Factor that Contributes to the Success of Green Technology Implementation in Malaysian Public Universities

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***Abstract*— The purpose of this study is to investigate the relationship between technology and green technology implementation. Besides that, the author also determines the effect of government support as moderator to the relationship between technology and green technology implementation. The respondents for this study are three hundred and eighty-four (384) staff from Malaysian Public Universities in northern region. The primary data (using questionnaire) then were analysed using Statistical Packages for the Social Sciences (SPSS) by referring to Pearson Correlation, Hierarchical regression and Simple Slope analysis. The finding from Pearson Correlation shows that technology has a positive relationship with green technology implementation. Hierarchical Regression and Simple Slope analysis confirmed that government support moderates the relationship between technology and green technology implementation.**

***Keywords*—** *green technology implementation, public university, moderator, hierarchical regression, government support, green supply chain*

1. Introduction

Globally, increasing human population has burdened the world resources and caused rising of energy demand [1]. The energy consumption in Malaysia from year 1978 to 2015 is illustrated in Figure 1. All fossil fuels sources exhibited growth in energy consumption. Figure 2 also shows that energy consumption increased with rate 136.74% in 2015 compared to year 1995. In 1995 energy consumption was highest for the petroleum products at 73.8%, followed by the electricity at 15.4%. These were followed by natural gas at 7.5%, the coal and coke at 3.3% and the biodiesel at 0.0%. However, in year 2015, petroleum products decrease by 18.4% (energy consumption 55.4%) but still the highest consumption sources. In order to fulfill this rising situation, fossil fuels were used [2]. Fossil fuel can be defined as a natural fuel such as coal or gas which formed in the geological past from the remains of living organisms. Based on the statistics produced by Malaysian Energy Commission, until the end of December 2016, the reserves sources of fossil fuel were quite decreasing [3]. Referring to that statistics, reserves quantity for crude oil and condensates in year 2016 (5.028 billions barrels) reduced by the rate of 14.88% compared to year 2015 (5.907 billions barrels). However, the decreasing rate of reserves natural gas was recorded at 12.6% which are 87.762 trillion standard cubic feet in 2016 compared to 100.413 trillion standard cubic feet at year 2015. Besides crude oil and natural gas, reserves quantity for coal also decreased. With decreasing rate of 77.178%, coal reserves quantity reduced from 8493 millions tonnes in 2015 compared to the amount of 1938.37 millions tonnes emitted in year 2016 [3].

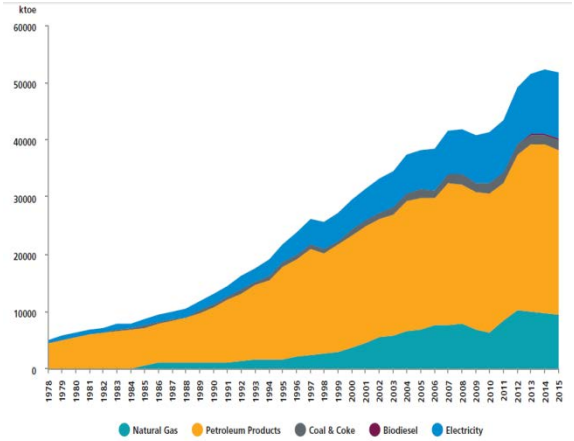

Figure 1. Energy Consumption of Fossil Fuels
Sources: [3] - [4]

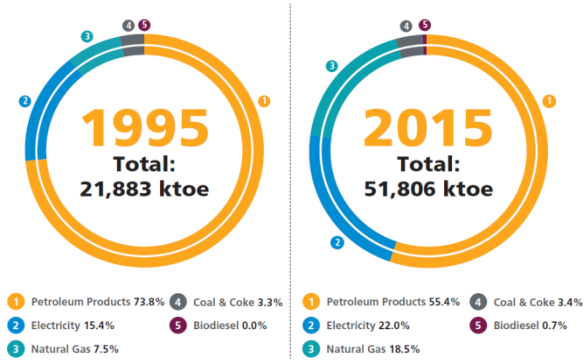

Figure 2. Comparison Energy Consumption of year 1995 and 2015
Sources: [3]-[4]

The current scenario is worrying because more energy resources were extracted than found. It is related with what been predicted by [5], another 40 to 200 years, reserves sources of fossil fuels will be depleted [1]. Although fossil fuels are continually being formed via natural processes, they are generally considered to be non-renewable resources because they take millions of years to form and the known viable reserves are being depleted much faster than the new ones to be made.

These fossil fuels are not only unsustainable but are also environmentally harmful. [6] found that human activities like burning fossils fuels, cutting and burning the trees in the forest are the main reasons for GHG emission [7]. Apart from the effect of fossil fuels, [8] found that there is a strong relationship between the use of fossil fuels and lung cancer. Combustion of fossil fuels which consists of natural gas, oil and coal released billions tonnes of carbon dioxide (CO_2) gases per year. Almost 30 billion tonnes of CO_2 gas enters the atmosphere as a result of human activities each year [9]. This scenario caused cumulative emissions of carbon dioxide (CO_2) [10] which increases the emission and concentration of greenhouse gasses (GHG). Continued emissions of greenhouse gases caused global warming and climate change [11].

Some examples of climate change that are caused by global warming are floods, droughts, rising of sea level, decreased ecosystem and havoc to weather system. For this reason, immediate and appropriate action is crucial to solve climate change issue before the world is harmed. Therefore, the implementation of green technology is desired to mitigate the climate change.

This paper is organised as follows. The literature review and hypothesis development will be discussed in Section 2. Section 3 presents research methodology, followed by results and discussion in Section 4. Conclusions, limitations and recommendations are presented in Section 5.

2. Literature Review

2.1 Green Technology Implementation in Malaysian Universities

Green technology (GT) is defined as the development and application of products, equipment and systems used to conserve the natural environment and resources, which minimizes and reduces the negative impact of human activities [12]-[13]. The Malaysian Government's commitment to green technology industries is clear. This is evident in the commissioning of the Green Technology Policy 2009, and the establishment of the Green Technology Financing Scheme (GTFS) in the 2010 with a fund of RM1.5 billion for three years ending December 31 2012. The fund enables companies which are producers or users of green technology to obtain soft loans, with the Government subsidizing 2% of the interest rate and providing a guarantee 60% of the amount of financing. As stated by [14], to date, approximately RM800 million has been approved to 50 local companies. In order to further boost the production and utilization of green technology-based products, under the 2013 budget, the fund for GTFS will be increased by RM2 billion and the application

period extended for another three years ending December 31 2015 [14]. Besides that, starting 2018, GTFS is extented to year 2020 with a total financing up to RM5 billion.

Malaysia is one of the earliest countries in the World that has taken a serious consideration regarding the environment by enacting the Environment Quality Act way back in 1974. Besides the introduction of new legislation to protect the environment, the Malaysian government has also recently formed a new Ministry of Energy, Green Technology and Water (KeTTHA) to cater the rising need and importance of green technology towards sustainable advancement. The main elements of KeTTHA's green technology policy are based on energy, water and waste, building and township, transportation sector. Besides KeTTHA's policy, related to the specific criteria and indicator of UI Green Metric, each university was ranking. There are six specific criteria and indicators of UI Green Metric which consist of setting and infrastructure (15%), energy and climate change (21%), waste (18%), water (10%), transportation (18%) and education (18%). In Malaysia, listed public universities that implement green technology comprise of Universiti Putra Malaysia (UPM), Universiti Malaya (UM), Universiti Malaysia Sabah (UMS), Universiti Teknologi Malaysia (UTM), Universiti Utara Malaysia (UUM), Universiti Malaysia Pahang (UMP), Universiti Teknikal Malaysia Melaka (UTEM), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM), Universiti Malaysia Terengganu (UMT), Universiti Tun Hussein Onn Malaysia (UTHM) and Universiti Malaysia Perlis (UniMAP).

In order to achieve the vision of Malaysian Government, universities are committed and endeavours as far as practicable to: 1) forbidden the use polystyrene containers, 2) planting trees to reserves the forest, 3) endeavour to reduce the release of greenhouse gasses which contribute to climate change through efficient use of energy, 4) reduce the production of all types of residues through the 4R (reduce, reuse, repair, recycle) programme, 5) reduce the use of threated water in daily activities and promote the use of untreated water such as rain water and underground water, 6) reduce the use of private motor vehicles in campus and others activities.

2.2 Technology

Technology can be one of the relevant affecting the adoption of new technologies [15]. It is because technology may change by time. Moreover, different green technology applications use different technology. In the process of implementing green technology in higher education institution, the normal practice and technique may be outdated. Although technological factor was often discussed in technical innovation, their influence on green technology implementation in university is scarcely analyzed. As suggested by [15] technology characteristics should be one of the factors when analyzing the adoption of green practices.

Besides that, as stated by [16], if campus community does not agree with the changes or not familiar with the technology, green technology implementation will fail. Although there is only few studies that explore the relationship between technology and green behavior, some studies found technology as important factor of behavioral intentions such as intention to use technology [17] green practices adoption [15]-[18] and green innovation adoption [19]. For example, [15] has studied on green practices adoption for Logistics Company in China and concedes that technological contexts affect green practices adoption. In this study, three contexts of technology were used which are relative advantage, compatibility and complexity. Relative advantage and compatibility has positive effect to green practices adoption while complexity negatively affects green practices adoption.

Similarly, [19] noted that the result of their study also admits that technology was significant towards green innovation adoption. [15]-[19] also used the same three contexts of technology such as relative advantage, compatibility and complexity. Besides that, as proposed by [18], five contexts of technology used include relative advantage, complexity, compatibility, cost and company image. [17] conducted a study in Singapore to investigate the factors that affect the intention to use technology. This study confirmed that perceived usefulness and perceived ease of use were significant to the attitude towards usage.

However, even technology considered as one of the important and significant positive determinants of behavioral intention in most of the previous researches, while at the same time some prior researchers also have found that the influence of technology on behavioral intention is statistically insignificant[15]. For example, [15] has conducted a research on 628 university students in Korea and affirmed that perceive usefulness and perceive ease of use was insignificantly affected by behavioral intention to use E-Learning.

2.3 Government Support

Malaysian Government was very committed to mitigating climate change by introducing green technology. For example, in Malaysia, Green Technology Financing Scheme (GTFS) was announced in National Budget 2010 and was the first soft loan given to companies towards supporting green technology [21]. Hence, financial incentives are vital to drive environmental improvement.

Previous study by [22] identified that the variety of incentives offered by the federal, state and local governments are the drive that motivates the consumers to adopt new hybrid vehicles. Another study by [23] found that government support may also lessen barriers for organizations to embrace environment practices. Government policy (GP) can help higher education institution to obtain green technology by training and providing technologies [23]. Thus, considering dominant role of government support in prior literatures as an important factor of behavioral intention in green context, government support is considered in this research and expects that this variable will play important role on behavioral intention in the context of green technology implementation in Malaysia. As government support is seen as the strongest predictor to green behavior, therefore government support was chosen as moderating variable.

2.4 Hypothesis development

Based on the previous studies, there are inconsistent findings between technology and behavioural intention. There are positive significant relationships [15]-[19]-[17]-[18] and insignificant relationships [20]. Hence, this study hypothesizes the relationship as follows:

H1: There is a positive relationship between technology and green technology implementation.

Besides that, since the previous studies have inconsistent findings, therefore, it is needed to add moderating variable. The moderator is likely to exist if the relationship between independent and dependent variables are not consistent [24] Therefore hypothesis 2 below was proposed to cater moderating effect of government support to the relationship between technology and green technology implementation.

H2: Government supports moderate the relationship between technology and green technology implementation.

3. Methodology

Quantitative approach was used in this research. Primary data was collected by distributing questionnaires to the respondents. A Likert Scale questionnaire was used to access the relationship between technology and green technology implementation, as well as moderator effect of government support to the relationship between technology and green technology implementation. Statistical Packages for the Social Sciences (SPSS) was used as a tool to analyse the primary data. By using SPSS, several statistical techniques were used such as Pearson Correlation and Hierarchical Regression. The respondents were staff from public universities in the northern region of Malaysia. Around 370 of staff were needed to fulfil the sampling size based on [25]. In order to accurately get the sample size needed, 600 set of questionnaires were distributed online and manually. This method also been used by [26]. Individual staff was used as the unit of analysis for this study. Figure 3 shows the research framework for green technology implementation study in public universities. In this study, government support was used as moderating variable and technology for independent variable.

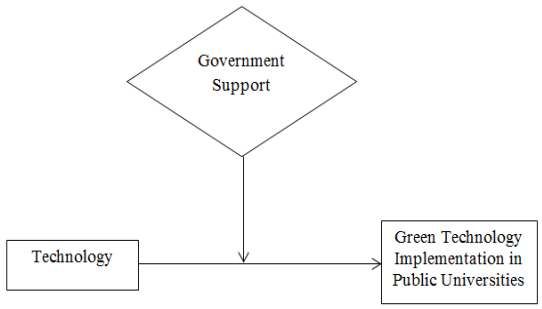

Figure 3. Research framework for Green Technology Implementation

4. Findings and Discussions

Hypothesis 1 concerns about the relationship between technology and green technology implementation. Technology has a positive relationship with green technology implementation as shown in Table 1 (r =.637, p-value < 0.000). The positive direction of correlation coefficient indicates that the easier to learn and use the technology, the more motivated a person is to implement green technology. In terms of strength of the relationship, the results indicate that the strength of technology and green technology implementation is considered as strong. It means that, technology is strongly related to green technology implementation. The findings also indicate that technology effects on the implementation of technology by 40.6% (R^2 = .406). Meanwhile, the remaining 59.4% is influenced by other factors. Therefore, the hypothesis proposed for the variables is supported.

Table 1. Correlation between Technology and Green Technology Implementation

Variable		TE	GTI
Technology (TE)	Pearson Correlation	1	.637**
	Sig. (2-tailed)		.000
Green Technology Implementation (GTI)	Pearson Correlation	.637**	1
	Sig. (2-tailed)	.000	

** Correlation is significant at the 0.01 level (2-tailed)

The result was in line with the findings of [15]-[27], where they found that technology was a predictor of green behavior. This result proves that compatibility and benefits of green technology are affecting the implementation behavior.

Table 2. Effect of Moderator Variable to the Relationship between Technology and Green Technology Implementation

Predictors variables	Beta	P	R^2	t
Step 1- Main effect				
Technology	0.637***	0.000	0.406	6.536
Step 2- Interaction effect				
Technology	0.323***	0.000	0.501	3.510
Government Support	0.212***			2.647
Technology* Government Support	0.325***			3.745

*Note: *Significant level is p < .05, ** Significant level is p < .01, *** Significant level is p < .001*

For further analysis, this study applied hierarchical regression analysis to test if the interaction effect between technology and government support significantly predicted green technology implementation. Table 2 above illustrates the result of moderator effect towards relationship between technology and green technology implementation. Step 1 shows the effect of technology on green technology implementation. By referring to that step (Step 1), it can be seen that the relationship between technology and green technology implementation was significant, where R^2 = .406 and p-value < .001. Finding indicates that technology is an accelerator in implementing green technology. In Step 2, (refer Table 2.), it was found that the interaction between government support and technology was positive and significant with R^2 = .501 and p-value less than 0.05.

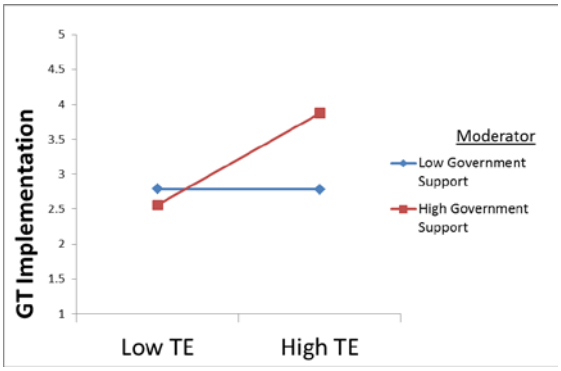

Figure 4. Slope Analysis between Technology, Government Support and Green Technology Implementation

Besides hierarchical regression analysis, simple slope analysis is used to determine the effect of government support as moderating variable towards the relationship between technology and green technology implementation. As shown in Figure 4, when government support is high, technology values had significant relationship with green technology implementation. Hence, according to the result, it can be concluded that the government support has acted as moderating variable in the relationship between technology and green technology implementation. Therefore, hypothesis 2 is supported. This result is also consistent with previous findings by [28]-[29]-[30].

5. Conclusions, Limitations and Recommendations

As a conclusion, technology has a positive relationship towards the success of green technology implementation in public universities. Moreover, government support helps to moderate the positive relationship between technology and green technology implementation. It means that, in order to successfully implement green technology in public universities, government should consider technology factor. With easier and more compatible green technology, it will increase the intention to implement green technology. Moreover, the presence of government support could strengthen up the positive relationship between technology and green technology implementation.

There are several limitations of this study. The current study only focuses on one independent variable instead of more variables. Besides that, this study is only limited to public universities in the northern region of Malaysian. Due to limit the scope of study, it is not too widespread and difficult to implement. However, different sector may have diverse sector influencing them.

It is also suggested to include intangible variable (variable that is unable to be touched or not having physical presence) like culture, religion, knowledge and other variables for future study. Moreover, it is suggested to extend the study to other sectors like manufacturing.

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