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# Green Initiatives and Sustainable Green Practices in SMEs: The Moderating influence of Green Technology Awareness

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**ABSTRACT**

**Background:** Small and medium-sized enterprises (SMEs) play a vital role in the economic development and provide most of new jobs. At the same time, SMEs are contributing factors in environmental degradation due to their high numbers and their cumulative effect. **Objective:** The objective of this paper is to examine how green technology awareness moderates green initiatives and sustainable green practices. A sample of 254 manufacturing SMEs owners/managers completed the questionnaire survey. **Results:** Regression analysis result shows that green initiatives were significantly related to sustainable green practices and green technology awareness moderates the relations between green initiatives and sustainable green practices**. Conclusion:** The findings provide owners/managers with valuable implications and guidelines in enhancing their firm's efficiency and to adopt sustainable green practices.



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## INTRODUCTION

The quality of life in society at large can considerably be reduced by the dispersed impacts of pollution from businesses resulting from the contamination of soil, water and air (Barrow, 2006). The role of all stakeholders in society, from government and large multinational companies to individuals and small and medium enterprises has been questioned as a result of the paradigm shift to the concept of sustainable development (Smith *et al*., 2000). On the contrary, Condon (2004) and Hobbs (2000) stated that the aggregate impact of SMEs are massive; economically, socially, and environmentally whereby at the same time, make considerably smaller individual contributions. Needless to elaborate, SMEs play an important role in worldwide economy and as well as in Malaysia. Based on the census of Department of Statistics Malaysia (2012), about 97.3% of all Malaysian enterprises are SMEs while 77.7% of the total workforce is employed by SMEs. Additionally, SMEs as a whole have significant effects although their individual contribution to environmental impacts is typically small. The figures between 50% and 70% are often mentioned as the proportion of the total environmental impacts although the exact proportion is unknown (Berends *et al*., 2000, Hillary, 2000).

In view of the above figure, Modahl and Thorensen (2002) defined SMEs as a small companies with less than 250 employees with limited resources in term of financial, knowledge as well as workforce. Moreover, they find that the environmental aspects and environmental impacts measurement are hard to identify. In support of Modahl and Thorenson's view, Hillary (2000) claimed that they might have limited knowledge with regard to environmental management tools. Nonetheless, they do not care much on the benefits of environmental improvements and they are lack of confidence, information and data to do so (Fanshawe, 2000). In term of degradation scale, Malaysian SMEs are still reluctant and they score high, whereby Yacob *et al*. (2013) stated that UK and US are among the countries in other jurisdictions that has been questing in relation to sustainable development and environmental protection by virtue of green values and clean production. As a result, there is a need to identify the reason for slow adoption of this promising green technology (Gerstenfeld and Roberts, 2000) and there is a possibility to mitigate that an urgent need for the adoption and implementation of sustainable green practices in SMEs.

In spite of this, Worthington and Patton (2005) found out the fact that green initiatives in SMEs are relatively under researched although not much

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attention is given to this issue (except they are energy intensive venture or wish to present a clean and green image) by the majority of SMEs . In order to help SMEs to adopt green initiatives and go green, Hitchens *et al*. (2003) stated that there are more to be done. Since this is the right time for SMEs to joint the bandwagon of green, new knowledge and important insights that will benefit SMEs in Malaysia and other developing countries would be provided. Therefore, the influence of green technology awareness as a moderating factor in sustainable green practices would be studied in this paper.

***Green Initiatives:***

Overall, green initiatives implementation has heralded a growth of green-related concepts in different forms, from efforts toward fulfilling with environmental legislations (Sharma and Vredenburg, 1998), endeavors continually improving production and business processes (Sarkis, 1998), changes in business strategies which eventually lead to innovations of product designs (Porter and van der Linde, 1995), renovations of production processes (Hart, 1995; Pujari, 2006), as well as modification of production technologies (Van Hoek, 2001). In addition, Porter and van der Linde (1995) and Lin and Huang (2012) stated that there are several activities in the context of SMEs that minimizing waste by-production, reducing waste generation, reducing water conservation, energy consumption, enhancing or reducing material utilization, minimizing occupational health hazards and safety and improving workplace safety thru the implementation of green initiatives. Even though there is a large and diverse implementation on green initiatives in business operations, Handfield *et al*. (2005) claimed that the implementation of green initiatives need firms to plan the supporting strategies and disburse resources.

Whilst explaining various green-related concepts in term of eco-development, there was an argument by Brammer *et al*. (2012) whereby green initiatives affects a range of business operations, such as managing production processes (for instance, pollution control, waste disposal and air emission), purchasing input materials and handling outputs (green and clean products) whether continuous or discontinuous. In fact, Iraldo *et al*. (2010) found that environmentally responsible manufacturing is equivalent to the green initiatives process. Additionally, in some manufacturing activities, firms are dependent on their suppliers, distributors and stakeholders in order to cultivate improvements in relationships with customers, as suggested by Revell and Blackburn (2007) and Rezai *et al*. (2013). In supporting, Hart (1997) explained that the main mission of green initiatives is to "*develop green technologies and to implement strategies that drastically reduce the environmental burden*" although there are various ways to perceive and implement green initiatives by SMEs. On the other hand, Bansal and Gao (2006) found that larger firms are the main focus with regards to empirical literature regardless the infinite range of conceptual perspectives that have been used in examining the implementation of green initiatives and SMEs are among the few that have been explored green initiatives. Thus, the contexts and mitigating circumstances surrounding green initiatives implementations in SMEs is still questionable and will be examined in this study. In this regards, the above discussion lead to the formulation of the first hypotheses.

$H_1$: There is a positive relationship between green initiatives and sustainable green practices.

***Green Technology awareness:***

Green technology is defined as equipment's, systems or products that fulfill the criteria of (1) the degradation of environment is minimized, (2) the greenhouse gas emissions is reduced, (3) promoting healthy and improving environment for all forms of life and safer to use, (4) the use of energy and natural resources is conserved, and (5) the use of renewable resources. Malaysia Green Technology Corporation (GTM) is the national agency entrusted to promote green technology in Malaysia. Green technology awareness involves executing new or modified processes, techniques and systems to reduce environmental harmfulness. The adoption of green technologies can be viewed as an innovation process that use of new technical and administrative knowledge (Jeyaraj *et al*., 2006). Henriques and Sadorsky (2007), Lin and Ho (2011), Rothenberg and Zyglidopoulos (2007) are several researchers who examined environmental issues in SMEs from the viewpoint of technology by providing an insight into the influence of certain organizational and environmental factors on green technologies. Hence, it is concluded that technological characteristics should be considered in order to analyze the adoption of green technologies. However, studies found to be lacking on how organizational, environmental and technological factors concurrently influence the adoption of green technologies in SMEs (Prajogo *et al*., 2014).

To date, not many SMEs owners/managers in Malaysia perceive green technology adoption as a relevant business concern and thus, do not possess any green strategy at present. This could due to three reasons, first, the SMEs owner/managers have lack of green knowledge and adopting conservative strategy, second, there has been no demand or pressure imposed by their customers to undertake strategic moves and follow-ups to go green, and third, going green is seen like adopting technological innovation to achieve corporate social responsibility (CSR), and this is a costly affair. Such attitudes were substantiated and aligned with the findings of the SME Annual Report 2011-12 (National SME

Development Council, 2012), wherein it was revealed that the three broad perspectives that vexed SMEs in Malaysia are: (a) sales-related, (b) finance-related, and (c) other operating issues, such as uncertain economic environment and availability of manpower.

With environmental awareness growing by the day, the most adamant SME owners/managers cannot even deny that green technology is indeed a very real concern for their businesses and no longer ignore the need for a commitment to balancing social, environmental and financial performances (Aras and Crowther, 2009). More critically, climate change poses a genuine threat to the SMEs, taking into consideration that SMEs are less equipped and do not possess the pertinent financial muscles and technology know-how, compared to the larger companies, in fulfilling the requirements of green economy. Even though it is encouraging that Green Technology Malaysia and the government's commitment in promoting and conserving natural environment resources and low carbon technology, an understanding of moderating factor of green technology is essential to influence SME owners/managers in implementing sustainable green practices is still questionable and this leads to the formulation of the second hypotheses:

$H_2$: Green technology awareness moderates the relationship between green initiatives and sustainable green practices.

***Research Methodology:***

The focus of the study is at the firm level where the unit of analysis is the individual SME in Malaysia and examines the relationship between green initiatives, green technology awareness and sustainable green practices. In July 2013, a new definition of SMEs was endorsed where, the sales turnover for small sized SMEs is from RM300,000 to less than RM15 million or full-time employees from 5 to less than 75 while the sales turnover for medium sized SMEs is from RM15 million to not exceeding RM50 million or full-time employees from 75 to not exceeding 200 employees. Therefore, SMEs is defined by the author as an enterprise with full-time employees not exceeding 200. A total of 837 SMEs have been identified based on this definition (Economic Census 2011, Department of Statistics, Malaysia, 2012). Survey questionnaire was sent through mail and email to the owners/managers of each firm. An email was sent to firms based on the email addresses provided on their profiles in the Federation of Malaysian Manufacturer (FMM) directory while the rest of the firms received printed questionnaires with returned postage attached. However, the number of surveyed fell to 791 SMEs when disqualified and inaccessible firms were excluded. Two hundred fifty four (254) SMEs returned the survey via conventional and electronic mail and the overall response rate was 32%. Pertaining to the questionnaire's lower return rate, Macpherson and Wilson (2003) and Gadenne *et al*. (2009) stated that low rates of participation in research among SME owners/managers are ordinary.

***Measurement Scale:***

A five-point Likert scale from "strongly disagree" to "strongly agree" was used for the questionnaire. To meet the study objectives, Section A of the questionnaire titled as "Demographic Profile" and contains selected 6 demographic questions of author. Section B titled as "Green Initiatives", contain 3 green initiatives variables namely, "energy management, water conservation and waste management" and make-up of 6 questions each variable and all 18 questions were adopted and translated from Kannan and Boie (2003), McKeiver and Gadenne (2005), Tchobanoglous (2009), and Cassells and Lewis (2011) studies. The moderating variable titled "Green Technology Awareness" in Section C and all 6 questions make-up in this variable were adopted form Green Technology Malaysia website. Finally, the dependent variable titled as "Sustainable Green Practices" in Section D and all 6 questions make-up in this variable were adopted and translated from Cassells and Lewis (2011), Kerr (2006) and Sharma (2000) studies. In order to verify the aggregate scores of each construct, Cronbach's alpha was then used. The results indicate an acceptable level of reliability for all constructs, with a Cronbach's alpha level of 0.74 for green initiatives, 0.81 for green technology awareness and 0.79 for sustainable green practices.

***First stage of analysis:***

***Test of normality:***

For the purpose of examining the bivariate relationship by comparing the average (mean) for each variable, the descriptive statistics were used. Furthermore, the standard deviation, skewness, kurtosis and variation of the distribution were also analyzed and the findings were summarized in Table 1.

**Table 1:** Descriptive Statistics.

| Variable | Mean | Median | Std. Deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|
| Sustainable green practices | 2.2749 | 2.0141 | .38594 | .133 | -.025 |
| Green initiatives | 2.3642 | 2.1593 | .39520 | .542 | -.861 |
| Green technology awareness | 1.5950 | 1.6320 | .39619 | .175 | -.361 |

It is known that an unbiased, efficient estimator and consistent sample data are normally distributed. Nonetheless, the results of the descriptive data shown in Table 1 indicated that the sample was normally

distributed. The values of mean and median for all variables were almost the same. The skewness and kurtosis of the outcome variable (sustainable green practices) was at acceptable range of Zscore±1.96.

On the other hand, the result in Table 2 illustrated the standardized residual, where the mean value was 0 and its standard deviation was closer to 1 which also indicates that the data distribution was normal. The Mahalanobis distance of each item was smaller than 13 except for item no 19 which was at 13.036. For sample size of 150 and above, this was acceptable (Schönbrodt & Perugini, 2013).

**Table 2:** Residuals Statistics.

| | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| Residual | -1.86232 | 1.39572 | .00000 | .63700 |
| Std. Residual | -1.375 | 1.875 | .000 | .798 |
| Mahal. Distance | .04921 | 13.036 | 2.785 | 3.372 |

***Test of autocorrelation and multicollinearity:***

Table 3 describes the autocorrelation and multicollinearity of the variables. Since the value of Durbin Watson is not less than 1 and not greater than 3, this specifies that there was no serious problem of autocorrelation. In order to detect multicollinearity issue in the model, collinearity and conditional index test were performed. Since the result of variance-inflation factor (VIF) (< 10), tolerance value (< .10) and conditional index (< 30), it is affirmed that the data does not face any serious multicollinearity problem.

**Table 3:** Collinearity Statistics.

| | | Tolerance | VIF | Condition Index | Durbin Watson |
|---|---|---|---|---|---|
| 1 | (Constant) | | | | |
| | Green initiatives | .628 | 1.753 | 23.274 | 1.212 |
| | Green technology Awareness | .801 | 1.631 | 24.481 | 1.764 |

a. Dependent Variable: Sustainable green practices

Furthermore, Pearson correlation analysis performed and preliminary analysis in Table 4 suggested a moderately strong and positive relation between green initiatives and sustainable green practices ($r$ = .50, $p$ <.001), green technology awareness and sustainable green practices ($r$ =.59, $p$ <.001). In summary, the results provided preliminary evidence of the significant relation and support for the further testing of hypothesis.

**Table 4:** Correlation matrix between variables.

| Constructs/Variables | 1 | 2 |
|---|---|---|
| Green initiatives | - | |
| Green technology awareness | .541** | - |
| Sustainable green practices | .503** | .593** |
| Mean | 3.28 | 3.24 |
| Standard deviation | 0.92 | 0.94 |

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

***Second stage of analysis: Hypothesis testing:***
***Correlation between Green initiatives and Sustainable green practices:***

The relationship between green initiatives and sustainable green practices was examined by testing the first hypothesis ($H_1$). The finding in Table 5 shows the correlation coefficient ($r$ = .503, $p$< 0.05) between green initiatives and sustainable green practices, which indicates a strong positive correlation. In addition, the linear regression analysis shows that the $R^2$ coefficient of determination value of green initiatives on sustainable green practices accounts for 25.3% percent of the variations in sustainable green practices, leaving 74.7% of the variations unexplained.

**Table 5:** Correlation between Green initiatives and Sustainable green practices.

| | R | $R^2$ | $R^2_{adj}$ | β | F | t | Sig. |
|---|---|---|---|---|---|---|---|
| $H_1$ | .503[a] | .253 | .250 | .503 | 87.441 | 9.351 | .000 |

Additionally, the standardized coefficients β value of 50.3% proved that there is a direct relationship between green initiatives and sustainable green practices. Furthermore, the significance associated with ANOVA output shows that the model had $F(1, 252) = 87.441$ with $p$ <.001. This meant the model was statistically significant at α = 0.05 level in explaining the linear relationship between green initiatives and sustainable green practices. Finally, the $t$-statistic is greater than 2 and can be interpreted that the coefficient is significant. Overall, the regression model above shows a positive relationship exists between green initiatives and sustainable green practices and that the higher the levels of green initiatives implementation, the higher

the levels of sustainable green practices in SMEs. Therefore $H_1$ is accepted.

***Hierarchical regression analysis:***

The moderating effect of green technology awareness between green initiatives and sustainable green practices was examined by testing the second hypothesis ($H_2$). To test whether green technology awareness moderates the relationship between green initiatives and sustainable green practices, a hierarchical multiple linear regression analysis was conducted and the result shown in table 6.

**Table 6:** Hierarchical regression analysis.

| | Step | DV | IV | R | $R^2$ | $R^2_{adj}$ | β | t | Sig |
|---|---|---|---|---|---|---|---|---|---|
| $H_2$ | 1 | SGP | GI | .503 | .253 | .250 | .503 | 9.351 | .000 |
| | 2 | SGP | GrnT | .541 | .293 | .290 | .541 | 10.333 | .000 |
| | 3 | SGP | GI x GrnT | .584 | .341 | .339 | .584 | 11.564 | .000 |

*p< .05. **p< .01. ***p<.001

Note: Abbreviations for the dimensions are as follow; Green initiatives (GI); Green technology awareness (GrnT); Sustainable green practices (SGP)

In Step 1, two variables were tested, green initiatives and sustainable green practices. The result presented in Table 6 shows $R^2$ coefficient of determination values was 25.3% of correlation between sustainable green practices and green initiatives. In Step 2, the second correlation between sustainable green practices and green technology awareness shows a 29.3% of the variations in sustainable green practices. This meant that the model in Step 1 and Step 2 provided a significant correlation with $p$ <.001, whereby showed that green initiatives and green technology awareness was significant in predicting changes in sustainable green practices. Furthermore, the $t$-statistic for both steps show that the values are greater than 2 and can be interpreted that the coefficient is significant at $p$ <.001. The standardized coefficient β account for 50.3% for Step 1 and 54.1% for Step 2 proved that a unit increase in green initiatives and green technology awareness will increase in sustainable green practices.

Next, in Step 3, the interaction term between green initiatives and green technology awareness was added to the regression model, which accounted for a significant proportion of the variance in sustainable green practices, $R^2$ = 0.341, standardized coefficient beta of 58.4%, $p$ <.001, $t$=11.564. Table 6 illustrates the moderation analysis of green technology awareness on green initiatives and sustainable green practices.

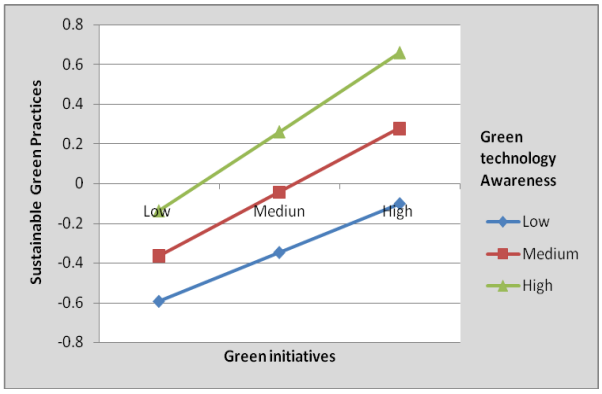


**Fig. 1:** Moderation by Green technology awareness.

In this continuous moderator the main effect along the X-axis is green initiatives whereas the three lines known as high, medium, and low are depicted as moderating variable in Figure 1. Aiken & West (1991) explained that for both the continuous main effect as well as the continuous moderating variable, the three levels of high, medium, and low are computed using the mean as the medium value, one standard deviation above the mean as the high mean, and one standard deviation below the mean as the low mean. Examination of the interaction plot showed an enhancing effect that as green initiatives and green technology awareness increased, sustainable green practices increased. The interaction plot shows that respondent with low green initiatives have low green technology awareness to practice sustainable green practices. Further, respondent with medium green initiatives have medium green technology awareness to practice sustainable green practices, whereas, respondent with high green initiatives have higher green technology awareness to practice sustainable green practices. Since the above result shows medium range of green initiatives, therefore green technology awareness moderates the sustainable green practices. Therefore $H_2$ is accepted since it explains that green technology awareness moderates the relationship between green initiatives and sustainable green practices.

***Discussion:***

Our results show a significant and positive relationship between green initiatives and sustainable green practices.. This finding showed that SMEs' limitation of resources is not an obstacle in attaining green practices as it complements previous literature that supports a positive relationship between green initiatives and sustainability for smaller firms (e.g. Del Brío and Junquera, 2003; Gadenne *et al*., 2009). Referring to the positive association of environmental proactivity and sustainability as frequently discussed in the literature on large firms, our results regarding the positive association between green initiatives and sustainable green practices are also coherent (e.g. Russo and Fouts, 1997; Roxas and Chadee, 2012). Furthermore, our findings offer the rationale for reconsidering existing assumptions in the literature that claimed that SMEs cannot obtain relevant advantages from green practices.

On the other hand, evidence suggested that for each of the 3 steps, green technology had a significant interaction effect with green initiatives and the outcome variable, sustainable green practices. Analysis revealed that when green technology awareness levels were high, the relation between green initiatives and sustainable green practices were stronger. The result suggested that most of the owners/managers have the intention to learn in using green technology in their firm and these findings are consistent with previous research (Henriques and Sadorsky, 2007; Hsu and Hu, 2008; Lin and Ho, 2011). The findings provide potential new leverage points for examining how green technology awareness could influence the systematic leadership and organizational structures of SMEs (e.g., environment, culture, climate, performance management and sustainability) (Savita *et al*., 2012). Furthermore, the influence of green technology implementation may reduce the climate change to global warming instead of having lower potential to expose the environment to waste and pollutants.

***Limitations and future directions of the study:***

Based on the limitation of existing study, the possible directions for future research can be examined. The limitation of this study is the respondent's biasness towards the questionnaires provided and due to the different background and different level of experience and they may answer the questions based on their own perceptions. Additionally, a more complete list of items and other relevant data collection techniques can be developed in the future research. Nevertheless, it is recommended that the validated framework be replicated in other sector or industries with large sample size which would provide further validation and reinforcement to the framework from this study. By this way, more fine-grained analyses in term of a similarity effect on green management may be allowable to examine.

***Conclusion:***

The key issue for SMEs at the present is to distinguish the risk of potential earning if the implementation of sustainable green practices is not to protect the environment from deteriorating. The increasing effect on the environment is significant and may lead to biodiversity loss and natural resources degradation and SMEs have an important role to play. Sustainable green practices and green technology offers the opportunity for SMEs to introduce products and services that also benefit SMEs in economic such as increasing the market base, cost savings and better business profits and at the same time also protect and preserve the environment. Since green technology is one of the key drivers of the adoption of sustainable green practices among SMEs, more aggressive approach by government should be taken in implementing laws and regulations that are related to SMEs and not just large corporations. In order to further promote the sustainable green practice, there should be easy access to information and advice on environmental programmes that are affordable and suitable for SMEs. Through this way, SMEs are more convince by the information and advice whereby long-term financial benefits and demonstrates their social responsibility can be contributed by sustainable green practices.

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