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Procedia CIRP 26 (2015) 646 – 652
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12th Global Conference on Sustainable Manufacturing

Importance-Performance Analysis of Green Strategy Adoption within the Malaysian Manufacturing Industry

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Abstract

The highly competitive nature of the manufacturing environment requires manufacturers to consider the ultimate outcome of their green strategy adoption, focusing on those that are strategic to their environmental and business performance. Based on the Natural-Resource-Based framework, a model is proposed to analyse the total effects of green strategy adoption on competitive benefits within the manufacturing industry. The conceptual model has been formulated by applying structural equation modelling and empirically analysed using a dataset collected from a survey of ISO 14000 certified manufacturers from among the Malaysian industries. The results show that there is a significant relationship between the green strategies, environmental performance and competitive benefits. The results also imply that a clean technology strategy has considerable importance in terms of generating competitive benefits, and yet it received the least attention from the manufacturers.

Peer-review under responsibility of Assembly Technology and Factory Management/Technische Universität Berlin.

Keywords: Green Strategy; Importance-Performance Analysis; Competitive Benefits; Natural-Resource-Based View, Structural Equation Modelling; Manufacturing Industry

1. Introduction

In today's business world, a firm's competitiveness is intertwined with its environmental activities [1-3]. Initiating new practices that lead to the development of new products, new markets and new technologies can be considered as a main mechanism for developing competitive advantages [4]. In this view, innovative environmentally related practices that lead to producing new green products, developing new clean technology, and developing new market opportunities, might improve or generate a firms' competitive advantage.

The adoption of green strategies not only enables the firms to reduce their total costs and risks, but can also help them to increase their revenues and intangible values, such as reputation and trusted brands that might contribute to the firm's competitive advantages [5].

According to the Natural-Resource-Based View (NRBV) framework [1-3], which is an expanded version of the resource-based view (RBV) to develop a theoretical linkage between green strategies and a firm's competitive benefits, there are different kinds of environmental strategy, which include pollution prevention, product stewardship, and clean technology. There are several environmental activities associated with these different types of green strategy that can be implemented by the manufacturers across their supply chain. However, as Porter & Kramer [6] noted, because of resource constraints, no business can address all environmentally conscious issues and undertake all green practices, so they have to identify the practices that are more strategic to their business. In fact, the competitive pressures drive the organizations to consider the ultimate outcome of their practices in terms of organizational performance and competitive advantage [7].

Previous studies showed a considerable interest in investigating the linkage between environmental practices and the firm's economic and competitive performance. However, far too little attention has been given to which kind of green strategy can provide companies with the

Peer-review under responsibility of Assembly Technology and Factory Management/Technische Universität Berlin.
doi:10.1016/j.procir.2014.07.180

greatest competitive benefits. In today's competitive market, business managers are crucially required to answer this question before investing in environmental improvement programmes.

In order to address this question, this paper attempts to investigate the impact of three types of green strategy pollution prevention, product stewardship, and clean technology – on environmental performance and competitive benefits.

2. Background of the study

Although several researchers have studied the impact of environmental initiatives on competitiveness, some of these studies only examined the tangible measures of competitiveness, such as profitability, productivity, market share, economic and financial [8-12], while others expanded the measures of competitiveness to the intangible items, such as corporate image and innovation [13, 14].

The previous studies show inconsistent results regarding the impact of environmental practices on competitive benefits. While some studies [8, 12-14] show a significant positive relationship between the implementation of green practices and competitive outcomes, others [15-17] show a non-significant or even negative relationship.

There might be various reasons for this inconsistency, of which one could be related to the measures of competitiveness. The authors' findings from the review of the literature show that those studies that only focus on the measures, such as profitability, economic and financial outcomes, are more likely to result in a non-significant or negative relationship between green initiatives and competitiveness.

The nature of environmental strategies is another influencing factor that might affect the linkage between green strategy adoption and competitiveness. As Porter and Kramer [6] noted, it cannot be expected that all the environmental initiatives affect a firm's competitiveness. They argued that, on the one hand, there are some general environmentally related activities that are important to society, but do not have any significant impact on companies' competitiveness, while, on the other, there are value chain and competitive context practices that have a significant impact on the drivers of competitiveness. Although such knowledge is important to business managers when they are planning to adopt the green strategies and launch environmental activities, there are few studies in the literature addressing this matter.

Once again, although some studies examined the linkage between different types of green initiative, such as green purchasing, green manufacturing, eco-design, green packaging, and reverse logistics, and the competitive outcomes [12, 14, 18], they did not consider how the firm's green strategic approach might affect the extent to which the environmental activities will be performed across these operational areas.

One of the studies that partially addressed this matter was conducted by Kurapatskie and Darnall [19], who investigated the impact of different kinds of green strategy on a firm's financial payoffs. They divided the green strategies into two categories, namely, lower-order, and higher-order strategies. Lower-order green strategies include pollution prevention and product stewardship, which provide the companies with an incremental improvement in their existing processes and products. Higher-order green strategies foster the disruptive changes in a firm's processes and products. By developing the innovative clean technologies, companies adopting these kinds of strategy try to radically change their products and business model and gain benefits from the future market opportunities. The results of their study showed that higher-order environmental activities have greater financial outcomes compared to the lower-order green initiatives.

Considering the importance of the topic and due to the shortcomings of the existing literature, this paper examines the impact of different types of green strategy on competitive benefits in terms of both tangible and intangible competitive outcomes.

3. Conceptual model

The conceptual model developed in this paper is composed of five constructs involving seven causal relationships (see Fig. 1). These constructs are green strategies- pollution prevention strategy, product stewardship strategy, clean technology strategy-, environmental performance, and competitive benefits. The conceptual model proposes seven causal relationship. It assumes that all three green strategies have positive impact on environmental performance, and competitive benefits. Also it implies that environmental performance has a positive significant impact on competitive benefits. These causal relationship conceptual model is tested using Partial Least Squares based Structural Equation Modelling (PLS-SEM) [20] by applying SmartPls [21].

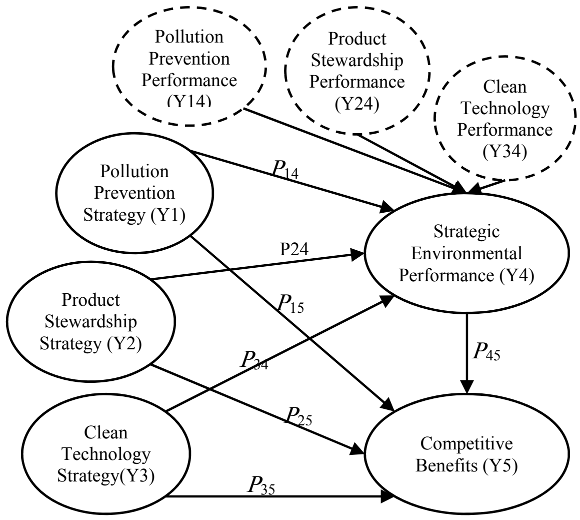

Fig. 1. Conceptual model

3.1. Green strategies

This paper investigates the environmental performance and competitive benefits associated with three types of green strategy derived from the NRBV framework introduced by Hart and Milstein [1]. These green strategies are pollution prevention, product stewardship, and clean technology.

3.1.1. Pollution prevention strategy

Pollution prevention refers to reducing waste and emissions from the company's current operations through incremental improvement of the company's existing products and processes [1-3]. According to the NRBV framework [1, 3], the aim of this strategy can be achieved through better housekeeping, material substitution, internal recycling, or process innovation.

The environmental outcomes of this strategy are indexed by reducing waste and emissions [1-3].

The competitive benefits associated with this strategy are more likely to be related to cost reduction advantages generated through the continuous improvement of products and processes [1-3].

3.1.2. Product stewardship strategy

Product stewardship is a more integrated approach compared to pollution prevention and relates to reducing the environmental impact of a company's existing products and processes at every stage of a product's lifecycle (from supplying raw material, though the production processes, to product consumption and disposition of end-of-life products). Life cycle analysis (LCA), end-of-life recovery, and collaboration with external stakeholders in environmental activities are some practices that originate from this strategy [1-3].

The product stewardship strategy will result in reduced environmental impact across the firm's value chain. Reducing the scarce material usage, and increasing the rate of reusing or recycling of spending products are some of the environmental indices used to measure the outcome of this strategy [3].

This strategy allows the companies to lower the life-cycle environmental costs of products. Also, by integrating different stakeholder views into business processes, adoption of the product stewardship strategy will provide the companies with the competitive advantages of reputation and legitimacy [1, 2].

3.1.3. Clean technology strategy

Clean technology extends beyond a company's existing products and business models. Companies adopting this approach, try to identify innovative solutions to tackle the environmental problems. By applying the clean technologies they are willing to make disruptive changes in their product and process design [1, 2].

While the environmental measures of pollution prevention and product stewardship are more related to environmental efficiency, the environmental outcomes of the clean technology strategy are associated with reducing the consumption of material and energy [2].

Clean technologies can provide the opportunities for organizations to reposition their internal skills and capabilities for gaining benefits from the future markets [1].

3.2. Environmental performance

The previous studies show that the adoption of green strategies will result in the improvement of environmental performance [12, 14, 22, 23].

The measures for the environmental performance construct are derived from the various validated measures offered in the literature [12, 14, 23]. To cover a comprehensive list of environmental measures, a formative-formative second-order construct is introduced for representing the environmental performance. The environmental performance construct is divided into three sub-constructs associated with three types of green strategy: pollution prevention performance, product stewardship performance and clean technology performance. However, due to the interconnection of the green strategies [3] that will be tested in the model, it is assumed that each green strategy can affect all the types of environmental performance. Hence, the impact of each green strategy is examined on the overall environmental performance as the second-order construct.

3.3. Competitive benefits

The positive impact of environmental initiatives and performance on competitive advantage is empirically tested and supported by previous studies [8, 13, 14].

According to the NRBV framework, the competitive benefits of cost reduction, reputation and legitimacy, and future positioning are the outcomes of the implementation of pollution prevention, product stewardship, and clean technology strategy, respectively [2]. In this study, both tangible and intangible measures of competitive benefits are considered. Tangible measures include cost reduction, productivity, and market share; and intangible measures include product quality, corporate image and innovation [8, 13, 14]. Table 1 shows the measures and items associated with the constructs.

4. Research methodology

4.1. Sample and data

To generate the dataset required to test the conceptual model, a questionnaire survey was conducted among the EMS ISO14001 certified manufacturers in Malaysia. The unit of analysis in this study is the individual company. The questionnaires were distributed to the firms' Environmental Management Representatives (ERMs). ERMs are the key informant person in EMS ISO14001 certified companies who have knowledge about the green issues [14]. A web-based survey solution entitled SurveyMonkey [24], was used to distribute the questionnaires and followed-up with phone calls to increase the response rate; 139 completed questionnaires out of 430 questionnaires were received. Table 2 shows the profile of the respondent companies.

Table 1. Operationalization of the constructs

Construct	Measure	Item	Code
Green strategy adoption	Pollution prevention	- Preventing or reducing emissions and effluents from the current manufacturing processes	I_{11}
		- Waste reduction during the manufacturing process.	I_{12}
		- Decreasing the use of hazardous /harmful/toxic materials in current product/ current manufacturing process.	I_{13}
	Product Stewardship	- Expand the scope of the environmental improvements to include the entire value chain or "life cycle" of the firm's product system	I_{21}
		- Engage all of the firm's stakeholders in the environmental improvement process.	I_{22}
		- Integrate the requirements of all of the firm's stakeholders into the environmental improvement process.	I_{23}
		- Share responsibility for reducing the environmental impacts of products across the value chain	I_{24}
	Clean Technology	- Considerable focus on tomorrow's technologies	I_{31}
		- Considerable focus on tomorrow's markets	I_{32}
		- Entrepreneurial activities in renewable energy and other clean technologies domain.	I_{33}
		- Developing the sustainable competencies of the future.	I_{34}
Environmental Performance	Pollution Prevention	- Reducing CO_2 emissions.	I_{411}
		- Reducing waste generation.	I_{412}
		- Reducing use of hazardous material.	I_{413}
		- Increasing rate of internal recycling (waste recycling).	I_{414}
	Product Stewardship	- Reducing use of scarce material.	I_{421}
		- Increasing use of recyclable materials.	I_{422}
		- Increasing use of renewable materials.	I_{423}
		- Increasing use of recycled materials into new products.	I_{424}
		- Increasing rate of end-of-life recycling (recycling from packaging /products/components).	I_{425}
		- Increasing level of recyclability in firm's products.	I_{426}
	Clean Technology	- Reducing material consumption.	I_{431}
		- Reducing energy consumption.	I_{432}
		- Reducing water consumption.	I_{433}
		- Increasing use of renewable energy.	I_{434}
		- Increasing proportion of zero-emission/low emission products in firm's product portfolio.	I_{435}
Competitive Benefits		- Cost reduction.	I_{51}
		- Improved productivity.	I_{52}
		- Improved corporate image.	I_{53}
		- Improved quality.	I_{54}
		- Improved innovation.	I_{55}
		- Improved market share.	I_{56}
		- New market opportunities.	I_{57}

Table 2. Profile of responding companies

Variable	Category	Frequency	%
Type of Industry	Automotive and other Transport Equipment	25	17.99%
	Electrical and Electronic	50	35.97%
	Metal, Machinery, Equipment and Appliance	20	14.39%
	Rubber and Plastic Products	15	10.79%
	Chemical and Chemical Products	13	9.35%
	Textiles, Paper Products and Products of Wood	16	11.51%
Company's age	<=15 Years	17	12.23%
	15 Years >	122	87.77%
Company's size	5–50	25	6.47%
	51–150	50	25.90%
	151–500	20	33.09%
	501–1000	15	15.83%
	1000>	13	18.71%
Ownership	Local owned (Fully Malaysian)	48	34.53%
	Local and Foreign Joint Venture	19	13.67%
	Foreign based Company	72	51.80%
Market	Local	25	5.76%
	Regional/Asian	50	11.51%
	Global	20	56.12%
	Local & Regional	15	12.95%
Suppliers	Local & Global	13	13.67%
	Local	25	6.47%
	Regional/Asian	50	15.83%
	Global	20	41.73%
	Local & Regional	15	12.23%
	Local & Global	13	23.74%

4.2. Data analysis

To test the conceptual model Partial Least Squares based SEM (PLS-SEM) is applied [20]. The main reasons for its use include its ability to: 1) predict and explain the variance of key target constructs (e.g. firm's competitive benefits) by different explanatory constructs (e.g. green strategies as the sources of competitive benefits), 2) handle the small sample size, 3) manage the non-normal data, and 4) analyse the formatively measured constructs [25]. The main reason for using SEM-PLS in this study is related to its ability for prediction. As PLS-SEM focuses on prediction, this method can be used to obtain the importance of the green strategies in achieving the key target constructs of environmental performance and competitive benefits.

In PLS-SEM, the model is made up of two elements, the measurement model (the relationships between the constructs and their measure), and the structural model (the relationships between the constructs). The objective for analysing the measurement model is to evaluate the model's validity and reliability, while the objective of analysing the structural model is to examine how significant the relationships are between the independent and dependent constructs [20]. There are several steps to evaluate the measurement model and structural model, which are discussed in the next section.

5. Results and Discussion

5.1. Measurement model evaluation

To evaluate the reflective measurement model, the composite reliability (CR), convergent validity, and discriminate validity [20] were analysed. Table 3 depicts the results of testing the reflective measurement model. The factor loadings for all reflective items exceed the recommended value of 0.7. The composite reliability, which is a measure of internal consistency reliability, ranged from 0.943 to 0.946, which is acceptable. Convergent validity refers to the extent to which a measure correlates positively with alternative measures of the same construct [20]. To analyse the convergent validity, the outer loadings of the indicators and the average variance extracted (AVE) were calculated. In the reflective measurement model, all the indicator loadings exceed the recommended value of 0.7. All the values of AVE, which refers to the communality of the constructs [20], are acceptable according to the minimum recommended value of 0.5.

Table 3. Reflective measurement model

Construct	Item	Loadings	AVE	CR
Pollution Prevention Strategy (Y_1)	I_{11}	0.932	0.846	0.943
	I_{12}	0.946		
	I_{13}	0.880		
Product Stewardship Strategy (Y_2)	I_{21}	0.883	0.805	0.943
	I_{22}	0.918		
	I_{23}	0.891		
	I_{24}	0.896		
Clean Technology Strategy (Y_3)	I_{31}	0.879	0.814	0.946
	I_{32}	0.927		
	I_{33}	0.884		
	I_{34}	0.919		

Discriminant validity refers to the distinction of a construct from the other constructs in the measurement model. To test the discriminant validity the Fornell-Larcker criterion approach – which is a conservative approach to assessing discriminant validity – was applied [20]. According to this approach the square root of the AVE for each construct must be larger than its correlation with other constructs, which is true for the measurement model (see Table 4).

Table 4. Inter-construct correlation

	Y_1	**Y_2**	**Y_3**	**Y_4**	**Y_5**
Y_1	**0.920**				
Y_2	0.626	**0.897**			
Y_3	0.674	0.757	**0.902**		
Y_4	0.565	0.537	0.664	**NA**	
Y_5	0.524	0.579	0.677	0.726	**NA**

To evaluate the formative measurement model, the collinearity issue was first assessed by looking at the variance inflation factors (VIF), which is recommended to be less than the value of 5 [20]. All the VIF in the formative measurement model satisfy this condition (see Table 5). Secondly, the significance of the outer weights was analysed. For this purpose, the bootstrapping procedure was run by creating 1000 random subsamples. The t-value, which was calculated after running this procedure, shows the significance of each indicator's weight. As can be seen from Table 5, several indicators have insignificant weight (less that 1.645); however, these items were not deleted as their outer loadings are above 0.5, which shows that the item has absolute importance, but no relative importance [20].

The procedure for evaluation of the formative measurement model is also followed for evaluation of the second-order construct of environmental performance (see Table 6).

5.2. Structural model evaluation

Table 7 depicts the results evaluating the structural model. The results show that the product stewardship and clean technology strategy have a positive direct significant impact on competitive benefits, while there is no significant direct relationship between pollution prevention and competitive benefits. However, the pollution prevention strategy has a positive significant impact on environmental performance, which is significantly related to competitiveness.

Table 5. Formative measurement model

Construct	Item	Weight	Loading	T-Value	VIF
Pollution Prevention Performance (Y_{41})	I_{411}	0.361	0.764	2.630	1.548
	I_{412}	0.537	0.902	3.683	2.293
	I_{413}	0.094	0.790	0.578	2.409
	I_{414}	0.273	0.607	1.766	1.198
Product Stewardship Performance (Y_{42})	I_{421}	0.723	0.931	5.398	1.647
	I_{422}	0.114	0.591	0.481	2.036
	I_{423}	-0.090	0.659	0.381	3.108
	I_{424}	0.043	0.552	0.237	2.735
	I_{425}	0.130	0.774	0.688	4.052
	I_{426}	0.270	0.724	1.323	3.259
Clean Technology Performance (Y_{43})	I_{431}	0.113	0.797	0.756	2.412
	I_{432}	0.446	0.898	2.768	3.676
	I_{433}	0.179	0.857	1.044	3.489
	I_{434}	0.206	0.669	1.617	1.521
	I_{435}	0.285	0.763	1.906	1.719
Competitive Benefits (Y_5)	I_{51}	0.200	0.808	0.921	3.064
	I_{52}	0.349	0.855	2.019	4.244
	I_{53}	0.166	0.795	0.840	3.468
	I_{54}	-0.380	0.724	2.293	3.918
	I_{55}	0.578	0.911	3.134	3.072
	I_{56}	0.012	0.831	0.068	3.938
	I_{57}	0.176	0.832	0.988	3.828

Table 6: Second-order measurement model

1st order	2nd order	weight	Loading	T-value	VIF
Y_4	Y_{41}	0.142	0.935	0.889	4.656
	Y_{42}	0.267	0.798	1.587	2.188
	Y_{43}	0.647	0.985	3.646^{***}	4.888

$^{***}p<0.01$

Table 7. Summary of the structural model

Relation	Path coefficient	Standard error	t-value	Results
Y_1-Y_4	0.211	0.107	1.975^{**}	Significant
Y_2-Y_4	0.024	0.096	0.252	Non-significant
Y_3-Y_4	0.503	0.105	4.811^{***}	Significant
Y_1-Y_5	-0.006	0.089	0.063	Non-significant
Y_2-Y_5	0.117	0.085	1.375^{*}	Significant
Y_3-Y_5	0.269	0.094	2.865^{***}	Significant
Y_4-Y_5	0.487	0.084	5.821^{***}	Significant

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

5.3. Importance-performance analysis

The key characteristic of the PLS-SEM technique, which is the extraction of the latent variable scores [20], provides us with the opportunity for importance-performance analysis of the green strategies regarding their impact on competitiveness. To measure and compare the total effect of green strategies on firm's competitiveness, the sum of all the direct effects and indirect effects of each green strategy on the target construct of competitive benefits were calculated (see Table 8). The results show that the clean technology strategy has the greatest impact on the competitive benefits in comparison with the two other green strategies.

The performance of the green strategies in the Malaysian manufacturing industries is also calculated by using equations (1) and (2). The weights of the formative indicators for each green strategy, which were calculated using SmartPLS, are given in Table 9. The performance for pollution prevention, product stewardship, and clean technology strategy are 80.842, 68.688, and 68.221, └誠└諶└諸└諺└諼└諾└謀└謂└謄└諭└謈└謊└謌└謎└ e ultimate results of the importance-performance matrix analysis (IPMA).

Table 8. Total effect of green strategies on competitive benefits

Green Strategy	Effect on competitive benefits		
	Direct effect	Indirect effect	Total effect
Pollution Prevention	-0.006	0.211*0.487	0.097
Product Stewardship	0.117	0.024*0.487	0.129
Clean Technology	0.269	0.503*0.487	0.514

Performance Y_i= Average (performance $Y_{i\ case1:}\ Y_{i\ case139}$) *(1)*

Performance $Y_{i\ case\ n}=\sum_{j=1}^{m} Score\ I_{ijcase\ n} * Weight\ I_{ij}$ *(2)*

i=1,…,3; n=1,…,139;

m= Total number of the items in variable Y_i

Table 9. Performance measurement model

Variable	Code	Item	Normalized weight
Pollution Prevention	Y_1	I_{11}	0.31
		I_{12}	0.35
		I_{13}	0.34
Product Stewardship	Y_2	I_{21}	0.24
		I_{22}	0.24
		I_{23}	0.25
		I_{24}	0.27
Clean Technology	Y_3	I_{31}	0.25
		I_{32}	0.25
		I_{33}	0.23
		I_{34}	0.27

The results show that clean technology has the greatest impact on competitive benefits with the importance value of 0.514. Although this strategy has a performance value of 68.221, it has received less attention compared to the other two strategies. Another finding of this study refers to the insignificant importance of the pollution prevention strategy in respect of competitive benefits. Meanwhile the performance of a pollution prevention strategy exceeds the product stewardship and clean technology performance. One possible reason for this finding could be associated with the regulatory pressures in Malaysia driving the companies to be more focused on pollution prevention. Since a great number of EMS ISO14001 certified companies are doing well in the adoption of pollution prevention strategies, it leaves no room to gain competitiveness as a result of leading to homogeneity.

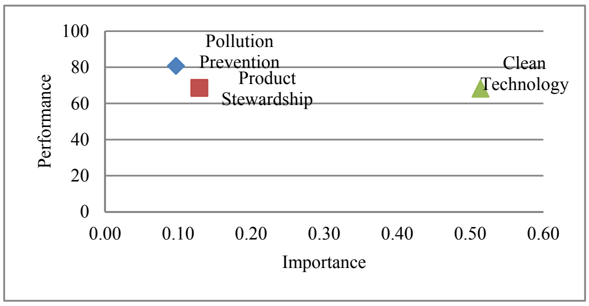

Fig. 2. Importance-Performance Matrix Analysis (IPMA)

6. Conclusion

This study analysed the importance-performance of three types of green strategy, namely, pollution prevention, product stewardship, and clean technology in relation to environmental and competitive performance among Malaysian EMS ISO14001 certified manufacturers.

This study, by applying the technique importance-performance matrix analysis (IPMA), analysed the results provided by standard Partial Least Squares based SEM (PLS-SEM) analysis to prioritize the green strategies in the Malaysian manufacturing industry.

The results show that while the Malaysian manufacturers show considerable attention to performing a "pollution prevention" strategy, the importance of this strategy for generating competitive benefits is not as significant as two other green strategies – clean technology and product stewardship.

The findings of this paper have several implications for practitioners:

- The findings of this research suggest that the manufacturers should pay more attention to the implementation of "product stewardship", and clean technology. In this respect, they are required to develop their key resources of stakeholder integration and disruptive change [1-3].
- By assessing their current performance in each green strategy, the manufacturers can compare their own performance with the average performance in the industry. This insight assists them to strategically manage their environmental programmes.

There are also several future research opportunities to improve this work:

- The scope of research can be narrowed to particular industries. This can provide the opportunity for further deeper studies on individual industries and identify the specific issues associated with the performance and importance of green strategies in those industries.
- This findings of this research confirm the importance of implementation of green strategies for gaining

environmental and competitive benefits. To assist the Malaysian manufacturing industry to effectively implement these strategies, future research can bring a contribution to practitioners by exploring the drivers and barriers for implementing each green strategy in the Malaysian manufacturing industry.

Acknowledgements

The authors would like to extend their appreciation to the University of Malaya for the Postgraduate Research Fund (Grant no. PV087/2011A) that made this study and paper possible.

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