An Investigation on current situation of green ICT in University Technology Malaysia - Based on Stage of Growth and monitoring Green Technology Standardization criteria

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Abstract

Information Technology is known as one of the most important elements in changes and the development of the current world and consequences from it will have a direct impact on people. These changes will carry words such as: Electronic commerce, Electronic Banking, Electronic city and even electronic government. It's been many years that Electronic development is practically used in many countries yielding large capital returns and saving significant resources and capacities for those countries. Green ICT as one of the emerging concepts born with the development of Information Technology. It would cover concepts such as Carbon Dioxide Emission from computer hardware, green transportation and so. The current situation of progress in green ICT in UTM has been investigated in this paper. There are various tools to gauge project progress aspects. We used "Stage of growth" as our strategic tool to investigate the progress of green technology establishment in a different area for UTM with concentration on Green ICT. Our evidences on the current situation of UTM revealed that UTM has passed the first stage of growth successfully, whereas UTM has been known as a pioneer in green Technology and technology development in Malaysia. Therefore, it is expected to represent the better level of progress and effort to be green. Our findings show that there are many reasons, which caused this failure. Among these reasons, we concentrated on management role as a key player on this Deviation. Finally, we offer to recover the failure by a new applicable methodology in the form of establishing a steering committee for Green ICT Implementation in order to compensate current situation.

Key words: Green Technology, University technology Malaysia, Management role in green technology, stage of growth, Green ICT, Green ICT standards.

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1. INTRODUCTION

Information and communication technology (ICT) consumes energy, but it is also an important means to conserve energy. Classically, it did so by optimizing the performance of energy using systems and processes in industry and commerce. In the near future, ICT will also plays a critical role in supporting the necessary paradigm shifts within the energy sector towards a more sustainable generation of electricity [1]. The field of "green technology" encompasses a continuously evolving group of methods and materials, from techniques for generating energy to non-toxic cleaning products [2]. The present expectation is that this field will bring innovation and changes in daily life of similar magnitude to the "information technology" explosion over the last two decades. In these early stages, it is impossible to predict what "green technology" may eventually encompass. During recent decades, our beloved “Green Earth” has experienced a rapid increase in population while its natural resources were terribly limited. In addition, Earth residents are polluting the Earth severely [3]. As the result, human clicked a compensation program to run and tried to replace industrial and more scientific and even fiction solutions. On the other hand, ICT can make some of the best tools for measuring and reporting carbon emission and either reducing them [4]. One of the most outstanding solutions, which have been run by genius scientist, is keeping the natural resource sustainable. All these global efforts on suitability are categorized as “Green”. UTM as a predominant university in technology and pioneer in engineering education and research in Malaysia has conducted a new innovative plan for green technology university. This paper aimed to point the current situation of green technology progress in UTM focusing on Green ICT.

2. ICT and the Environment

The impact of the ICT could be considered as three different aspects:

1. Direct: that refers to ICTs themselves, for instance e-waste and energy consumption
2. Indirect: That refers to applications of ICT such as smart grids
3. Third-order and rebound: this is referring to impacts enabled by the direct or indirect use of ICTs, such as greater use of more energy efficient transport [5].

It is clear that attempts to measure the impacts of ICT on the environment should take account of the potential rebound effects and the entire life cycle, rather than simply the direct impacts of the product or application itself [6].

2.1 Green Technology and Green ICT

Current studies on ICT define it at different aspects and perspectives. Definitions created and proposed by Mingay [7], Mines & Davis [8], Nunn [9], Murugesan [10] and Molla [4], focus on industry and business aspects in terms of resource consumption, e-waste production and carbon footprint. Moreover, Green ICT also defined more generally from perspectives of organizational, economic and social [11] [12] [13]. Green ICT is known as a plan to encourage stakeholders engaged in ICT activities to deal with environmental problems and discover solutions to them [14]. Green Technology is the development and application of products, equipment and systems used to conserve the natural environment and resources, which minimize and reduces the negative impact of human activities [15].

Green Technology refers to products, equipment or systems, which satisfy the following criteria:

- It minimizes the degradation of the environment;
- It has zero or low greenhouse gas (GHG) emissivity is safe for use and promotes a healthy and improved environment for all forms of life;
- It conserves the use of energy and natural resources; and
- It promotes the use of renewable resources [15].

On the other hand, Green ICT frequently refers to meeting the requirements of present generations not including compromising the ability of prospect generations to meet their requests and entails pollution prevention at the end of a product's use, product stewardship in order to minimize the environmental footprint during use, and use of clean technologies to lessen and reduce the make use of polluting material and expand and develop environmentally friendly competencies [16]. Furthermore, Organization for Economic Co-operation and Development (OECD) in "Greener and Smarter" report defines "Greener ICT as ICT with a better green and environmental performance rather than the earlier generations (direct impacts) as well as the technology made the most of to develop environmental performance throughout the economy and society (enabling and systemic impacts)" [17].

2.2 Background of green Technology

A dawning era of creativity and innovation in "green technology" (also known as "clean technology") is bringing the promise of a healthier planet. Green Technology is a non-profit initiative designed to inform government efforts toward sustainability, providing a forum in which government officials can communicate with those in the private sector who are developing and distributing green technologies [18]. The field of "green technology" encompasses a continuously evolving group of methods and materials, from techniques for generating energy to non-toxic cleaning products. According to our rapidly changing world, authors try transform UTM University to green Technology University to reduce our environmental impacts, support the principles of sustainable development and use renewable non-toxic resources.

3. Research Model

The research model on this study is based on conceptual model that gather three useful tools (SWOT Analysis, CSF and Stage of Growth tool) for assess the ICT impact on sustainability, which reveals the principles of sustainable development in the area of ICT [19]. By focusing on the UTM situation in green ICT and its sustainability, and regarding to ICT lifecycle, two phases has been acquired in order to represent research model:

This research model is constitutes of two phase. The first phase is talking about Use of ICT. It would clear that which approaches would be better to make use of energy more efficient. On the other part, at the second phase, the author tried to show the end of ICT use. It would shows what happens at this phase.

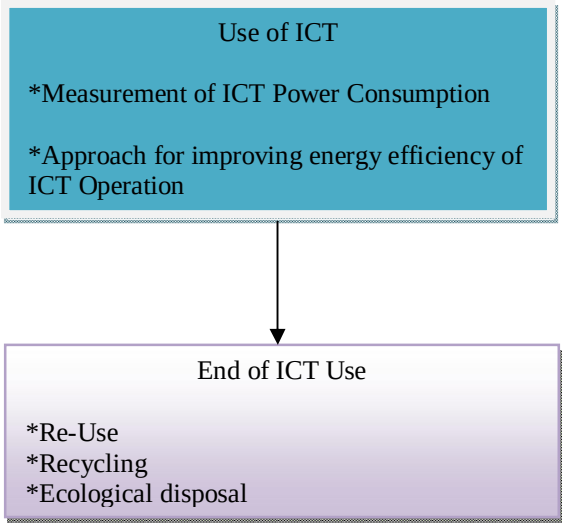

Figure 1: Research Model, Source: [20]

As it can be seen in figure 1, in order to understanding the current situation of UTM for being a green university and accomplish the sustainability, at first, authors would understand the use of ICT inside the university and this work will be done by measuring the ICT power consumption and also the approaches for improving energy efficiency of ICT operation. In order to ascertain the second part, there is a need to achieve the SWOT analysis, Define the CFS and finally by using the stage of growth tool, try to understand that in which stage of growth the university is placed.

4. UTM Current Situation

UTM is in 'unsustainable living environment'. With high and increasing cost of campus maintenance (utilities, operations) and non-utilization/participation (or minimum) of our own experts in the management of campus living. UTM is not taking advantage of the self-regulatory status of our campus and non-participative (or minimum) of the campus community towards sustainability.

Table1: Total Electricity Consumption in UTM from year 2004 to year 2008 (kWh)

Year	RM (Million)
2005	45
2006	54
2007	65
2008	70
2009	106 (approved 79.3)

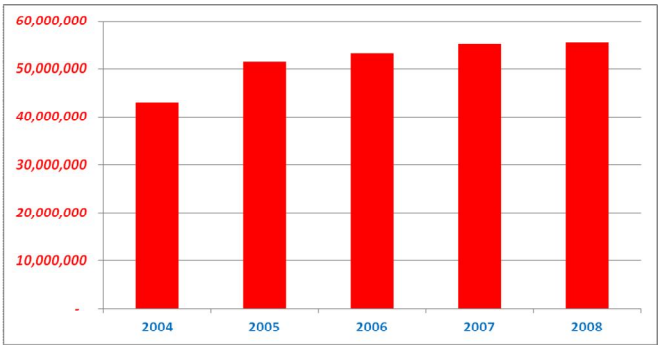

Figure2: Total cost for electric consumption in UTM from year 1998 to 2008 (RM) [21]

As it can be seen in table 1 and figure 2, total cost for electronic consumption in UTM is very high. On the other hand, the rate of its growth is also high and would become a great challenge for university. By acquiring appropriate way in Green ICT, this amount of electricity consumption and its cost would decrease considerably.

4.1 UTM efforts on Green Technology

Some efforts on Green Technology had been done by UTM that the most obvious move made by UTM was establishing few research alliances that contribute directly on green technology.

UTM in its quest to become a Research University (RU) has begun to re-brand and re-structure itself. UTM believe that the current faculty based structure is too large and rather difficult to implement the Key Performance Index (KPI) based on research on its academic staff. Historically, the faculties in UTM are unlike faculties of other universities. In this respect, the faculties in UTM tend to become so large that it is difficult for Dean's to closely monitor and motivate both teaching and research activities among the academic staff. UTM believes that by re-structuring its faculties into two organizations, one which is based on teaching and the other which is based on research, would eventually be more practical to accelerate research activities and maintain itself as a research university. In the new structure, the faculties in UTM will now concentrate on academic programs alone. Moreover, the KPIs of the staff in the faculties will be based on teaching and all matters related to academic programs at both the undergraduate and postgraduate levels.

On the other hand, UTM will set up Research Alliances (RAs) to motivate staff towards all matters related to research. Each academic staff must now belong to both, one being in the faculty and another being inside a research alliance.

4.2 OBJECTIVES OF RESEARCH ALLIANCE

1. Enhancing key research fields to boost UTM reputation both national and international recognition.
2. Enable Center of Excellence to fulfill its purpose of establishment aligned with MOHE expectation.
3. To assist University towards reaching MOHE Research University criteria's in Research and Publication.
4. Optimizing and structuring human resources and equipments for research.

5. Enhancing research output and competitiveness through affiliation between Centre of Excellence involving energy, expertise and resources.

6. Creating a clear direction and reporting mechanism on research and publication.

4.3 SWOT Analysis

The following table demonstrates the weaknesses and strength points of Green IT in the university. Knowing these factors would help the author to make the best decisions in a stage of growth analysis [22]. Table2 is showing weaknesses and strength points of Green IT in UTM. Based on the research on different aspect, this SWOT had been found out and mentioned in the table [23].

Table 2: weaknesses and strength points of Green IT in UTM

Strength:(Internal)	**Weakness:(Internal)**
➢ Geographical position ➢ R & D development team existence ➢ Human resource availability ➢ Pollution Control ➢ Waste control ➢ Durability ➢ E-learning ➢ Existing infrastructure ➢ Workshops	➢ Lack of enough budget ➢ Lack of strategy in reducing energy consumption ➢ Lack of integrated management ➢ existence of old building ➢ lack of cooperation ➢ Lack of enough documentation
Opportunities:(External)	**Threats:(External)**
➢ Government support ➢ Partnership ➢ Workshops ➢ Waste management ➢ Pollution control ➢ Energy Auditing ➢ Environmental Monitoring and auditing	➢ Change government policy ➢ Lack of adaption with new technology ➢ Lack of worker support ➢ Increase in cost ➢ Need more time ➢ Corruption

4.4 Critical success factor for Green UTM

Critical Success Factors have been used significantly to present or identify a few key factors that organizations should focus on to be successful. In any organization certain factors will be critical to the success of that organization, in the sense that, if objectives associated with the factors are not achieved, the organization will fail - perhaps catastrophically so [24].

They are also the most significant factor in governing the achievement and success of those which are steady and constant with the company's goals and objectives by keeping the industry or organizations on-track with the company's vision, goals and objectives [25]. Critical success factors (CFS) for an organization

or an industry were well thought-out fundamental to the need of preparation and planning and also control within the firms or organization [26]. As a result, in order to be successful in an educational organization, its performance should not be ignored and overlooked.

4.4.1 Types of Critical Success Factor (CFS)

There are four basic types of CSF's

1. Industry CSF's resulting from specific industry characteristics;
2. Strategy CSF's resulting from the chosen competitive strategy of the business;
3. And temporal CSF's is resulting from internal organizational requirements and changes.

Each CSF should be measurable and associated with a target goal. You don't need exact measures to manage.

It could be mention that both SWOT analysis and CFS are useful tools for strategic management decision and analysis. These two methods of analysis would help us to understand the factors better and decide better on the strategic situation.

What do you need to transform UTM to green UTM?

- UTM's capability
- Management satisfaction
- Prepare budget
- Research
- Training and education
- Involvers cooperation and Human awareness

4.5 Stage of Growth Compatibility for UTM as Green Technology University

Modeling and using of Stage of Growth is not a new topic in scientific era [27]. The approach that became popular in information systems field was proposed by Nolan between decades of 70's and 80's [28] and then was stalwartly assess by Kraemer and king who found that it would be a very good empirical, practical and theoretical tool in different scientific aspects [29].

In fact, the stage of growth analysis is mostly useful for IT and IS systems and using this tool to monitor the growth of Green Technology University establishment and implementation might not be useful and sufficient. By using this analysis we can understand where we are and it will help us to make a better and clearer picture of what would be the prospect activities in terms of maturity of being green.

"Stage I" - in Green Technology University (GTU)

As per our investigations and existing evidences, UTM has been entered and passed this stage during the years 1994 to 2009 which all pioneer and predominant departments such as SUTRA, IPASA, PROSPECT and ERA has been established:

- ERA, 18th May 2009 [30]
- SUTRA 1994 [31]

- IPASA established on 1994 [32]
- PROSPECT 1994 [21]

"Green Policy" has been defined and confirmed by Vice Consular of UTM as well. During these years "VISION" and "MISSION" were defined and announced, too. So many projects started and the most focused attentions paid to the concept of being a green technology university.

Evidences based on "Stage 1 Key Point" are as follows:

- UTM awareness of being green has been started and UTM proceeded with first step to green.
- Management and professional body of UTM tried to be specialized for technological aspects of "Green University" and opened a new point of view in UTM from prospect of "Sustainability".
- UTM started so many activities as well as VISSION and MISSION definition and establishment of many new organizations, but there is insufficient evidence showing there were effective control over those activities and there is no tangible output in terms of green.
- There is a proliferation of Green projects in all faculties in UTM
- Rapid growth in budget of green projects and research activities in different sectors and technological field of green.
- There is no centralized assessment and verification for the objectives and achievements of green projects

As a conclusion, UTM is in the first stage of growth and trying to reach to the next stage successfully.

Stage II – Contagion

Even though the computers are recognized as “change agents” in Stage I, Nolan acknowledged that many users become alienated by computing. Because of this, Stage II is characterized by a managerial need to explain the potential of computer applications to alienated users. This leads to the adoption of computers in a range of different areas. A problem that arises in Stage II is that project and budgetary controls are not developed. Unavoidably, this leads to a saturation of existing computer capacity and more sophisticated computer systems being obtained. System sophistication requires employing specialized professionals. Due to the shortage of qualified individuals, implementing these employees’ would result in high salaries. The budget for computer organization rises significantly and causes concern for management. Although the price of Stage II is high, it is evident that planning and control of computer systems is necessary.

Stage II Key points:

- There is a proliferation of applications.
- Users are superficially enthusiastic about using data processing.
- Management control is even more relaxed.
- There is a rapid growth of budgets.
- Treatment of the computer by management is primarily as just a machine.
- Rapid growth of computer use occurs throughout the organization's functional areas.

Computer use is plagued by crisis after crisis.

There is no evidence for stage 2 in UTM based on Key points.

5. Conclusion and future work

Green Technology and sustainability are one of the most popular issues nowadays. Tremendous climate change in recent years is one of the obvious indicators that the earth is sick. The whole world is responsible to protect our environment.

UTM is pioneer in Engineering education and research in Malaysia, therefore, it is reasonable that UTM is responsible to develop, implement, and promote green technology. Literature reviews are done and it shows that UTM is giving effort in Green Technology, evidence and effort done by UTM also included in this report. There are lots activities and researches running in UTM, but, those efforts are consider at root level. Furthermore, each faculty and research alliances in UTM who doing in Green technology are not centralized, we believe that centralizing all related faculty and research alliance will be more effective and efficient. In short, development and implementation of green technology in UTM still have a long way to go, but at least, it started and it highly potential.

There are many areas of green technology, including, green building, green transportation, green Nano-technology, green energy and much more. After a quick observation, we found out that UTM is doing very minimum in Green ICT, therefore, this report will concentrate and scope on Green ICT implementation in UTM. Strategies and implementation report are done in part 3, based on the UTM current situation and strength; we purposed a Strategy plan on Green ICT for UTM. We hope that this report will be references for UTM management, and as a guideline to implement it as soon as possible.

In the future work, we will extend the range of data collection and recheck the situation of UTM in GREEN. By implementing stage of growth, we would understand that what university did to become greener and smarter. We will extend the range of interviews with stakeholders in UTM and collect more data with this trend. Also, collecting data with questionnaire would be another good way for doing so.

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