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Green IT Framework implementation– a study in Ministry of Interior, Kingdom of Bahrain

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Abstract: ***The purpose of this study was to implement a Green IT framework suitable for Ministry of Interior (MOI) which large organization that have good resources to implement these Green imitative. This study can show the levels of awareness of Green IT that currently exists among MOI and find out about the current rates of using of Green IT among MOI. Data required for the study was collected using three methods: observation, interviews and questionnaires. The study shows that the level of awareness among MOI regarding Green IT is low. In general the government organization is slow to adopt Green IT practices when compared to their non-government organization. This research proposes some recommendations and Green IT tips that can guide and direct MOI in the implementation of a Green IT project and to list the gaps of the implementation.***

Keywords: Green IT, e-waste, data center, recycling, virtualization

I. INTRODUCTION

Environmental responsibility and sustainability have emerged as important considerations for the broader community and for organizations today. Now a days most of the government organization in Bahrain start Complying with all relevant environmental legislation and adhering to agreements and standards at local, national and international levels .

Green IT is fairly new concept it's also called Green Computing. There's only few definitions of Green IT Simon Mingay defines Green IT in a Gartner report titled "Green IT[1]: The New Industry Shock Wave". defined Green IT as the "optimal use of ICT for managing the environmental sustainability of enterprise operations and the supply chain, as well as that of its products, services, and resources, through their life cycles. " Proposed by Hiner [2], Green IT is the computer industry's effort to obtain a more sustainable civilization. [3]

Recently most of the organization in Kingdom of Bahrain has been widespread interest in Green IT. Now Green IT has moved from 'save the planet' to 'save the organization money'. Where there's no matter an organization's size or industry, it can realize business and environmental benefits through Green IT [4][5]. Ministry of Interior is one of the biggest organizations in Bahrain made up of enterprises which employ more than 20 thousand persons. The Green IT recommended activities are often more applicable to large organizations that have the extensive resources to implement these Green initiatives [6][7]. This research paper shows the ways to save energy, cost-savings and environmental benefits from implementing Green IT project in MOI.

II. METHODOLOGY

This research paper aims to identify the Green IT practices suitable to MOI by evaluating the current level of knowledge and adoption of Green IT among MOI and identifying the barriers associated with Green IT.
The aim of the study is to address one primary research question:
PQ1: "What is the best-practice cost-saving innovative Green IT framework and steps to follow suited to MOI?"
Depend on this primary question the study will demand to answer the following 4
Related secondary questions:
SQ1: "What levels of Knowledge currently exist regarding Green IT among MOI?"
SQ2: "What are the levels of adoption that currently exist regarding Green IT among MOI?"
SQ3: "What are the barriers to implementing Green IT in MOI?"
SQ4: "What are the benefits MOI can achieve by implementing Green IT as government organization?"

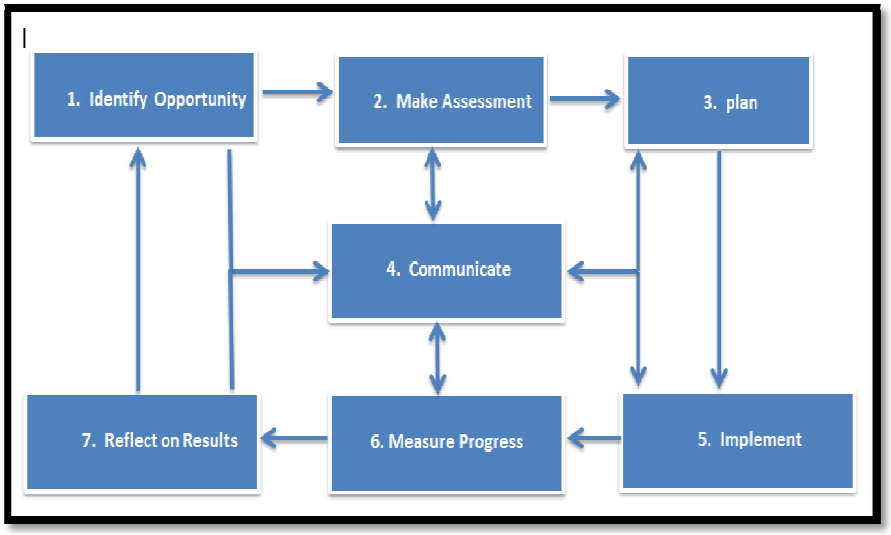

Figure 1: Proposed Green IT Framework Suitable for MOI

The choice of research design in this study includes data collection analysis from three research methods: Questionnaires, interviews and observations.

2.1 Sampling Procedure

HR Department in Ministry of Interior chosen as the population for the study because it has covers most of cases in this study. Also HR department covers the biggest number of employees and tasks in the ministry how using information technology in their daily work. This survey was distributed to the managers, IT managers, IT employees, the normal employees in the department who's using the Information technology in their works. The survey distributed to other government organization in Bahrain, ministry of finance, ministry of education as well as ministry of work. The researchers tried to cover all the business line to have a large number of answers from different employees in different jobs in the department.

2.2 Instrumentation:

This research was carried out through an online survey of Green IT in ministry of Interior .For the purpose of the study; the respondents were presented with the questionnaire regarding using the website. The research measurement items were translated into questions in the questionnaire. This research study wishes to utilize a questionnaire containing (mainly) closed-ended and open-ended questions administered to the respondents as the instrument for data collection.[] By using open-ended questions, the study participants shall be in a position to express their views with minimal limitations and closed and open ended questions can catch the authenticity, richness, depth of response, honesty and can dour which is the hallmark of quantitative data. Closed-ended and a limited amount of open-ended questions is the best approach to explore the views and opinions of the respondents to the study.

2.3 Data Collection:

Data has been obtained from primary and secondary sources. Primary source used is persons with direct knowledge of a situation. And the secondary research consisted of the literature on several aspects relating to Green IT [8][9]. The main sources of secondary data were found in online sources, such as websites of Research Institutes, online journals a, published books. Primary data was obtained through observation, interviews and questionnaires.

2.3.1 Interviews:

Some interviews were carried out with IT professionals at management level at selected ministries and organizations. The questions were loosely aligned with the questions in the questionnaire and heavily tied to the themes exposed in the literature review.

2.3.2 Questionnaires:

In contrast to in-depth and semi-structured interviews, the questions that are asked in the questionnaire in this study were exact and clear-cut prior to data collection [10]. The questionnaire designed for this study consisted of 18 questions. In addition to these questions, the start of the questionnaire asked the respondents to provide some demographic details and other basic information about their organization e.g. quantity questions like the number of employees and number of printers.

1. Do you have a server room / data center?
2. Does your organization have power management implemented on PC and Peripherals?
3. Does your organization reducing unnecessary printing?
4. Do you know what percentage of your organization's energy use is attributed to IT Equipment?
5. Does your organization have a written policy regarding recycling of old IT Equipment?
6. Are your organization's employees aware of the environmental impact of IT equipment?
7. Which of the following statements best describe your company's current Involvement with Green IT? (Please tick one).
   - We have not considered Green IT yet 18.3 %
   - We are planning to launch a Green IT project 20.41 %
   - We are currently running a Green ITproject28.5
   - We have implemented some Green IT practices but will not be implementing
   - anymore12.2
   - We have implemented some Green IT practices and are planning to implement some more Green ITpractices20.2
   - Other: (Specify)……
8. Perceived Benefits of Green IT Please number each of the benefits listed below in order of importance to your organization. Number the most important1, the next 2 and so on. If a factor has no importance at all, please leave blank.
   - Reduce your organization carbon footprint [ ]
   - Reduce e-waste [ ]
   - Re use of IT equipment [ ]
   - Reduce energy consumption and saving money [ ]
   - Extending the life of equipment and Refurbishing IT equipment for reuse [ ]
   - Reducing waste such as wasting energy, wasting space and wasting materials [ ]
   - Contribution to your organization's overall social responsibility
   - Comment:
9. Perceived Barriers to and challenges associated with Green IT Please number each of barriers listed below in order of relevance to your organization. Number the most important 1, the next 2 and so on. If a factor has no importance at all, please leave blank.
   - Culture – The business does not care about being Green IT[ ]
   - Costs – perceived as barrier to Green IT[ ]
   - Organization Not sure what to Green first (PCs, printers, servers)[ ]
   - Lack of knowledge and understanding of the benefits of Green IT[ ]
   - Complexity of implementing and maintaining Green IT[ ]
   - Perceive management's lack of support or its resistance as a big barrier [ ]
   - Perceive the employees' lack of support or their resistance as a big barrier [ ]
   - Comment:

10. Please tick the box beside the Green IT practice; below that your organization plans to introduce. Please leave blank if your organization has no plans to implement the practice.

Practice 1 – Policies and Performance Management

- Implement a responsible environmentally aware purchasing policy [27.7 %]
- Implement an electronics and IT equipment recycling policy [51.5 %]
- Include environmental performance in performance reviews for employees [21.2%]

Practice 2 – Strategic Asset Management

- Integrate measures to extend hardware lifespan in strategic plan [ ]
- Plan incremental upgrades for mid-life hardware [ ]
- Upgrade power supplies for mid-life computers where possible [ ]
- Replace inefficient equipment with responsibly purchased new equipment [ ]
- virtualize your servers [ ]

Practice 3 – Energy Consumption

- Implement power management [ ]
- Consolidate and reduce the number of deployed devices [ ]
- Evaluate the layout and design of the server room [ ]

Practice 4 – Supporting Green Business

- Implement duplex printing by default where possible [ ]
- Enable network scanning and desktop faxing [ ]
- Develop posters and presentations with energy- and paper-saving techniques [ ]
- Support electronic document management system i.e. paperless office [ ]

Likert Analysis Questions:

The choices are: Always frequently Sometimes Rarely

11. Green IT offers, or has the potential to offer, your organization benefits.
12. Green IT is consistent with your overall organizational strategy.
13. Your organization is fully aware of what actions are categorized as Green IT
14. The cost of implementing Green IT practices is justified by the benefits to be received.
15. The top management team in your organization is actively supporting and leading the drive for Green IT practices.
16. Your organization has sufficient resources to implement and maintain Green IT practices.
17. Energy costs will heavily influence your organization adoption of Green IT practices.
18. Your organization is aware of several Green IT practices that cost very little or nothing at all to implement such as double sided printing and turning off IT equipment when not in use.

III. DATA ANALYSIS

Data was collected from Ministry of Interior as well as other government organizations the aim of this is to understand the topic of Green IT in MOI while comparing the result from other government organizations, comparing between them will assist in answering the primary and secondary research questions. Data collected has categorized under four different headings in order to highlight the main findings which were based on the four secondary questions. The headings are Awareness, Adoption, Barriers and Benefits.

3.1 Findings from Interviews

Data was collected form 4 interviews, 3 from other ministries in Bahrain and1 from Ministry of interior (MOI).

Table 1: Details of 5 interviews

Interview No:	Organization name	Interview Method	Job Title	Organization's Size
1	Ministry of finance	In-person	IT Manager	Medium
2	Ministry of interior	In-person	Technical Coordinator	Large
3	E_ government	Telephone		Medium
4	Public commission for the protection of marine resources, Environment and wildlife	Telephone	IT Manager	Medium

3.2 Findings from Questionnaires

The findings from the questionnaires, in keeping with the other methods, are presented below, represented using the same four categories; Awareness, Adoption, Barriers and Benefits.

3.2.1 Awareness

The results from Q6, Q13 give an indication of the level of knowledge organizations have in relation to Green IT. These results:

Table 2: Questions Addressing Awareness of Green IT

Awareness	
SQ1: "What levels of Knowledge currently exist regarding Green IT among MOI?"	Q6 Employees awareness of environmental impact of IT Q13 Fully aware of what is a Green IT action

Q6: Are your organization's employees aware of the environmental impact of IT equipment?

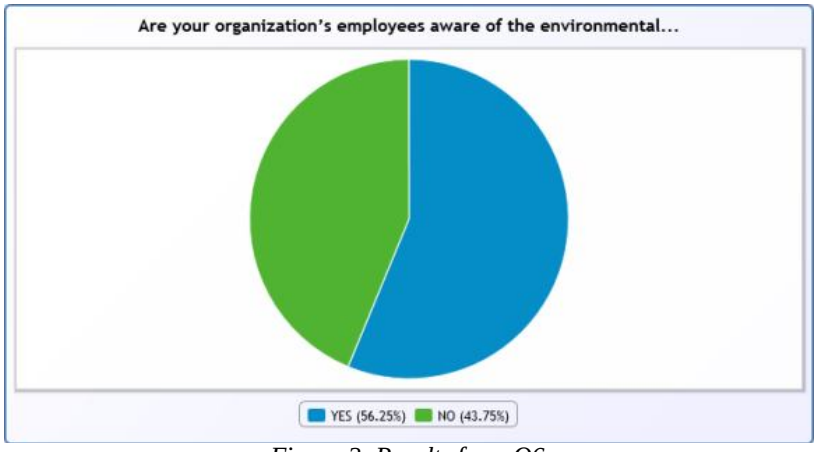

Figure 2: Results from Q6

Figure 3 show that 56 % from the organizations surveyed stated that their employees were aware of the environmental impact of IT equipment this show that the most of the stuff have knowledge about green IT , but if the stuff have knowledge about green IT not mean that they working in green practices for green IT .

Q13: Your organization is fully aware of what actions are categorized as Green IT?

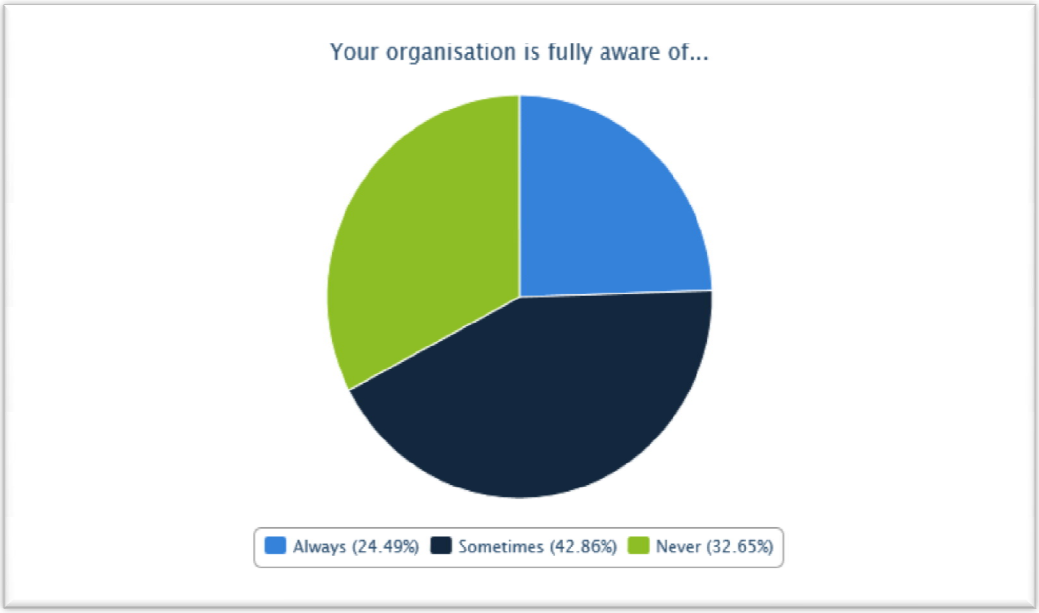

Figure 3: Results from Q13

Figure 4: shows that 24 % of the surveyed answer always, 42 % sometimes and 32 % of them said the organization never aware of what actions are categorized as green IT.

3.2.2 Adoption

The results from Q2, Q3, Q7 and Q10 give an indication of the current level of adoption that exists in organizations in relation to Green IT.

Table 3: Questions Addressing Adoption of Green IT

Adoption	
SQ2: "What are the levels of adoption that currently exist regarding Green IT among MOI?"	Q2 Power management Q3 Reduce printing Q7 Company's current level of involvement in Green IT Q10 Green IT practice(s) that have been implemented

Q2: Does your organization have power management implemented on PC and Peripherals?

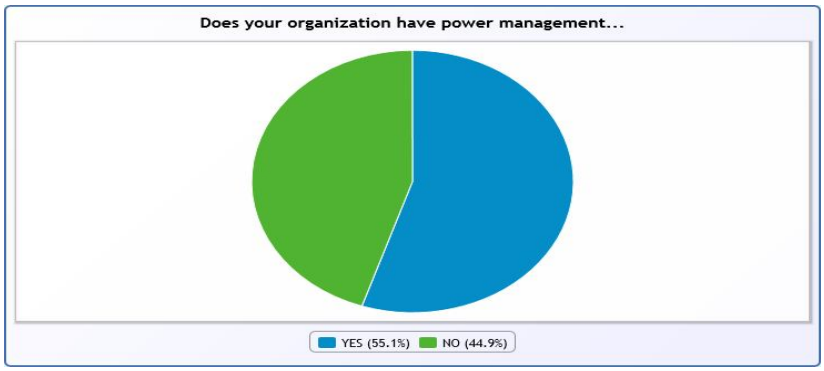

Figure 4: Results from Q2

Figure 6 shows that 55.1 % of the organizations surveyed have applied power management and 44.9 % still not applied power management implemented on PC and Peripherals.

Q3: Does your organization reducing unnecessary printing?

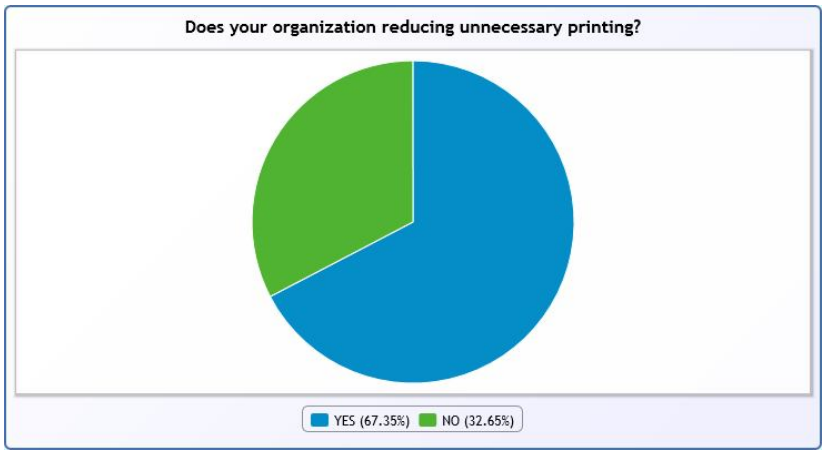

Figure 5: Results from Q3

Figure 7 shows that 67.3 % from organization reducing unnecessary printing and 32% still not starting to reduce unnecessary printing.

Q7: Which of the following statements best describe your company's current Involvement with Green IT?

The question asked the respondents to select the option that best described their organization's current involvement with Green IT They were given a choice of 5 options and none of the respondents selected the last option which was other: please specify.

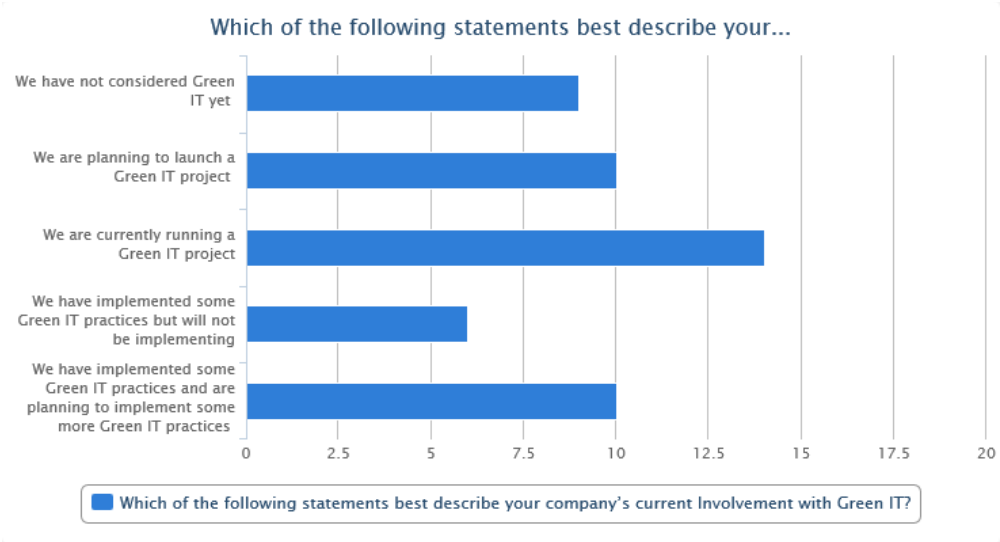

Figure 6: Results from Q7

From Figure 8: the result can be described as:

- We have not considered Green IT yet 18.3 %
- We are planning to launch a Green IT project 20.41 %
- We are currently running a Green IT project 28.5 %
- We have implemented some Green IT practices but will not be implementing anymore 12.2 %

- We have implemented some Green IT practices and are planning to implement some more Green IT practices 20.2 %.

Respondents were asked in Q10 to select from a list of 19 Green IT actions the ones that their organization had already implemented. The results revealed the following:

Practice 1 – Policies and Performance Management

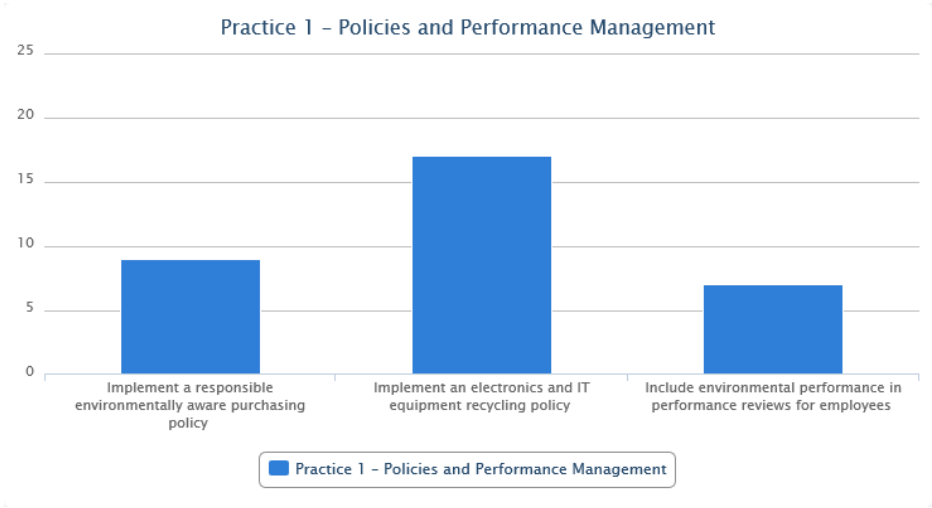

Figure 7: Practice 1

- Implement a responsible environmentally aware purchasing policy [27.7 %]
- Implement an electronics and IT equipment recycling policy [51.5 %]
- Include environmental performance in performance reviews for employees [21.2%]

Practice 2 – Strategic Asset Management

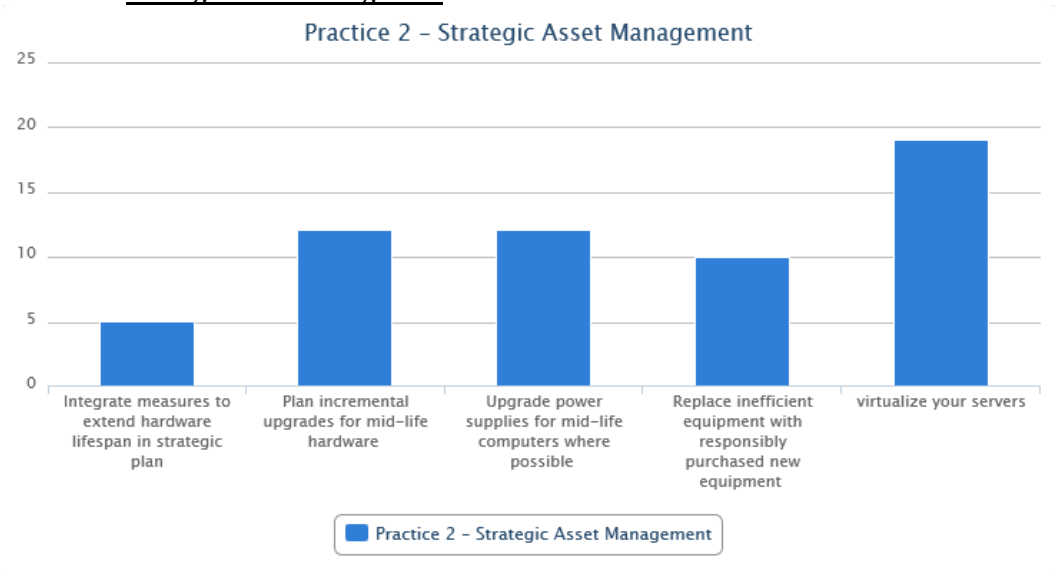

Figure 8: Practice 2

- Integrate measures to extend hardware lifespan in strategic plan [15.2 %]
- Plan incremental upgrades for mid-life hardware [36.4%]
- Upgrade power supplies for mid-life computers where possible [36.4 %]
- Replace inefficient equipment with responsibly purchased new equipment [30.3 %]
- virtualize your servers [57.6 %]

Practice 3 – Energy Consumption

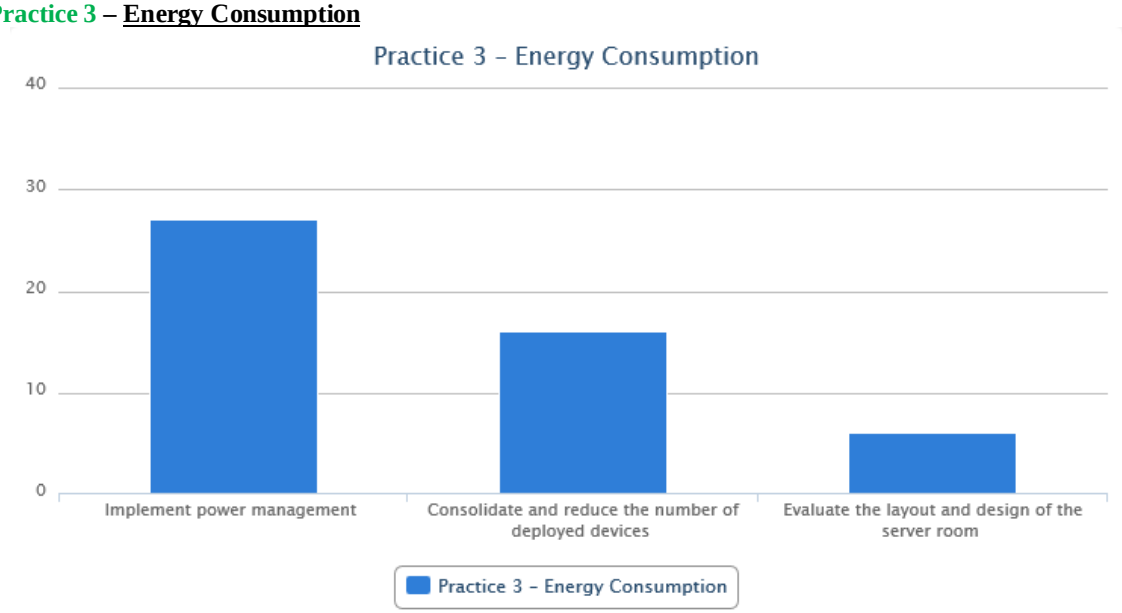

Figure 9: Practice 3

- Implement power management [73.0 %]
- Consolidate and reduce the number of deployed devices [43.2 %]
- Evaluate the layout and design of the server room [16.2 %]

Practice 4 – Supporting Green Business

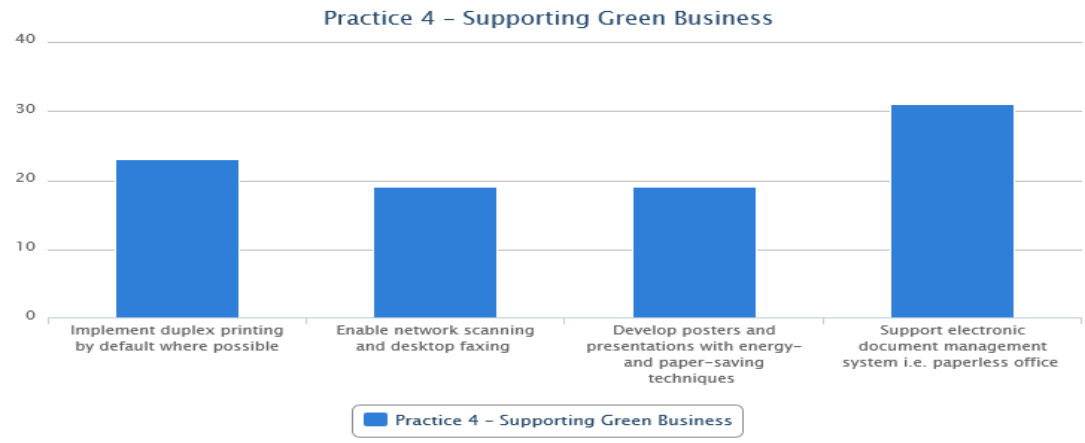

Figure 10: Practice 4

- Implement duplex printing by default where possible [53.5%]
- Enable network scanning and desktop faxing [44.2%]
- Develop posters and presentations with energy- and paper-saving techniques [44]
- Support electronic document management system i.e. paperless office [72.1]
-

3.2.3 Barriers

The answers given in the questionnaires to Q9 and Q16 assist in identifying potential barriers associated with Green IT.

Table 4: Questions Addressing Barriers of Green IT

Barriers	
SQ3: "What are the barriers to implementing Green IT in MOI?"	Q16 Do you have enough Resources? Q9 Perceived Barriers

Q16: Your organization has sufficient resources to implement and maintain Green IT practices?

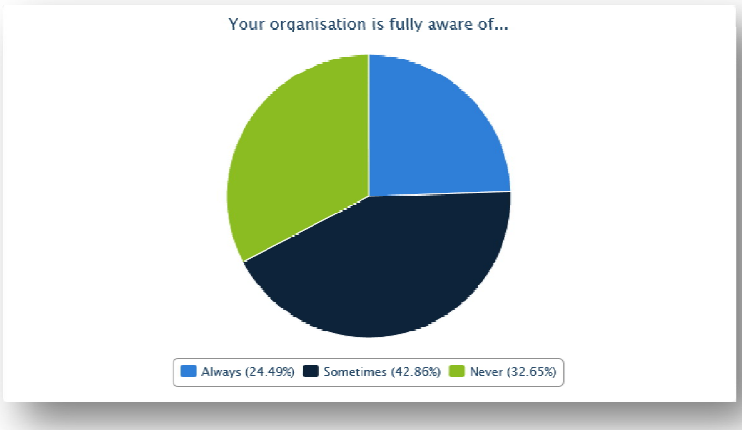

Figure 11: Results from Q16

Both financial and human, can be a barrier to Green as showed from Figure 14 also this figure show that they are not sure if they have sufficient resources t to implement Green IT actions.

Q9 asks the respondents to select the barriers associated with Green IT in order of relevance to their organization.

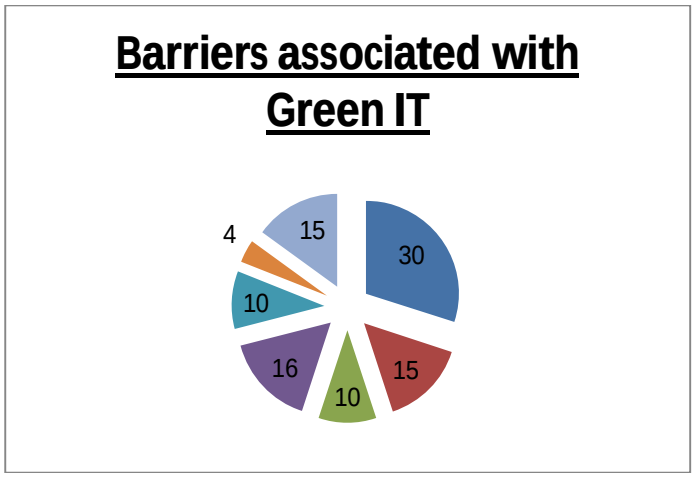

Figure 12: Results from Q9

Figure 15 shows the barriers associated with green IT as following:

- Culture – The business does not care about being Green IT[10 %]
- Costs – perceived as barrier to Green IT[10 %]
- Organization Not sure what to Green first (PCs, printers, servers)[10%]
- Lack of knowledge and understanding of the benefits of Green IT[32%]
- Perceive management's lack of support or its resistance as a big barrier [3%]
- Perceive the employees' lack of support or their resistance as a big barrier [30 %]

3.2.4 Benefits

The benefits associated with Green IT meant reviewing the answers to Q8.

Q8 from the questionnaire was a ranking question in which the respondents were
Asked to place the listed 8 Green IT benefits in order of importance in relation to their individual organization

Table 5: Questions Addressing Benefits of Green IT

Benefits	
SQ4: "What are the benefits MOI can achieve by implementing Green IT as government organization?"	Q14 Are the costs justified? Q17 Influence of energy costs Q8 Perceived benefits

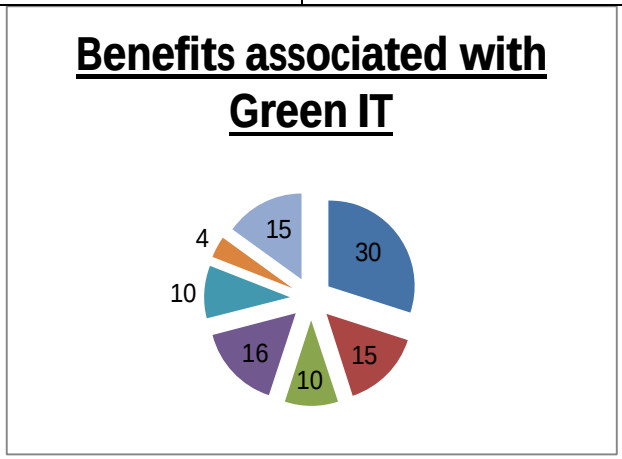

Figure 13: Results from Q8

Figure 17 shows the barriers associated with green IT as following:

- Reduce your organization carbon footprint [30 %]
- Reduce e-waste [15%]
- Re use of IT equipment [10 %]
- Reduce energy consumption and saving money [16 %]
- Extending the life of equipment and Refurbishing IT equipment for reuse [10 %]
- Reducing waste such as wasting energy, wasting space and wasting materials [4 %]
- Contribution to your organization's overall social responsibility [5%]

IV. CONCLUSION

The results obtained from the research were categorized under four headings: Awareness, Adoption, Barriers and Benefits. Findings from observation, interviews and questionnaires were presented in that order. The aim is to answer the 4 secondary research questions and equipped these answers subsequently be able to answer the study's primary research question. The research demonstrated that the level of awareness regarding Green IT is low. Some Ministry of Interior (MOI) surveyed not knowing, what practices belong to the Green IT category. MOI in general are slow to adopt Green IT practices particularly when compared to other larger organization this caused of a government organization not profit organization. The study identified that a worrying 46 % of MOI surveyed, have yet to consider Green IT. The level of knowledge organization possesses on the subject of Green IT will greatly determine the level at which it will embrace any new Green IT technique. In conjunction with that, raising awareness on the potential benefits and barriers associated with Green IT can accelerate the adoption process of new Green IT ways. In relation to Green IT the barriers that MOI encounter are costs, lack of knowledge understanding of the benefits associated with Green IT , Culture resistance from employees , resistance from top management , budget . The study revealed that the benefits MOI can achieve by implementing Green IT are: Being kinder to the environment, Cost-savings, improved reputation, increased efficiency. Upon reflection of the findings from the research, we propose a list of guidelines for MOI, in relation to their approach to Green IT way. These guidelines make up a 7-step framework. The steps are as follows: Identify Opportunity, Make, Assessment, Plan, Communicate, Implement, Measure Progress and Reflect on Results. This framework is a cost-saving one, as the study focused on those Green practices that cost little or nothing to implement like turning off Personal Computers, using double-sided printing and utilizing power management systems to turn off computers when idle. This framework is called a best practice one, the most efficient and effective way of completing a Green IT project.

Figure 1 shows that the framework is based on repeatable procedures. Green IT development is still at an early stage. We expect the technology behind Green IT solutions to be ever evolving and improving hence why the framework is called an innovative one.

V. RECOMMENDATIONS

- Ministry of interior in their green IT way should Consider environmental factors in service level agreements and performance measures :
  - Power measures.
  - CPU loads on servers
  - Storage utilization, especially for attached storage
  - Desktop virtualization uptake
- The ministry should conduct frequently survey of the different stuff in different department on campus to measure the awareness of and participation in current green IT practices.
- Measure and evaluate the success of the awareness program and the adoption of conservation.
- The ministry should work with other government organization same ministry of finance to take some experiences of green IT good practices running there.
- Dissemination the knowledge about green IT between the ministry stuff and the benefit of it to the environment and to the ministry by sending graphical emails about that.
- When purchasing new IT equipment the ministry should choose energy-saving devices that have been manufactured in an environmentally.
- Start running a new green IT strategies in paper cut project such as :

  Video Conferencing

  The objective of this strategy is the reduction in travel and staff time/costs through enhanced video-conferencing.

  The Use of Personal Computers (and Laptops)

  The objective of this strategy is to reduce the energy consumed through the use of computers

  Virtualization

  The objective of this strategy is to encourage the adoption of consolidation and virtualizations, leading to a more efficient and flexible IT operation. Planning and adoption to consolidation and virtualization across the ministry

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