Green Supply Chain Management Practices in Malaysia Manufacturing Industry

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***Abstract* — The purpose of this study is to determine the relationship between green supply chain management practices towards environmental and operational performances among Malaysian manufacturing firms. The research design for this study employs quantitative method using survey questionnaires which was developed based on a thorough review of relevant literature on green practices. A total of 300 questionnaires were distributed randomly among the manufacturing firms in Malaysia. A total of 7 variables included in this study, comprising green purchasing, investment recovery, eco-design and packaging, reverse logistic, and cooperation with customers, manufacturing environmental and operational performance. This study will measure the impact between green supply chain management practices towards environmental and operational performance in Malaysian manufacturing industry.**

Keywords *— Green practices, Supply chain, Environment, Manufacturing*

1. Introduction

Many environmental problems such as global warming, solid waste management, air pollution, forest management and ozone layer depletion came from business organization which aims for profit maximization [13]. As such, environmental issue are becoming an important task as pertinent to work related to manufacturing [17]. Also, [4] concur that in Malaysia, environmental issue has become priority for the government and public.

Based on [18], manufacturing industry is one of the main contributors for environmental deterioration. Moreover, with the decreasing resource and increase environmental problems, the manufacturer in the developing economies have experience high pressure from all corners of the world to improve their green routine across supply chain, hence to further improve environmental and economic performance [29]. Therefore, this study is purported to identify the right set of green practices that could enhance manufacturing firms' performance in terms of environmental and operational performance in a single setting.

2. Conceptual Framework and Hypotheses Development

2.1 Green Purchasing

According to [28], there are a number of researches that have been studying green purchasing or also known as environmental purchasing. Studies such as, [5] which study the level of adoptions of green initiatives which consist green purchasing among certified companies in Malaysia. Acute awareness of environmental problems following continuous environmental deterioration drives a growing consumer and individual preference for environmentally oriented firm. Firms and supply channel networks thus recognize the importance of being environmentally proactive in developing and implementing green strategies [8] in purchasing to balancing economic and environmental performance [16], and operational performance [14] in response to various situations such as competitive, regulatory, and community pressures [28].

H1 There is a significant relationship between green purchasing and environmental performance.

H2 There is a significant relationship between green purchasing and operational performance.

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2.2 Investment Recovery

According In an environmental perspective, investment is recovered in the form of "surplus asset". It is then can be "redeployed" within the firm or sold on the outside, avoids the "disposition" of these assets to scrap yards or landfills. The asset selling via online "disposition avenues" such as online auction, more decrease in ecological effects by "eliminating" the logistics of transporting the equipment to a "central staging area", also suggesting online viewing potentials [11]. [11], also mention there are limited studies which pointed out the positive connection of environmental practices and operational performance. [23] stated that "environmental management practices are strategic innovative programs and tools for industry to encourage company's operational performance.

H3 There is a significant relationship between investment recovery and environmental performance.

H4 There is a significant relationship between investment recovery and operational performance.

2.3 Eco-Design and Packaging

Previous studies have identified in an organisation, there are elements of green design and packaging is include to ensuring that packaging is reusable and recyclable [15], minimizing waste by reducing packaging [25], and avoidance of hazardous material [1]. Moreover, [26] stressed that the environmental impacts of a product occur at all stages of its lifecycle and they identified lifecycle assessment as a commonly used attribute of GSCM. Thus, these attribute measures the environmental and operational performance in the firm's supply chain.

H5 There is a significant relationship between eco-design and packaging, and environmental performance.

H6 There is a significant relationship between eco-design and packaging, and operational performance.

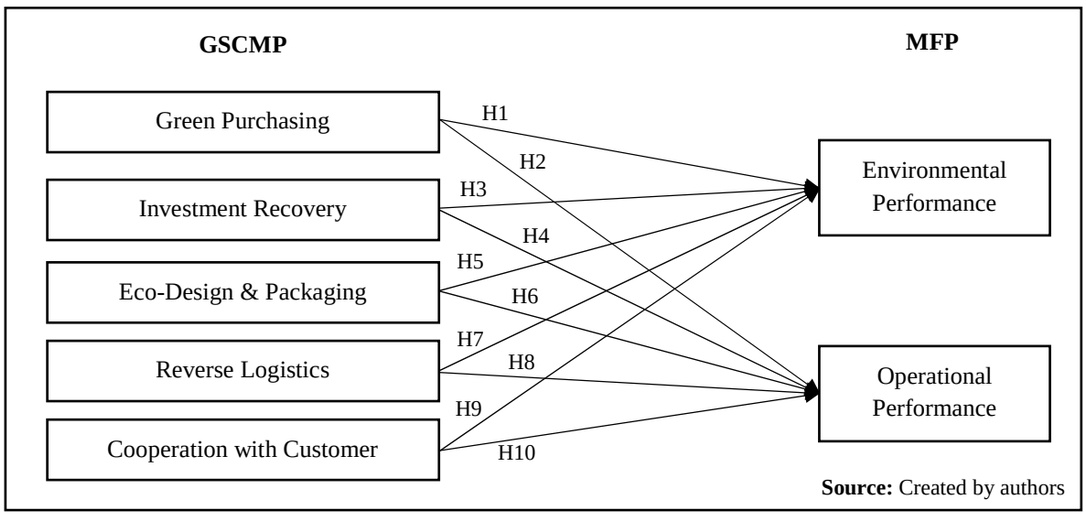

Figure 1. Research framework

2.4 Reverse Logistics

Reverse logistic generally define as the process of returning faulty goods from customers to the suppliers or any other company acting as an agent to reverse logistics [24]. It is a return good handling process, which will reduce the cost of resource by improving manufacturing and shipping process since many goods are damage transit [21]. The reverse logistics can mean different things to different people. Since old times, materials of used objects are recovered and reused for similar or complete different purposes [19]. According to [12], it forms a post-operational practice that able the organization to focus on adding value and at the same time minimizing any harm the might come to the environment and firm performance. Hence, reverse logistics could demonstrate a positive relation among operation and environmental performance.

H7 There is a significant relationship between reverse logistics and environmental performance.

H8 There is a significant relationship between reverse logistics and operational performance.

2.5 Cooperation with Customer

A Customers' ask for green products and services have now become the most significant driver for green initiatives [3]. But these customer calls are still evolving [11]. Thus, cooperation with customers requires working with customers to design cleaner production processes that produce environmentally sustainable products with green packaging [30] and to resolve all inquiries concerned by customers. Therefore, the cooperation with customer will help boost firm's environmental and operational performance.

H9 There is a significant relationship between cooperation with customer and environmental performance.

H10 There is a significant relationship between cooperation with customer and operational performance.

3. Methodology

The research design employed in this study was quantitative method using survey questionnaires. Potential respondents were identified using stratified random sampling technique. This is because the population could be division into smaller groups with similar characteristics based on the firm size. [20,22].

This study has conducted in Peninsular Malaysia i.e. Selangor, Kuala Lumpur, Melaka and etc. The actual sample size required for this study is 300 samples and was calculated using Daniel Soper online statistics calculator [2] and minimum acceptable standard from [9]. About 1000 questionnaires distributed by hand, as well as mail to get maximum response in short period.

Out of 1000 questionnaires distributed, only two hundred and fifty were received back. Among these questionnaires, 11 questionnaires are discarded because that have more than 10% missing values [9]. As a result, only 239 questionnaires are valid for data analysis and the resulting response rate is 23.9% for this study.

4. Data Analysis and Results

4.1 Main Sample Characteristics

The main respondents of this study are managers which are 34.7 percent; follow by executive officers with 28.9 percent. A majority of 104 companies (43.5 percent) have an ownership status of joint ventures companies. Furthermore, 103 of these respondent's companies (43.1 percent) have gain nearly or equal to an amount of RM1, 000,000 in annual sales.

It is no surprise these companies can gain high yearly sales as majority of them have more than 1,000 employees (40.6 percent). Moreover, 101 respondents which are more than 40 percent of them have been working in a company that have more than 10 years of operating experience.

4.2 Reliability

Reliability analysis has been performed to find out the cronbach alpha values for these adopted scales. All the dimension alpha values are ranged between 0.856 to 0.922, which is an acceptable standard. This is because the reliability of reflective constructs based on cronbach alpha's value must be in the scale range 0.7 and above to be acceptable [6,7,10].

In **Error! Reference source not found.**, all dimension with values that are reported above the acceptable standards are green purchasing (0.906), investment recovery (0.863), eco-design and packaging (0.922), reverse logistics (0.891), cooperation with customer (0.903), environmental performance (0.895) and operational performance (0.856).

The results in

Table 1 show a five dimensional structure for GSCM practices constituting green purchasing, investment recovery, eco-design and packaging, reverse logistics, and cooperation with customers, all with acceptable factor loadings of above 0.5. Finally, for the other two dimensional structure with results for environmental and operational representing manufacturing firm's performance, also show all items related to these constructs were examined with acceptable factor loadings more then 0.6 (see

Table 1).

4.3 Descriptive

Table 2 highlighted mean, standard deviation and correlations values to describe the green supply chain management practices relationships with environmental and operational performances. The average scores have reflected that GSCM practices and manufacturing firm's performance is within 5.43 to 5.95. The variable with the highest mean score is green purchasing with 5.95 out of 7 points. While the lowest average score is environmental performance with 5.43 out of 7 points.

On another part, the standard deviation (SD) is a more accurate and detailed estimate of dispersion because an outlier can greatly exaggerate the range. It also shows the relation that set of scores has to the mean of the sample. The highest standard deviation is from investment recovery which is 0.84. Whereas, operational performance has the lowest standard deviation of 0.56.

The correlation analysis is used to measure the relationship strength between the dependent and independent variables [27]. Based on Table 2, the results suggest that all GSCM practices paired with environmental and operational performance are positively correlated and all correlations were significant and greater than +.40 and up to +.78, with $p < .001$ (two-tailed). Furthermore, investment recovery, eco-design and packaging, and reverse logistics have a very strong positive relationship with both environmental and operational performances. However, although green purchasing and cooperation with customers have a strong relationship with operational performance, they have a

moderate relationship with environmental performance.

Table 1. Scale Items, Reliabilities and Factor Loadings results of the research instrument

Dimension	Items	Alpha	Factor Loadings
Green Purchasing α = 0.906	Providing suppliers with design specifications that include environmental requirements for purchased items	.749	.717
	Cooperation with suppliers towards environmental objectives	.793	.767
	Environmental audits for suppliers' internal management	.817	.832
	Suppliers' ISO 14000 certification	.747	.786
	Buying environment-friendly raw materials	.718	.807
Investment Recovery α = 0.863	Sale of excess inventories/materials	.790	.711
	Sale of scrap and used materials	.684	.705
	Sale of excess capital equipment	.749	.773
Eco-design & Packaging α = 0.922	Design of products for reduced consumption of material/energy	.677	.742
	Design of products for reuse, recycle, recovery of material and/or component parts	.794	.847
	Design of products to avoid or reduce use of hazardous products and/or their manufacturing process	.841	.861
	Design of products for disassembly	.832	.877
	Makes sure that its packaging has recyclable contents	.745	.717
	Makes sure that its packaging is reusable	.785	.755
Reverse Logistics α = 0.891	Collects used products from customers for recycling, reclamation, or reuse	.723	.714
	Collects used packaging from customers for reuse or recycling	.807	.781
	Requires suppliers to collect their packaging materials	.739	.834
	Returns products to suppliers for recycling, retaining of materials, or remanufacturing	.783	.797
	Returns packaging to suppliers for reuse or recycling	.635	.549
	Returns the products from customers for safe refill	.572	.639
Cooperation with Customer α = 0.903	Cooperation with customer for eco-design	.699	.693
	Cooperation with customers for cleaner production and distribution	.777	.726
	Cooperation with customers for green packaging	.823	.848
	Cooperation with customers for using less energy during product transportation	.802	.887
	Cooperation with customers for developing environmental database of products	.695	.656
Environmental Performance α = 0.895	Reduction of air emission, waste water, solid wastes	.642	.848
	Decrease of consumption for hazardous/harmful/toxic materials	.806	.887
	Decrease of frequency for environmental accidents	.848	.832
	Improve company's environmental situation	.790	.807
Operational Performance α = 0.856	Product durability	.662	.761
	Perceived overall product quality	.581	.685
	Promptness in solving customer complaints	.656	.773
	Manufacturing throughput time	.687	.742
	Meeting delivery due date	.602	.847
	Ability to change delivery date	.583	.861
	Ability to change product mix	.628	.877

Note: George and Mallery (2003) highlighted the ranges of reliability e.g., >=.9 excellent, >=.8, >= Good, >=.7 acceptable, >=.6 questionable, >=.5 poor, <.5 unacceptable.

Table 2. Descriptive Statistics Results

Variable Description	Mean	Std D	1	2	3	4	5	6	7
Green purchasing	5.95	.59	1						
Investment recovery	5.57	.74	.510**	1					
Eco-design & packaging	5.43	.76	.375**	.687**	1				
Reverse logistics	5.70	.60	.475**	.562**	.494**	1			
Cooperation with customer	5.81	.63	.559**	.481**	.432**	.647**	1		
Environmental Performance	5.47	.70	.400**	.718**	.778**	.502**	.435**	1	
Operational Performance	5.85	.56	.817**	.760**	.575**	.663**	.727**	.595**	1

**. Correlation is significant at the 0.01 level (2-tailed). Pearson Correlation, N= 239. According to Cohen (2013), weak relationship range is .10-.29, medium range is .30-.49 & strong rang is .50 to 1.

Source: Created by authors

4.4 Multiple Regression Analysis (GSCMP and Environmental Performance)

The R^2 value is reflecting that the green supply chain management practices produce 96% variations in environmental performance. According to the F-value= 1138.017 with sig < .001, it can be said that the model has a good fit for the data. **Error! Reference source not found.** shows that eco-design and packaging (β = 0.92, T = 50.396, P < 0.001), and investment recovery (β = 0.081, T = 4.08, P < 0.001) has explored strong positive relationship with environmental performance. Therefore, it shows that H3 and H5 are supported. Whereas green purchasing (β = 0.021, T = 1.241, P > 0.05), reverse logistics (β = -0.000, T = 0.004, P > 0.05), and cooperation with customers (β = -0.013, T = -0.696, P > 0.05) have no significant relationship with environmental performance. Hence, H1, H7 and H9 are not supported.

Table 3. Multiple Regression Analysis (GSCMP and Environmental Performance)

R = 0.980	R^2 = 0.961	Adjusted R^2 = 0.960	Std. Error = 0.158	
F = 1138.017	P < 0.000			
Dependent Variable: **Environmental Performance**				**Results**
Independent Variables	**Std. β**	**T value**	**P value**	
Green purchasing	.021	1.241	.216	Not Supported
Investment recovery	.081	4.080	.000	Supported
Eco-design & packaging	.920	50.396	.000	Supported
Reverse logistics	.000	.004	.997	Not Supported
Cooperation with customers	-.013	-.696	.487	Not Supported
Constant: B = -.204	Std. Error = .122	t = -1.677	Sig.= .095	

Assumptions:
Normality: Kolmogorov-Smirnov Statistics 0.045 < 0.721 at a significant level of.001
Linearity: Confirmed by the analysis of partial regression plots
Homoscedasticity: Confirmed by the analysis of partial regression plots
Independence of Residuals: Durbin-Watson test, score = 1.543
No Collinearity and Multicollinearity problems confirmed by Correlation coefficients.

Source: Created by authors

4.5 Multiple Regression Analysis (GSCMP and Operational Performance)

The R^2 value is reflecting that the green supply chain management practices produce 96% variations in operational performance. Based on **Error! Reference source not found.**, the F-value= 1138.017 with sig < .001, it can be said that the model has a good fit for the data. There are three variables with highly positive relations with operational performance, which are green purchasing (β = 0.414, T = 18.022, P < 0.001), investment recovery (β = 0.352, T = 12.791, P < 0.001), and cooperation with customers (β = 0.382, T = 14.982, P < 0.001). However, eco-design and packaging (β = 0.003, T = 0.114, P > 0.05), and reverse logistics (β = 0.02, T = 0.781, P > 0.05) shows that they have no significant relationship with operational performance. As a result, this study supported H2, H4 and H10, while H6 and H8 are not supported.

Table 4. Multiple Regression Analysis (GSCMP and Operational Performance)

R = 0.962 F = 576.099	R^2 = 0.925 P < 0.001	Adjusted R^2 = 0.924		Std. Error = 0.154
Dependent Variable: **Operational Performance**				**Results**
Independent Variables	**Std. β**	**T value**	**P value**	
Green purchasing	.414	18.022	.000	Supported
Investment recovery	.352	12.791	.000	Supported
Eco-design & packaging	.003	.114	.910	Not Supported
Reverse logistics	.020	.781	.435	Not Supported
Cooperation with customer	.382	14.982	.000	Supported
Constant: B= -.117	Std. Error=.118	t = .989	Sig.= .324	
Assumptions: Normality: Kolmogorov-Smirnov Statistics 0.018 < 0.721 at a significant level of.001 Linearity: Confirmed by the analysis of partial regression plots Homoscedasticity: Confirmed by the analysis of partial regression plots Independence of Residuals: Durbin-Watson test, score = 1.988 No Collinearity and Multicollinearity problems confirmed by Correlation coefficients.				

Source: Created by authors

5. Discussion and Conclusion

This study identified the important practices of green supply chain in the manufacturing industry from a developing economy, Malaysia. Among the five green practices only investment recovery, and eco-design and packaging practices are positively supported with environmental performance. On the other part, within all five GSCM practices identified in this paper only three practices have significant relationships; green purchasing, investment recovery, and cooperation with customers would bring a positive impact towards operational activities in manufacturing firms performance. A more complete understanding of the GSCM practices and their relationships, through a logical structure, will help managers to better prioritize and target their resources in a more effective way and a better communication or effective involvement with suppliers. In conclusion, the GSCM practices react mostly in the operational activity compare to environmental concern in manufacturing performance.

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References

[1] Buyukozkan, G., and Cifci, G., "*Evaluation of green supply chain management practices: a fuzzy ANP approach"*, Production Planning & Control, Vol. 23, No. 6, pp. 405–418, 2012.

[2] Cohen, J., Cohen, P., West, S. G., and Aiken, L. S., *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences* (3rd edition), Mahwah, NJ: Lawrence Earlbaum Associates, 2003.

[3] Doonan, J., Lanoie, P., and Laplante, B., "*Analysis Determinants of Environmental Performance in the Canadian Pulp and Paper Industry: An Assessment from Inside the Industry"*, Ecological Economics, Vol. 55, No. 1, pp. 73–84, 2005.

[4] Eltayeb, T. K., Zailani, S., and Filho, W. L., "*Green business among certified companies in Malaysia towards environmental sustainability: benchmarking on the drivers, initiatives and outcomes"*, International Journal Environmental Technology and Management, Vol. 12, No. 1, pp. 95–125, 2010.

[5] Eltayeb, T., and Zailani, S., "*Going green through green supply chain initiatives towards environmental sustainability"*, Operations and Supply Chain Management, Vol. 2, pp. 93–110, 2009.

[6] Fomell, C., and Larcker, D. F., "*Evaluating structural equation models with unobservable variables and measurement error"*, Journal of Marketing Research, Vol. 18, No. 1, pp. 39–39, 1981.

[7] George, D., and Mallery, M., *Using SPSS for Windows step by step: a simple guide and reference Boston*, MA: Allyn & Bacon, 2003.

[8] Gifford, D., *"The value of going green"*, Harvard Business Review, Vol. 75, No. 5, pp. 11–12, 1997.

[9] Hair, J. F., *Multivariate Data Analysis*, Prentice Hall, 2010.

[10] Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E., *Multivariate data analysis* (7th ed.), Upper Saddle River, NJ: Pearson Prentice Hall, 2010.

[11] Hajikhani, M., Wahat, N. W. A., and Idris, K. Bin., *"Considering on green supply chain management drivers, as a strategic organizational development approach, Malaysian perspective"*, Australian Journal of Basic and Applied Sciences, Vol. 6, No. 8, pp. 146–165, 2012.

[12] Hsu, C.-C., Tan, K. C., Zailani, S. H. M., and Jayaraman, V., *"Supply chain drivers that foster the development of green initiatives in an emerging economy"*, International Journal of

Operations & Production Management, Vol. 33, No. 6, pp. 656–688, 2013.

[13] Kamaruddin, N. K., Kovalan, V., Adi, M. N. M., Ahmad, A. R., and Noor, H. M., *Adoption of green supply chain initiatives among small and medium sized suppliers*, Entrepreneurship Vision 2020: Innovation, Development Sustainability, and Economic Growth, pp. 527–536, 2013.

[14] Khiewnavawongsa, S., *Barriers to green supply chain implementation in the electronics industry*, Purdue University, West Lafayette, Indiana, 2011.

[15] Large, R. O., and Thomsen, C. G., *"Drivers of green supply management performance: evidence from Germany"*, Journal of Purchasing & Supply Management, Vol. 17, No. 3, pp. 176–184, 2011.

[16] Luthra, S., Garg, D., and Haleem, A., *"Green supply chain management: Implementation and performance – a literature review and some issues"*, Journal of Advances in Management Research, Vol. 11, No. 1, pp. 20 – 46, 2014.

[17] New, S., Green, K., and Morton, B., *"An analysis of private versus public sector responses to the environmental challenges of the supply chain"*, Journal of Public Procurement, Vol. 2, No. 1, pp. 93–105, 2002.

[18] Rusli, K. A., Rahman, A. A., and Ho, J. A., "*Green supply chain management in developing countries : A study of factors and practices in Malaysia"*, International Annual Symposium on Sustainability Science and Management, Vol. 11, pp. 278–285, July 2012.

[19] Sundram, V. P. K., and Chandran, V. G. R., *"The supply chain management in reverse logistics. A case of product recovery management"*, Academic Journal of UiTM Johor, Vol. 4, pp. 145–162, 2004.

[20] Sundram, V. P. K., and Chandran, V. G. R., *Research Method - A simple guide for business undergraduates*, Shah Alam: UPENA, Universiti Teknologi MARA, 2011.

[21] Sundram, V. P. K., Atikah, S. B., and Chandran, V. G. R., *Supply Chain Management: Principles, Measurement and Practice*, University of Malaya Press, Kuala Lumpur, 2016.

[22] Sundram, V. P. K., Chandran, V. G. R., Atikah, S. B., Rohani, M., Nazura, M. S., Akmal, A. O., and Krishnasamy, T., *Research Methodology: Tools, Methods and Techniques*, MLSCA, Selangor, 2016.

[23] Szwilski, T. B., *"Using environmental management systems to systematically improve operational performance and environmental protection"*, International Journal of Surface Mining, Reclamation and Environment, Vol. 14, No. 3, pp. 183–191, 2000.

[24] Thirunavukkarasu, K., Ahmad Razi. A., Akmal, A. O., Farha, A. G., Mohamed Afiq, Z. and Sundram V. P. K., *Logistics and Supply Chain Managements: A Malaysian Perspective*, Petaling Jaya, Selangor Malaysian Logistics and Supply Chain Association, 2014.

[25] Walker, H., DiSisto, L., and McBain, D., *"Drivers and barriers of environmental supply chain practices: lessons from the public and private sectors"* Journal of Purchasing and Supply Management, Vol. 14, No. 2, pp. 69–85, 2008.

[26] Wu, K.-J., Tseng, M.-L., and Vy, T., *"Evaluation the drivers of green supply chain management practices in uncertainty"*, Procedia – Social and Behavioral Sciences, Vol. 25, pp. 384–397, 2011.

[27] Wu, W.-Y., Chiag, C.-Y., Wu, Y.-J., and Tu, H.-J., *"The influencing factors of commitment and business integration on supply chain management"*, Industrial Management & Data Systems, Vol. 104, No. 4, pp. 322–333, 2004.

[28] Yen, Y.-X., and Yen, S.-Y., *"Top-management's role in adopting green purchasing standards in high-tech industrial firms"*, Journal of Business Research, Vol. 65, No. 7, pp. 951–959, 2012.

[29] Zhu, Q., and Sarkis, J., *"An inter-sectoral comparison of green supply chain management in China: Drivers and practices"*, Journal of Cleaner Production, Vol. 14, No. 5, pp. 472–486, 2006.

[30] Zhu, Q., Sarkis, J., and Lai, K., *"Confirmation of a measurement model for green supply chain management practices implementation"*, International Journal of Production Economics, Vol. 111, No. 2, pp. 261–287, 2008.