



How Green is Your Supply Chain? Evidence from ISO 14001 Certified Manufacturers in Malaysia

Khairul Anuar Rusli¹, Azmawani Abd Rahman^{2*}, Jo Ann Ho² and Rashid Abdullah²

¹*Faculty of Business Management and Accountancy, Universiti Sultan Zainal Abidin, Kampus Gong Badak, 21300 Kuala Terengganu, Terengganu, Malaysia*

²*Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia*

ABSTRACT

Extraordinary current consumption in the developed countries as well as in the Asian region, as a result of rapid industrialization, has increased the levels of energy and material consumption. This has posed negative consequences on the natural resources and the environment. The question of how to make economic and infrastructure growth environmentally and socially sustainable, so that it can continue to benefit people while conserving the natural assets and ecosystem continues to challenge policy makers, industry, and consumers. This research investigates the level of green supply chain management (GSCM) practices adopted by ISO 14001 certified manufacturers in Malaysia. Based on the data collected through the questionnaire survey, it was found that most manufacturers have not yet fully adopted the green practices within their supply chain activities. Only 17 percent of the total respondents were proactive adopters of the GSCM practices. The internal environmental practices have been found to be the top GSCM practices, followed by eco-design and investment recovery. The least common GSCM practice is reverse logistics. The study offers implications to both theory and practice.

Keywords: Green supply chain, practices, environment, manufacturing firms, Malaysia

ARTICLE INFO

Article history:

Received: 30 April 2012

Accepted: 30 September 2012

E-mail addresses:

anuarrosli@unisza.edu.my (Khairul Anuar Rusli),

azar@upm.edu.my (Azmawani Abd Rahman),

ann_hj@upm.edu.my (Jo Ann Ho),

rashidabdullah@upm.edu.my (Rashid Abdullah)

* Corresponding author

INTRODUCTION

Rapid economic growth, technological revolution and physical development all around the world has contributed to environmental deterioration. Hazardous wastes are generated by nearly every industry and manufacturing industry is not excluded

from contributing to the deterioration of environmental sustainability. In Malaysia, for instance, there had been an increase in the number of water pollution point sources recorded by the manufacturing industry in year 2010 as compared to the year 2006. In fact, the highest composition of water pollution is recorded from the manufacturing industry, where manufacturing industry contributes almost half of the water pollution (Department of Environment Annual Report, 2006-2010). This has yet to include the negative environmental impacts from the products produced and the technology used by these manufacturers.

Business organizations have been considered as the major contributors to the environmental problems (Eltayeb *et al.*, 2010). Therefore, firms should realize the importance of adopting green technology into their operations since the green technology is capable of achieving less waste and minimize the negative impacts to the environment. The involvement in the green practices by manufacturers is no longer a “yes” or “no” answer, but has become likely as “why” and “how” questions (Nunes, 2008). Nowadays, major leading companies from the western region have urged the paradigms of sustainable development and corporate environmental responsibility. According to Sarkis (2003), a few world-class companies have consistently extended far beyond just only complying with the environmental regulations, but also taking up green practices as their preferences. In fact, green initiatives are acknowledged as a value added for firms and provide new

opportunity for competition (Hansmann & Claudia, 2001).

Firms are expected to implement strategies to reduce the environmental impacts produced by their products and services because of the increasing pressures for environmental sustainability (Sarkis, 1995). According to Wisner *et al.* (2005), customers are increasingly demanding to know where the products come from, how they are made and distributed, and what impacts future legislations will have on the products they buy. Thus, organizations are continuously trying to come out with initiatives which can help them to achieve environmental sustainability. Success in handling environmental management issues may provide new opportunities to increase competitiveness and new ways to add value to core business programmes (Hansman & Claudia, 2001). It is necessary for the industry to react and transform their way of production towards more sustainable and environmental friendly approaches.

As part of green technology, green supply chain management (GSCM) is becoming an important factor that can close the loop of existing traditional supply chain approach. By extending and enhancing the green initiatives throughout the upstream and downstream of supply chain activities, it could provide better performance outcomes to both the firms and the environment. Complying with tight and strict environmental regulations, addressing the environmental concerns of customers, and mitigating the environmental impact of the production and service activities not only

enable firms to improve the environmental performance, but this concept has been recognized as a key strategic issue to enhance the competitiveness of organization (Bacallan, 2000). Green supply chain management practices such as cleaner production, environmental management system and eco efficiency initiatives have been implemented as commitments by the industry players to go green in their operations (Zhu, Sarkis, & Geng, 2005). GSCM has also become a double-barrel method in lowering environmental risks without neglecting the business objectives of generating maximum profit (van Hock & Erasmus, 2000).

As compared to developed countries, firms in developing countries like Malaysia are still in the learning process of how to incorporate the green management practices in their daily operations. As a matter of fact, the concept of green supply chain is relatively new in Malaysia (Wooi & Zailani, 2010). As issues surrounding the environment deterioration are dynamic and still revolving, green supply chain adoption in terms of motives, type of practices, and number of adopting firms may be different today compared to ten years ago or in the future. Therefore, a constant study is needed to fully understand and update knowledge in this area. As such, the core question in this paper is: "How green is the supply chain of manufacturers in Malaysia?" In more specific, this paper outlines the characteristics of green supply chain practices and measures the level of practices among manufacturers in Malaysia.

Given the rising environmental issues faced by the developing countries, this paper presents empirical evidences of GSCM practices among manufacturers in Malaysia. This paper also reviews past research conducted in the area of green supply chain management. The discussion of research method is then presented, followed by the data analysis, and discussion of research findings. It concludes with managerial implications that can benefit both practitioners and policy makers.

LITERATURE REVIEW

Supply chain management (SCM) has emerged as an extremely important operational approach for manufacturers due to today's competitive world that is driven by globalization. The philosophy of efficient supply chain is not only applicable in the manufacturing industry, but also to industries like agriculture (Nitschke & O'Keefe, 1997; Folkerts & Koehorst, 1997), retail (Leonard & Cronan, 2003), food (Robson & Rawnsley, 2001), and healthcare (Hazlinna & Porter, 2009). This area of interest has become very popular due to an increasing number of publications, programmes and conferences relating to the topic by practitioners and academia (Burgess, Singh & Koroglu, 2006). Li, Ragu-Natahn and Rao (2006) conclude that SCM is now recognized as a valuable asset for organizations in creating competitive advantage and better performance. To become more competitive, organizations have started to realize that it is not enough to improve efficiency only within the

organization, but also the whole supply chain has to be made competitive (Li *et al.*, 2005).

According to Beamon (1999), due to the changes in environmental requirements affecting manufacturing operations, increasing attention is being given to developing environmental management (EM) strategies for the supply chain. Changes in the state of the environment, leading to subsequent public pressure and environmental legislation have necessitated a fundamental shift in manufacturing business practices (Beamon, 1999). In this context, Green *et al.* (1996) asserted that

green supply refers to the way in which innovation in supply chain management and industrial purchasing may be considered in the context of environment.

According to Yu and Soon (2008), GSCM integrates the consideration of environmental impacts and resource efficiency, and it is based on the green management theory and supply chain management technology that involves suppliers, manufacturers vendors, and users in the whole supply chain. Meanwhile, developing a green supply chain strategy involves collecting and analyzing environmental regulations and

TABLE 1
Selected dimensions of the green supply chain practices

Researcher (Year)	Green Supply Chain Practices
Zhu <i>et al.</i> (2007)	Green purchasing, eco design and customer cooperation
Lamming and Hampson (1996)	Vendor assessment, total quality management, lean supply, collaborative supply strategies
Rogers and Lembke (2001)	Reverse logistic
Zsidosin and Siferd (2001)	Green purchasing
Hu and Hsu (2010)	Supplier management, product recycling, organization involvement and life cycle management
Holt and Ghobadian (2009)	Internal environmental management practices, logistics, supplier assessment, green procurement, supplier education and industrial network
Beamon (1999)	Eco design and reverse logistics
Eltayeb <i>et al.</i> (2010)	Eco design and reverse logistics
Hamner (2006)	Green purchasing
Helms and Hervani (2006)	Reverse logistic
Min and Galle (2001)	Green purchasing
Theyel (2006)	Customer and supplier relations
Bowen <i>et al.</i> (2006)	Reduce waste, strategic supplier, vendor assessment, clean technology, and supplier scoring
Zhu and Geng (2006)	Green purchasing
Sarkis (2003)	Design for environment, life cycle analysis and reverse logistics
Rao (2006)	Green purchasing

customer surveys from each of the supply chain locations; discussing the relevant environmental issues with the procurement, engineering and quality control departments at each firm; developing the green policy; communicating them to customers and suppliers along the supply chain; and then managing the programme to assure compliance with the policies (Wisner, 2005).

In an effort to understand more about SCM, some previous studies focused on developing the supply chain management practices construct. Basically, without a proper operationalization SCM-related construct, researchers cannot promote the benefits and success of the SCM practices (Min & Mentzer, 2004). Table 1 presents some of the green supply chain practices that have been widely highlighted and discovered in the literature.

A review of the literature indicates that past research in the area of GSCM has addressed different dimensions of the green supply chain practices. For instance, Zhu and Sarkis (2004) classified the green supply chain practices in terms of internal and external activities. Internal activity are top management support, organization environmental policy, investment recovery, and green eco design. Meanwhile, external activity related to the GSCM practices are green purchasing, reverse logistic, cooperations with customers to meet green requirements, and collaboration R&D with stakeholder and supplier evaluation and selection. Based on the literature review and field data from the onsite interviews with the practicing firms, dimensions of the green

practices considered in the present study are cooperations with suppliers in green purchasing, cooperation with customers, eco design, reverse logistic, investment recovery, and internal environmental practices. The following section is dedicated to a better understanding of each green supply chain dimensions used in this study in assessing how green is the supply chain of manufacturers in Malaysia.

Cooperation with Customers and Suppliers in Green Initiatives

Cooperation with customers and suppliers with regards to the environmental issues has been defined by previous researched as external GSCM practices. Cooperation with customers in reducing environmental hazard includes involving customers with various activities such as during product eco-design, cleaner production, packaging, and less energy option during product transportation. Meanwhile, key factors for environmental purchasing are providing design specification to suppliers including environmental requirements for purchased items, cooperation with suppliers for environmental objectives, environmental audit for supplier's internal management and suppliers' ISO14001 certification (Zsidisin & Hendrick, 1998). The recent emergence of green purchasing as an important participant in the corporate sustainable enterprise debate is the result of the convergence of several developments that have highlighted the purchasing role in effective environmental management (Handfield *et al.*, 2002). By incorporating

the green principle into purchasing activity, companies can provide design specifications to suppliers which include environmental requirements for green purchased items needed. Moreover, this will assist them in deciding which suppliers to collaborate with for materials, equipment, parts, and services that support environmental goals (Lamming & Hampson, 1996; Zsidisin & Hendrick, 1998).

Eco-design

No matter where in the product lifecycle a product or process lies, most of the environmental influence is “locked” in at the design stages when materials and processes are selected and product environmental performance is largely determined (Lewis & Gretsakis, 2001). Probably the strongest testament to the greening of the international market is the expanding number of companies seriously addressing environmental aspects as parts of their product development process (Lewis & Gretsakis, 2001). Eco-design includes designing product for reduced consumption of both material and energy, designing product which enables reuse, recycle, and recovery of material and component parts, and designing product to avoid or reduce the usage of harmful materials and harmful processes. By incorporating the green issue into new product development, green design is increasingly considered as a systematic method for companies to reduce the environmental impact of their products and processes while simultaneously cutting costs and increasing product marketability

(Berchicci & Bodewes, 2005). Xerox designers, for instance, choose a minimal number of materials from the Xerox material environmental index to simplify the eventual segregation of materials and to avoid the use of hazardous materials (Tsoufas & Pappis, 2006).

Reverse Logistic

Beside all the practices that have been discussed, another activity that can be classified as a green practice within the supply chain is reverse logistics. Lambert and Stock (1981) define reverse logistic as “going the wrong way on a one-way street because the great majority of product shipments flow in one direction”. A similar definition given by Murphy and Posit (1989) explains reverse logistic as the movement of goods from consumers to a producer in a channel of distribution. Carter *et al.* (1998) narrowed the scope of definition by asserting that reverse logistic can be thought of as the reverse distribution of materials/products among the supply chain members. Activities that can be included as reverse logistics or green logistics include remanufacturing, refurbishing, recycling, landfill, repackaging, returns processing, and salvage. Utilizing reusable containers that avoid the use of one-way cartons made of cardboard can also be categorized as both green and reverse logistics (Rogers & Tibben-Lembke, 2001). SIRIM, as the certification authority in Malaysia, agrees that the effort of a few companies in the country that collected wastes and sent them to Japan, US or Europe for recycling as a

reversed logistic in the green supply chain (Eltayeb *et al.*, 2010a).

Investment recovery and Internal Environmental Practices

In China, investment recovery is considered as one of the emerging environmental practices with significant internal and external influences on GSCM. The Chinese government's effort to improve investment recovery and better design of processes and systems has changed its policies from a focus on resource subsidies to levying taxes on some resources such as coal and natural gas. At the same time, both the United States and European enterprises have considered investment recovery as a critical aspect for GSCM (Zsidisin & Hendrick, 1998), which may occur at the back end of the supply chain cycle. Activities that can be included as investment recovery includes sale of scrap and used materials, sale of excess capital equipment, and sale of excess inventories. Close to investment recovery is the internal environmental practices within firms. Activities under internal environmental practices include actively managing disposal of packaging wastes, actively managing solid wastes, and adopting energy efficiency measures for lighting and heating.

RESEARCH METHODOLOGY

Data were collected from the ISO 14001 certified manufacturing firms registered as members of the Federation of Malaysian Manufacturers (FMM). The ISO 14001 certified companies were selected because

they were expected to adopt the green initiatives within their operations (Eltayeb *et al.*, 2010; Sroufe, 2009; Zhu *et al.*, 2007). A total of 378 manufacturers were certified with ISO 14001 under the FMM directory as of 2011. This study used self administered questionnaire survey to gain relevant information from the respondents. The survey was conducted using mail questionnaire in order to cover wide geographical area in lesser time and minimum cost. Before the questionnaires were sent, phone calls were made to confirm their postal addresses and the names of the persons in-charge. SIRIM Malaysia, as the certification organizations for ISO 14001, appoints Environmental Management Representatives (EMR) to act as a link between the certification organization and the certified firms (Eltayeb *et al.*, 2010). EMR acts as the representative between the firms and SIRIM as the certification body in various related environmental issues and matters. They can be from any department but EMR is usually a person from environmental, safety and health, quality control or operation department. In most cases, EMR is a person who is a part of the management team and involved in the overall operations of the company. The surveys were addressed to EMR in each firm.

The questionnaire used in this study was compiled from various validated instruments from the literature review, but some modifications were made to suit its context and purpose. Measurements of the variables in this study were based on the past

research by Zhu, Sarkis and Geng (2005), Holt and Ghobadian (2009), and Rogers and Tibben-Lembke (2001). In this study, green firms supply chain practices were measured by six dimensions, namely; green purchasing, cooperation with customer, investment recovery, eco design, internal environmental practices and reverse logistic. The study used a 5-point Likert scale for all dimensions ranging from 1 (not considering it) to 5 (implementing successfully).

At the end of the data collection period, a total of 112 responses were usable for data analysis. Reliability analysis was conducted to ensure that the measures of variables have internal consistency across time and across the various items that measure the same concept or variable (Sekaran, 2003). Initial reliability test was carried out on all the variables and the results indicted that the values are all above the recommended minimum of 0.7 (Nunally, 1987). Table 2 provides the values of Cronbach’s alpha for the variables. It appears from the table that the values of Cronbach’s alpha range between 0.702 and 0.860. These values exceed the minimum threshold of 0.70. Thus, it can be concluded that the measures have an acceptable level of reliability.

RESULTS AND DISCUSSIONS

The characteristics of the responding firms are presented in Table 3. The table shows that the highest number of responses was received from the electrical and electronic manufacturers, with 25% of the total response. This is expected since the electrical and electronics industry is the largest industry in Malaysia. More than half (58.9%) of the firms have been established for more than 20 years. Meanwhile, majority of the firms (69.6%) are public listed companies and almost all (95.5%) are ISO 9001 certified firms.

Table 4 shows descriptive statistics of the firms in terms of size (annual sales turnover and number of employees). The results indicate that half of the firms are considered as large firms (more than RM 25 million sales turnovers). Meanwhile, in terms of firm size by the number of employees, majority of them (76.8%) have more than 100 employees.

Table 5 indicates that manufacturers in Malaysia have initiated or adopted some green supply chain management practices. The scale used in measuring the green supply chain practices implementation ranges from 1 (not considering it) to 5 (implementing

TABLE 2
Cronbach’s Alpha for all the variables

Variables	Number of Items	Cronbach’s Alpha (α)
GSCM Practices	25	0.897
Green Purchasing	5	0.842
Eco Design	3	0.860
Reverse Logistic	5	0.784
Internal Environmental Practices	5	0.702
Investment Recovery	3	0.830
Cooperation with Customers	4	0.825

successfully). Internal environmental practice was found as the top GSCM practice implemented by the manufacturers in Malaysia, with the mean score of 4.37, followed by eco-design (mean score of 3.85) and investment recovery (mean score of 3.83). The least common GSCM practice implemented by manufacturing firms in Malaysia is reverse logistics (mean score of 3.18).

TABLE 3
Profile of the Respondents

Category	Total	(%)
Type of product manufactured	1	9
Agriculture products and machinery		
Chemical and adhesive products	8	7.1
Furniture and wood related products	2	1.8
Iron, steels products	13	11.6
Plastic products and resins	11	9.8
Stationeries	2	1.8
Automotive and components parts	9	8
Cement, concrete products	1	0.9
Footwear	1	0.9
Industrial and engineering products	8	7.1
Pharmaceutical, medical equipment, cosmetics, toiletries and household	4	3.6
Building materials and related products	2	1.8
Food and beverage products	2	1.8
Packaging, labelling and printing	13	11.6
Rubber products	4	3.6
Electrical and electronic products	28	25
Toy manufacturers	1	0.9
Others	2	1.8
Years of operation		
Less than 20 years	46	41.1
More than 20 years	66	58.9
Type of Ownership		
Local	4	3.6
Foreign and Local joint venture	53	47.3
Foreign based	55	49.1
Public Listed		
Yes	34	30.4
No	78	69.6
ISO 9001 certified		
Yes	107	95.5
No	5	4.5
TOTAL	112	

T-test was conducted on the GSCM practices by firms' age and public listed status to determine whether the GSCM practices differ by their attributes. The results in Table 6 indicate that there are no significant differences in the GSCM practices by years of operation and status in stock exchange.

One-way ANOVA tests were used to determine if the GSCM practices differ by firm size (in term of the number of full-time employees), and type of ownership. Results in Table 7 disclose that there are significant differences in the GSCM practices among small, medium and large firms ($t = 3.533$, $p < 0.01$). The mean value shows that large firms implement higher level of GSCM practices than small firms. The data also indicate that the GSCM practices increase as the firm size increases.

The GSCM practices in this study also differentiate firms into an operational typology (proactive, high average, low average and laggards), as suggested by Bowen *et al.* (2001), Henriques and Sadorsky (1999), and Holt and Ghobadian

(2009). Based on the mean scores for all the GSCM practices, firms were classified into four groups; proactive, high average, low average and laggards (see Table 8). The results indicate that 17% ($n = 19$) of firms are in the proactive group, 39.3% ($n = 44$) in the high average, 23.2% ($n = 26$) in the low average and 20.5% ($n = 23$) are in the laggards group. Comparing these results with the recent study by Holt and Ghobadian (2009), which examined the green supply chain management practices amongst UK manufacturers, it was found that the statistics illustrates almost the same result. The majority (72%) of manufacturers in UK were at the average level in practicing green supply chain management, and this is the same in Malaysia with 62%. Other than that, only 17% of the manufacturers in Malaysia were categorized into the proactive group, with the mean score above 4.33 over 5.00. In the other categories, 23% of the manufacturers in Malaysia were in the laggard group while 20% of manufacturers in UK were at the same level (Holt & Ghobadian, 2009). Table 8

TABLE 4
Size of firms

Variables	Categories	Frequency	(%)
Number of Employees	Less than 50	8	7.1
	50 to 100	18	16.1
	101 to 500	51	45.5
	501 to 1000	19	17
	More than 1000	16	14.3
Annual Sales Turnover	Less RM 250 000	4	3.6
	Between RM 250 000 to RM 10 million	15	13.4
	Between RM 10 million to RM 25 million	34	30.4
	More than RM 25 million	59	52.7

summarizes that the green practices among the manufacturing firms in Malaysia are gaining momentum. Previous studies in the environmentally friendly management dimensions revealed that firms tended to act in defensive compliance (Handfield *et al.*, 1997) and waste minimization or cleaner production (Sinding, 2000) when dealing with sustainable issues.

TABLE 5
Descriptive Statistics for the GSCM practices

No	Items	Mean	SD
	Green Purchasing	3.6	0.97
1	Provide design specifications for suppliers	3.75	1.18
2	Cooperation with suppliers for environmental objectives	3.84	1.09
3	Environmental audit for supplier	3.63	1.33
4	Supplier ISO 14001 certification	3.52	1.36
5	Second tier supplier environmentally practices evaluation	3.25	1.2
	Cooperation with customer	3.35	0.96
6	Cooperation with customer for eco design	3.27	1.21
7	Cooperation with customer for cleaner production	3.51	1.11
8	Cooperation with customer for green packaging	3.48	1.2
9	Cooperation with customer for using less energy transportation	3.15	1.24
	Investment Recovery	3.83	0.83
10	Sale of excess inventories	3.49	1.18
11	Sale of scrap and used materials	4.49	0.89
12	Sale of excess capital equipment	3.53	1.2
	Eco-design	3.85	0.97
13	Design of products for reduced energy consumption	3.74	1.14
14	Design of products for reuse, recycle material or components parts	3.89	1.12
15	Design of products to avoid or reduce use of harmful of products or their manufacturing process	3.9	1.14
	Internal Environmental Practices	4.37	0.59
16	Recycle toner cartridge in the office	3.96	1.29
17	Actively manage the disposal of packaging waste	4.49	0.81
18	Actively manage all the solid wastes	4.61	0.66
19	Energy efficiency measure are adopted for lighting and heating	4.22	0.8
20	Paper recycling in offices	4.56	0.68
	Reverse Logistic	3.18	1.01
21	Remanufacturing own products	3.17	1.5
22	Involve in refurbishing	3.17	1.37
23	Recycle own products	3.55	1.45
24	Involve in landfill disposal	2.95	1.63
25	Repackaging own products	3.07	1.47

TABLE 6
T-tests results for the green supply chain management practices on firms' attributes

Firm Attributes	Label	GSCM Practices			
		Mean	SD	t-value	Sig. Value
Firm Age	Less than 20 years	4.17	0.36	0.754	0.453
	More than 20 years	4.01	0.56		
Public Listed	Yes	3.82	0.59	1.543	0.128
	No	3.62	0.65		

TABLE 7
The ANOVA results for green supply chain management practices on firms' attributes

Firm Attributes	Label	GSCM Practices			
		Mean	SD	t-value	Sig. Value
Firm Size	Less than 50	2.96	0.76	3.533**	0.01
	50 to 100	3.62	0.59		
	101 to 500	3.77	0.61		
	501 to 1000	3.66	0.66		
	More than 1000	3.89	0.54		
Type of Ownership	Foreign Based	3.78	0.55	0.809	0.448
	Foreign and local joint venture	3.76	0.62		
	Federal/ state owned	3.61	0.67		
Annual Sales Turnover	Less than RM 250 000	3.52	0.67	1.63	0.187
	RM 250 000 - RM 10 million	3.42	0.67		
	RM 10 million - RM 25 million	3.62	0.62		
	More than RM 25 million	3.8	0.64		

TABLE 8
Operational typology of the manufacturing firms involved in green practices

Operational Typology	Mean score for GSCM activity	Frequency	%
Proactive	More than 4.33	19	17
High Average	3.69 to 4.33	44	39.3
Low Average	3.04 to 3.68	26	23.2
Laggards	Less than 3.04	23	20.5

DISCUSSION OF RESULTS

In recognition of the importance of environmental approaches in business, a growing number of firms in Malaysia have started to develop their green supply chain initiatives. A multi set of initiatives

relating to being environmentally friendly in managing the supply chain have been considered or implemented including green purchasing, investment recovery, eco-design, internal environmental practices, reverse logistics, and cooperation with

suppliers/customers. Throughout this study, it was found that most practices of green supply chain initiatives are internal environmental practices that are similar to the situation among the electronic industry in China (Zhu & Sarkis, 2006). Although there is an argument about whether internal environmental practices are related to green supply chain management or really just operational efficiencies that make economic sense (Holt & Ghobadian, 2009), the green practices adopted internally can be a stepping stone for other eco-friendly efforts along the supply chain.

Eco-design and investment recovery are the second highest activities that have been implemented by firms in adopting the green supply chain practices. Eco-design has been increasingly considered as a systematic method for firms to reduce environmental impacts, especially in new product development (Brezet & Hemel, 1997). Through eco-design or design for environment approaches, firms can identify the environmental aspects as parts of their product development process (Lewis *et al.*, 2001). This circumstance can lead to product marketability and cost cutting as customers nowadays show concern and prefer eco-friendly products (Sinnapan & Abd Rahman, 2011). Most firms are involved with investment recovery because it will generate additional income for them. This finding is supported by Zsidisin and Hendrick (1998) who mentioned that United States and European enterprises have considered investment recovery a critical aspect for the GSCM practices.

From the dimensions of manufacturers in Malaysia, they perceived investment recovery activities as an opportunity for them to reduce the excess and used materials/scrap and earn some money at the same time. Then, from the analysis, it was found that green purchasing is one of the favoured initiatives among manufacturer in Malaysia. Even though there are no regulations that dictate that firms must perform green purchasing activities in Malaysia (GPNM, 2003), firms tend to adopt it if they can see business benefits from these initiatives (Eltayeb *et al.*, 2010). However, the success of green purchasing activity can only be determined if purchasing personnel view the environmental issues as an opportunity rather than a threat (Bowen *et al.*, 2006). The green initiatives were unique practices because they go beyond normal practices and norms. For example, firms need to consider the negative environmental effect before they purchase any raw materials.

Cooperation with customers/suppliers is another perspective of green supply chain initiatives in Malaysia. The mean value from the analysis shows that many manufacturers in Malaysia are still considering this activity before implementing it. The application of cooperation with chain partners is also not yet fully initiated in China (Zhu *et al.*, 2005). The least implemented green initiative by manufacturing firms in Malaysia is reverse logistics. The data supported findings by Eltayeb *et al.*, (2010) which mentioned that only a few companies in Malaysia collect waste and sent it back to Japan, the United States or Europe for recycling purposes.

Tan and Kumar (2008) found that reverse logistics will be profitable to the firms if the return is in high volume. In addition to that, most of the firms admit they have less interest with reverse logistics because it will require more transportation and storage processes at a cost to them. This practice has less implementation among manufacturers because it will lead to more costs incurred such as transportation and logistics.

Comparison of green supply chain management practices among different firm attributes revealed that green practices have no significant differences between old and new firms, consistent to finding by Eltayeb and Zailani (2009). Thornhill and Amit (2003) argued that older firms tend to resist innovation such as green initiatives compared to conventional supply chain practices because the older firms have problems such as inability to adapt to environmental changes. However, this study fail to support this argument. This study found that there are significant differences in GSCM practices among small, medium and large firms. The mean values show that large firms implement more GSCM practices than small firms. The data also indicates that GSCM practices increase as the firm size increases. The result shows that a firm's size plays a significant role in determining operation of environmentally friendly practices as parallel with past studies that have been done in other countries (Gil *et al.*, 2001; Russo & Frouts 1997; Kenny & Lennox, 2000; Zhu *et al.*, 2007). Large firms not only have more financial resources and capabilities to tackle the

environmental issues, but they are also more visible to the customers. Thus, large firms usually will act in the right way to adopt green practices compare to smaller firms. However, the findings reported that there are no significant differences in green practices within different type of ownership and annual sales turnover.

CONCLUSIONS AND IMPLICATIONS

The findings from this study highlight several practical contributions and benefits to managerial and policy implementation. The major input from this research can be used by managers to enhance their knowledge and understanding of green supply chain management. With the knowledge and years of experience in the industry, managers can plan and develop specific models to improve their green supply chain management.

Another contribution underlined from this finding is categorization of responding firms into four operational typologies. The fact that only few proactive adopters and many low average and laggards adopters of green supply chain practices give cues for both managers and policy makers on the benchmark of green initiatives in Malaysia. For managers, they can use this level as the main information to build up their standard of practices and compete in the market especially when dealing in the international marketplace. As for policy makers, the typology indicated in this study can be a guideline to initiate and launch any assistance program or initiative for firms that already apply the green initiatives. Besides

that, regulatory bodies can also commence specific incentives for manufacturing firms that have already reached the minimum standard or level in green practices. A number of benefits offered by regulators will get manufacturers interested in adopting green supply chain management in their operations.

After the establishment of the Ministry of Energy, Green technology and Water in 2009, and then followed by a massive budget allocation provided by the Malaysian government, this is the exact time to evaluate the achievement of the government's efforts. How manufacturers perceive the importance of the government's efforts in promoting green practices can be determined through the relationship between green drivers and green practices. Serious action by the government will only be seen to be of value by the participation of manufacturers in aligning green practices and company operations. As world's manufacturing attention shifts to Southeast Asia, green supply chain management knowledge will become more critical (Rao, 2002), and thus, managers and policy makers must consider the findings of this research as a lesson learned and exploit the results as a preparation to become a world manufacturing hub.

REFERENCES

- Abdullah, A. R. (1995). Environmental pollution in Malaysia: trends and prospects. *Trends in Analytical Chemistry*, 14(5), 191-198.
- Bacallan, J. J. (2000). Greening the supply chain. *Business and Environment*, 6(5), 11-12.
- Beamon, B. M. (1999). Designing The Green Supply Chain. *Logistics Information Management*, 12(4), 332-342.
- Berhicci, L., & Bodewes, W. (2005). Bridging environmental issues with new product development. *Business Strategy and the Environment*, 14, 272-285.
- Bowen, F. E., Cousins, P. D., & Lamming, R. C. (2001). The role of supply management capabilities in green supply. *Production and Operations Management*, 10(2), 174-189.
- Bowen, F., Cousins, P., Lamming, R., & Faruk, A. (2006). Horses for courses: explaining the gap between the theory and practice of green supply. In J. Sarkis (Ed.), *Greening the Supply Chain*. London: Springer.
- Brezet, H., & van Hemel, C. (1997), *ECODESIGN—A Promising Approach to Sustainable Production and Consumption*. Paris: United Nations Publication, UNEP.
- Burgess, K., Singh, P. J., & Koroglu, R. (2006). Supply chain management: a structured literature review and implications for future research. *International Journal of Operations & Production Management*, 26(7), 703-729.
- Carter, C. R., & Ellram, L. M. (1998). Reverse logistics: a review of the literature and framework for future investigation *Journal of Business Logistics*, 19(1), 85-102.
- Eltayeb, T. K., Zailani, S., & Filho, W. L. (2010). Green business among certified companies in Malaysia towards environmental sustainability: benchmarking on the drivers, initiatives and outcomes. *International Journal Environmental Technology and Management*, 12(1), 95-125.
- Eltayeb, T. K., Zailani, S., & Ramayah, T. (2010). Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes. *Resource, Conservation, and Recycling*.

- Eltayeb, T. K., & Zailani, S. (2009). Going green through green supply chain initiatives towards environmental sustainability. *Operations and Supply Chain Management*, 2(2), 93-110.
- Folkerts, H., & Koehorst, H. (1997). Challenges in international food supply chains: vertical coordination in the European agribusiness and food industries. *Supply Chain Management*, 2(1), 11-14.
- Gill, M. J. A., Jimenez, J. B., & Lorente, J. J. C. (2001). An analysis of environmental management, organizational context and performance of Spanish hotel. *OMEGA*, 29(6), 457-471.
- Green, K., Morton, B., & Ne, S. (1996). Purchasing and environmental management: interaction, policies and opportunities. *Business Strategy and the Environment*, 5, 188-197.
- Hall, J. (2000). Environmental supply chain dynamics. *Journal of Cleaner Production*, 8(6), 455-471.
- Hamner, B. (2006). Effects of green purchasing strategies on supplier behavior. In J. Sarkis (Ed.), *Greening the Supply Chain*. London: Springer.
- Handfield, R., Walton, S. V., Sroufe, R., & Melnyk, S. A. (2002). Applying environmental criteria to supplier assessment: a study in the application of the analytical hierarchy process. *European Journal of Operational Research*, 141(16), 70-87.
- Hansmann, K. W., & Claudia, K. (2001). Environmental Management Policies. In J. Sarkis (Ed.), *Green Manufacturing and Operations: From Design to Delivery and Back*. Sheffield, UK: Greenleaf Publishing.
- Hart, S. L. (1997). Beyond greening: strategies for sustainable world. *Harvard Business Review*, 75, 66-77.
- Haszlinna, M. N., & Potter, A. (2009). Healthcare supply chain management in Malaysia: a case study. *Supply Chain Management: An International Journal*, 14(3), 234-243.
- Helms, M. M., & Hervani, A. A. (2006). Reverse logistics for recycling: challenges facing the carpet industry. In S. Joseph (Ed.), *Greening the Supply Chain*. London: Springer.
- Henriques, I., & Sadorsky, P. (1999). The determinants of an environmentally responsive firm: an empirical approach. *Journal of environmental Economics and Management*, 30(3), 381-395.
- Holt, D., & Ghobadian, A. (2009). An empirical study of green supply chain management practices amongst UK manufacturers. *Journal of Manufacturing Technology Management*, 20(7), 933-956.
- Hu, A. H., & Hsu, C-W. (2010). Critical factors for implementing green supply chain management practice: An empirical study of electrical and electronics industries in Taiwan. *Management Research Review*, 33(6), 586-608.
- King, A., & Lennox, M. (2001). Lean and green? An empirical examination of the relationship between lean production and environmental performance. *Production and Operations Management*, 10(3), 244-256.
- Kroon, L., & Vrijens, G. (1995). Returnable containers: an example of reverse logistics. *International Journal of Physical Distribution & Logistics*, 25(2), 56-68.
- Lambert, M. D., & Stock, J. R. (1981). *Strategic Physical Distribution Management*. Homewood: Irwin.
- Lamming, R., & Hampson, J. (1996). The environment as a supply chain management issue. *British Journal of Management*, 7, S45-S62.
- Leonard, L. N. K., & Cronan, T. P. (2003). Website retailing: electronic supply chain replenishment. *Journal of End User Computing*, 15(3), 45-55.
- Lewis, H., & Gretsakis, J. (2001). *Design and environment: a global guide to designing greener goods*. Sheffield: Greenleaf Publishing.

- MIDA. (2010). Malaysia: Performance of the Manufacturing and services sectors 2009. Retrieved 4 July, 2010, from <http://www.mida.gov.my/>
- Min, H., & Galle, W. (2001). Green Purchasing Practices of US Firms. *International Journal of Purchasing and Materials Management*, 10-17.
- Murphy, P. R., & Posit, R. P. (1989). Management of logistical retromovements: an empirical analysis of literature suggestions. *Transportation Research Forum*, 177-184.
- Nitschke, T., & O'Keefe, M. (1997). Managing the linkage with primary producers: experiences in the Australian grain industry. *Supply Chain Management*, 2(1), 4-6.
- Nunnally, J. C. (1978). *Psychometric Theory* (2nd ed.). New York: McGraw-Hill.
- Nunes, B. (2008). Car manufacturers are going green... But, is it green enough to survive? *Journal of Manufacturing Technology Management*. Editorial paper, 19(8).
- Rao, P. (2007). Greening the supply chain: an empirical study for SMEs in the Philippine context. *Journal of Asia Business Studies*.
- Rao, P. (2006). Greening of suppliers/In-bound logistics-in the South East Asian context. In J. Sarkis (Ed.), *Greening the Supply Chain*. London: Springer.
- Robson, I., & Rawnsley, V. (2001). Co-operation or coercion? Supplier networks and relationships in the UK food industry. *Supply Chain Management Review*, 6(1), 39-48.
- Rogers, D. S., & Tibben-Lembke, R. S. (2001). An overview of reverse logistics practice. *Journal of Business Logistics*, 22(1), 271-282.
- Russo, M. V., & Fouts, P. A. (1997). A resource based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, 40(3), 534-559.
- Sarkis, J. (1995). Manufacturing Strategy and Environmental Consciousness. *Technovation*, 15(2), 79-97.
- Sarkis, J. (2003). A strategic decision framework for green supply chain management. *Journal of Cleaner Production*, 11, 397-409.
- Sekaran, U. (2003). *Research Methods for Business*. USA: Wiley & Sons Inc.
- Sinnapan, P., & Abd Rahman, A. (2011). Antecedents of green purchasing behavior among Malaysian consumers. *International Business Management*, 5(3), 129-139.
- Sinding, K. (2000). Environmental management beyond the boundaries of the firm: definitions and constraints. *Business Strategy and the Environment*, 9(2), 79-91.
- Sroufe, R. (2009). Effects of environmental management system on environmental management practices and operations. *Production and Operations Management*, 12(3), 416-431.
- Tan, A., & Kumar, A. (2008). A decision making model to maximise the value of reverse logistics in the computer industry. *International Journal of Logistics Systems and Management*, 4(3), 297-312.
- Theyel, G. (2006). Customer and supplier relations for environmental performance. In J. Sarkis (Ed.), *Greening the Supply Chain*. London: Springer.
- Tsoufias, G. T., & Pappis, C. P. (2006). Environmental principles applicable to supply chains design and operation. *Journal of Cleaner Production*, 14(18), 1593-1602.
- Van Hock, R. I. & Erasmus (2000), From reversed logistics to green supply chains. *Logistics Solutions*, 2, 28-33.
- Walton, S. V., Handfield, R. B., & Melnyk, S. A. (1998). The green supply chain: integrating suppliers into environmental management

- process. *International Journal of Purchasing and Materials Management*, 34(2), 2-11.
- Wisner, J., Leong, G. K., & Tan, K.-C. (2005). *Principles of supply chain management*: South-Western College Publications.
- Wooi, G.C., & Zailani, S. (2010). Green supply chain initiatives: Investigation on the barriers in the context of SMEs in Malaysia. *International Business Management*, 4(1), 20 -27.
- Yu, B., & Son, C. (2008). *The green supply chain management based on SMEs* Paper presented at the IEEE International Conference on Automation and Logistics, Qingdao, China.
- Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management*, 22, 265-289.
- Zhu, Q., Geng, Y., Fujita, T., & Hashimoto, S. (2010). Green supply chain management in leading manufacturers: Case study in Japanese large companies. *Management Research Review*, 33(4), 380-392.
- Zhu, Q., Sarkis, J., & Geng, Y. (2005). Green supply chain management in China: pressures, practices and performance. *International Journal of Operations & Production Management*, 25(5), 449-468.
- Zhu, Q., & Geng, Y. (2006). Green purchasing in Chinese large and medium-sized state-owned enterprises. In J. Sarkis (Ed.), *Greening the Supply Chain*. London: Springer.
- Zhu, Q., Sarkis, J., & Lai, K.-h. (2007). Green supply chain management: pressures, practices and performance within the Chinese automobile industry. *Journal of Cleaner Production*, 15, 1041-1052.
- Zsidisin, G. A., & Siferd, S. P. (2001). Environmental purchasing: a framework for theory development. *European Journal of Purchasing & Supply Management*, 7, 61-73.
- Zsidisin, G. A., & Hendrick, T. E. (1998). Purchasing involvement in environmental issues: a multi-country perspective. *Industrial Management & Data Systems*, 7, 313-320.