologies and build the product specification. One of the respondents from private sectors indicated that: “....*design is one of the processes in the adoption of Green IT and stated that designing including building, updating and operating facilities, and product development which combating to optimize the use of energy and materials and minimize carbon emission. This stage is called the build stage where the company will recognize which technologies are most suitable and organisation will explore to upgrade the Green IT technologies*”. Table 2 simplified of the design phase in Green IT adoption.

Implementation Phase

In the literature, implement phase describes putting the design plan to practice, which refers to the servers that are not being utilised and consolidate to a fewer number and allow computing services to be distributed across available servers.

For a public company, results focus on energy efficiency and green practices. In energy efficiency application technologies is highlighted. The organisation in the public company, application technologies refer to the green data centre, intelligent cooling system, thin client usage, and cloud application. In green practices, IT using practices- Focused on several practices such as paperless, encouraging the use of email, using the word “Please consider before print. Please go green” in the email, encouraging every government servant with e-services such as e-government, e-Hasil,

Table 2. The summarize of design phase in Green IT adoption.

Design Phase	Asset management	Energy efficiency	Enabling green practices through the utilization of IT
Public Sector KeTTHA, MAMPU, GreenTech		Revised the technologies (Technical specification)	Disposal activities Follow the government's standards and disposal rules under government asset 2007. Procurement ICT Products ICTs equipment follow take back program, purchasing schedules, recycle materials Provide guideline/ module for Green IT MAMPU produced the standards, guideline and rules for all public sectors to explain the way of adopting and activities involved in the adoption of this Green IT. Person In charge. Officers in asset unit responsible to safeguard all the equipment.
Technology used and develop green policies		Collaboration with agencies	
Private Sector Company A, Company B	Raw material of the manufacturing product	Designing building and facilities to green Redesign green products	Implement standards Company has practiced eco-friendly disposal which help the movement of greener equipment and ensuring compliance with regulation and removing data before disposal.
Technology used			

e-procurement and others through the online services, PC needs to be closed, the ICT equipment must close, the limited paper gift in the section, introduced sharing device policy, send employees to the training called as Data Hijau Lestari (DAHLIA) Training. This is supported by secondary data where KeTTHA and Green Computing Initiative (2012) emphasised that Data Hijau Lestari (DAHLIA) programs targets a 40% decrease in carbon footprint and energy consumption of the public sector backed IT facilities with little or no capital expenditure (CAPEX) by encouraging government ministries and agencies to adopt best practices, construct energy-efficient IT facilities, and educate energy managers and information technology professionals. Employee participation refers to the organisation has carried out two types of maintenance. Preventive maintenance will be conducted regularly and the report will be produced, whereas immediate maintenance will be carried out in the event of any damage.

For a private company, they focus on asset management, energy efficiency and green practices. First, for asset management, the private company refer to recycle program. According to them, the organisation conducted recycling program which allows the organisation to go green and reduce the electronic waste along the operation based on the Waste Electrical and Electronic Equipment Regulation (WEEE) directive, product take back for recycling programs for covered products such as computer monitor, PC, batteries or packaging which vary depending on local regulations. For energy efficiency, the company focus on developing technology. They agree that the company is more focused on the virtualization technology in the green data centre, cloud technology and production side. Equipment and infrastructure have been innovated in engineering processes such as virtualization technology and cloud technology, which improves the efficiency of server and storage device where it can increase the processing loads and boosts the individual utilization rates which tend to provide a compelling rate of investment (ROI). In terms of green practices, the Company also encourages employees to practice, use the computer in a green manner. Besides, the company also provides

instruction and rules where employees should be practising the Green IT practices in the company as an awareness of them to save energy consumption.

At this stage, both public and private companies contained the development of technologies such as virtualization, cloud and products. The practising was held for both sectors where it follows the instruction and rules. In this phase, 23 out of 23 respondents from both sectors were agreed that the implementation phase in the adoption of Green IT. One of the respondents from the public sector mentioned: *"...Implementation is a process we are running after the design stage where this stage will lead to a reduction in energy consumption. This is because, if the analysis is carried out with the design, if no actions are taken, it will not be successful"*. However, the differences can be seen where the practices through the checklist and competition among the department. The public sector is more on energy efficiency and green practices, while private company focus on three elements: asset management, energy efficiency and green practices. Thus, it can be seen that competition is one of the way organisation should conduct to ensure that everyone in the organisation is applying practices as stated by one of the respondents from private sectors: *"...For those who are careless in practising Green IT in the company and not following the rules, the company will provide the penalties. For example, when staffs left the PC for the meeting or going to the washroom, then they are careless not to put the PC in the lock or screensaver when it caught by the others, the number of that PC will be taken and one letter will be passed to the Chief Executive Officer to take action. This is one of the ways to put staff in the awareness stage to secure the data of the client. Besides, every employee is encouraged to work from home as one way to reduce energy consumption in the organisation. Anyhow, in manufacturing sides, the company will emphasize the enforcement to ensure that besides practising of Green IT, the usage of materials also will follow the rules based on the product stewardship objectives"*. Table 3 simplified the results for the implementation phase.

Table 3. The summarize of implementation phase in Green IT adoption.

Implementation phase	Asset management	Energy efficiency	Enabling green practices through the utilization of IT
Public Sector KeTTHA, MAMPU, GreenTech		Application of technologies green data centre	IT using practices - paperless, email, and e-services Employee participation
Private Sector Company A, Company B	Recycle program	Develop the technologies	IT using practices

Measure the Performance Phase

Measuring performance phase refers to organisation environmental metrics. In this stage, 12 out of 13 respondents from public sectors and 8 out of 10 from the private company were agreed towards the measure the performance phase as one of the phases in the adoption of Green IT.

The result from the public company shows that the measurement process involved three factors: asset management, energy efficiency and green practices. In asset management, auditing asset in a public company is compulsory. An audit will be conducted annually to ensure the safety level and the assured equipment implemented by Standard and Industrial Research Institute of Malaysia (SIRIM). Internal and external audits will be conducted to determine the reach the objective or otherwise. For energy efficiency, the technology performance the measure is held to determine the effectiveness of development. Cloud reduces 40% of energy consumption, 60% reduction by application of green data centre, 40% reduction of energy by virtualization, ROI reduction to RM7000-RM8000 annually and Green IT adoption does not only conserve energy consumption, but it also saves on expenditure when viewed from the aspect of maintenance, human resources, and others. KeTTHA and Green Computing Initiative (2012) affirmed that virtualization can reduce energy consumption in the data centre around 10% to 40%, improve scalability, reduce downtime, faster deployments, speeds up disaster recovery efforts, move entire systems in just a few second and many others. In green practices, the results show the employee awareness. The effectiveness of Green IT retrieval using the employees. Awareness of every employee is very high. 90% of effectiveness and it has transformed the employee's attitude through the consciousness of the organization by promoting the proposed practices. Actively implemented a green technology exhibition called as International Genetically Engineered Machine (IGEM) which has been organized to attract them to see the technology that has been developed and from there we can see the efficient stage where they can use or come out with the new ideas related to Green. The promotion is being actively implemented on Green IT through a briefing to improve public awareness while explaining to them green goals in helping the world to get a good impact with the reduction of global warming and carbon emission at the same time developed another product called as Eco2 and thermodynamic solution for the green data centre.

For a private company, measuring phase based on asset management, energy efficiency and green practices. In energy efficiency, measuring the effectiveness of the technologies, including the

green products that have been produced to take control to systematize energy consumption. In this stage, the company will measure through innovative energy management software which possible to have energy billing metrics to control the consumption of IT energy in the company, saved up to 50% of energy through the green data centre, 80% energy-efficient technologies on virtualization, cloud, server and storage, and saved 53% of annual energy saving. For green practices, Employees have responsibility for carrying company corporate policy on energy conservation and climate protection program which including the strategy and action to reduce carbon emission. However, the effectiveness level among the employees is still in the medium level at the operational level but the high level at the top management level. The company was held internal audit, once a month which comes from the employees itself to calculate the energy efficiency to ensure that the company is always compliance with the green specification. External audit held by The Department of Environment (DOE) is responsible for conducting an energy audit for the equipment, quality of products and others. From the audit, DOE will provide a suggestion for the improvement. Outsourcing (2010) illustrated that cloud that has been developed by the company provides reduction of cost, improve agility and enhance user experience which proven benefits in reduction of labour cost by 50% to 75% of capital utilization improvement and license cost reduction. Furthermore, IBM (2017) stated that annual energy savings achieved using the solution increased by 52 per cent to 41,000 MWh from 2015 to 2016.

From five organizations highlighted on this phase, the similarities among them can comprehend through the measurement of technologies that have been implemented where all organizations showing the high of reduction. Besides, the similarities among them are the level of awareness and audit. As one of the respondents from public sector mentioned: *"...measure phase is a stage after the development. The measure is held to determine the effectiveness of subsequent development to decide whether it should be continued or otherwise"*. Besides, one of the respondents from private sectors illustrated: *"...Company will measure the effectiveness on the manufacturing sides, operation, products and others to continually improve company performance. From the development, the company has reduced carbon emission through the virtual and cloud up to 90,000 tons of carbon emission annually"*. The differences can be seen where the public sector is focused on the upcoming technologies including future technologies. As

Table 4. Summarize of measure the performance phase in Green IT adoption.

Measuring phase	Asset Management	Energy Efficiency	Green practices
Public Sector KeTTHA, MAMPU, GreenTech	Auditing asset	Technology performance	Employee awareness
Private Sector Company A, Company B	Auditing the performance of the energy saving products	Systematize energy consumption through technology performance	Employees responsibility

mentioned earlier, private sectors are going to evaluate their products to ensure the effectiveness of products so that they can be supplied to the customers. Both sectors fulfil the asset management, energy efficiency and green practices in their organisation. Therefore, results show that measure phase involves many aspects of which are the measurement of energy, carbon emission, costs including equipment costs and human resources costs, measurement of the effectiveness level of employees. Besides that, in this phase, as IT technology is rapid growth towards circulation, both sectors which are public and private sector, companies must prepare the strategies for future ICT technology either focusing on the other organization or product development for a business opportunity. Therefore, the organization will also look back at the planning phase if it is not successful and will always see the next futuristic technology. Hence, the measurement phase is a stage where the effectiveness and advantages can be seen accurately. Table 4. simplified the Implementation phase.

Conclusions

Malaysia intensity to implement Green IT in the organisation is proven through the investigation in the four phase's process. Even the results show inconsistent from the planning phases for the public company, however the tendency to improve Green IT adoption in the organisation is determined. Results reveal that Malaysia public and a private company have fulfilled the Green IT adoption in a different phase to accomplish the Green Tech Master Plan by 2017-2030. The different path in adopting Green IT in the organisation, gives benefits to policy-maker such as MAMPU, to improve the Green IT process in both sectors and evaluate the gap between them. This is the best way too stringent the enforcement to the organisations to the Green IT. public sector will be able to develop the Green IT strategies and Green IT agendas to ensure that the Green IT could improve the adoption and well-spread implementation of Green IT. Finally, the

results can be a guideline and reference for the researchers to conduct the other renewable energy sources such as solar computing where this initiative has been developed and produced by the other countries such as solar photovoltaic keyboard as Malaysia market about the solar photovoltaic in still low development.

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