Greening of the Supply Chain Through Supply Chain Initiatives Towards Environmental Sustainability

Tareq Al Khidir, Department of Business Studies, Marketing and E-Business Section,
Salalah College of Technology, Oman
Dr. Suhaiza Hanim Mohamad Zailani, School of Management, Universiti Sains Malaysia

ABSTRACT

Environmental issues constitute continuous concern for governments, societies, and business organizations. Green supply chains emerged as a new approach that extends environmental responsibility of organizations throughout their entire supply chains. Despite the importance of green supply chains in alleviating environmental issues and providing economic benefits to organizations, little is known about green supply chains, especially in the context of Malaysia. This paper is an attempt to highlight steps to be taken by business organizations through green supply chain to make sustainable development a reality. Specifically the paper is interested to investigate the adoption of green supply chain initiatives. The survey data was obtained from ISO 14001 certified manufacturing firms in Malaysia. The survey was conducted using structured mail questionnaire directed to the environmental management representative (EMR) in each firm. The results show that expected business benefits have the greatest influence on green supply chain initiatives followed by regulations and customer pressures, and finally social responsibility. Green supply chain initiatives can play significant role in achieving the "triple bottom line" of social, environmental, and economic benefits and, therefore, contributing to sustainable development of the society.
Keywords: Green Supply Chain Initiatives, Drivers, Environmental Sustainability

INTRODUCTION

Natural environment becomes a challenging issue to business organizations in recent years as a result of global and local environmental problems. Business operations, such as sourcing, manufacturing, and logistics, are believed to be responsible for most of these problems (Beamon, 1999). Consequently, business operations are subject to increasing pressures and scrutiny from various stakeholders inside and outside organization such as government agencies, workers, neighbors, and not-for-profit groups (Sarkis, 2006). This is over and above growing demand of customers and environmental societies for more environmentally friendly products. These challenges and pressures push firms to seriously considering environmental impacts while doing their business. Green becomes a common practice to portray the environmentally-friendly image of products, processes, systems and technologies, and the way business is conducted (Vachon & Klassen, 2006). However, most of the adopted green solutions, especially in developing countries, remain to be the traditional command-and-control or "end-of-the- pipe" solutions where a firm tries to eliminate or reduce negative environmental impacts, after they are created, rather than adopting a proactive approach to reduce the sources of waste or pollution (Anbumozhi & Kanda, 2005; Walton, Handfield, & Melnyk, 1998).

The traditional green initiatives are associated with many weaknesses and problems. The end-of-the-pipe approach does not eliminate pollutants, but merely transforms them from one medium to another (Sarkis, 2006). Moreover, focusing green practices inside organization may expose the organization to negative environmental performance of other organizations in its supply chain. For instance, the poor environmental performance of small suppliers can affect badly the performance and image of buying companies (Christmann & Taylor, 2001; Cousins et al., 2004; Faruk et al., 2002; Darnall et al., 2006; Hall, 2001). In addition, community stakeholders often do not distinguish between an organization's environmental practices and the practices of its suppliers (Rao, 2002; Sarkis, 2006). In recent years, a more externally-oriented approach has been emerged where a firm extends its environmental responsibility beyond its boundaries and tries to reduce sources of waste and pollution throughout its entire supply chain.

This extended responsibility occurs across multiple organizations, upstream and downstream the supply chain, and take different names including product stewardship, closed-loop supply chain, in addition to green supply chain (Canning & Hanmer-Lloyd, 2001; Vachon & Klassen, 2006).

This paper address the issue of green supply chains as promising area of study and practice that have the potential to provide significant benefits to the firm and the society. The study tries to identify key drivers or motivators to green supply chain initiatives. This paper starts with providing background of the study that includes explanation of environmental issues or concerns at the global as well as local (Malaysian) level and the concept and importance of green supply chain. The paper then discussed the literature review, methodology and analysis. Lastly, the paper portrays the significance of the study and its contributions.

LITERATURE REVIEW

Green supply chain is defined as "the extension of the traditional supply chains to include activities that aims at minimizing environmental impacts of a product throughout its entire life cycle, such as green design, resource saving, harmful material reduction, and product recycle or reuse." (Beamon, 1999). The traditional supply chain is typically defined as "a set of three or more entities directly involved in the upstream or downstream flows of products, services, finances, and/or information from a source to a customer." (Mentzer et al., 2001, p.4). The definition of traditional supply chain set the boundaries of supply chain to end in the final consumer. Moreover, the traditional supply chains are based on a linear production paradigm which relies on constant input of virgin natural resources and unlimited environmental capacity for assimilation of wastes (Geyer & Jackson, 2004). Nevertheless, green supply chain "close the loop" of a typical traditional or forward supply chain by including reuse, remanufacturing, and/or recycling of products and materials into the traditional forward supply chain (Wells & Seitz, 2005). The objective of green supply chain is to eliminate or minimize negative environmental impacts (air, water, and land pollution) and waste of resources (energy, materials, products) from the extraction or acquisition of raw materials up to final use and disposal of products (Hervani, Helms & Sarkis, 2005).

Drivers for Adoption of Green Supply Chain Initiatives

Drivers are defined in this study as motivators or inducements that motivate business organizations to adopt green supply chain initiatives. Previous studies identified numerous drivers that have a potential to motivate organizations to adopt environmental initiatives. These drivers generally emanate from pressures of external and internal stakeholders such as government, investors, customers, suppliers, community groups and employees (Donaldson & Preston, 1995) as well as from organizational culture or moral values related to doing the right or acceptable things (Carter & Jennings, 2002). Review of literature related to the drivers for environmental initiatives reveals that there are numerous drivers for green initiatives (Table 1). The study has identified 30 studies that empirically investigate the drivers for green initiatives and they can be ranked as follows; regulations (87 percent of studies found it significant driver), customer pressures (43%), expected business benefits (40%), social responsibility (30%), community pressures (17%), competition (10%), employee pressures (7%), and lastly supplier pressures and market demand (3%). Nevertheless, the analysis shows that the drivers for green supply chain initiatives have similar ranking; regulations (82%), expected business benefits (54%), customer pressures (45%), social responsibility (27%), competition (18%), supplier pressures and employee pressures (9%), and lastly market demand and community pressures (0%). This result discloses that the top drivers that motivate organizations to adoption general green initiatives as well as green supply chain initiatives are; regulations, expected business benefits, customer pressures, and social responsibility.

Although most of the available studies, on drivers for green supply chain initiatives, support the significant effect of the top four drivers as potential key drivers to green supply chain initiatives, some other studies found no significant effect of these drivers on green supply chain initiatives. Bowen et al. (2001a) found no significant relationship between regulations and green purchasing. Similarly, Zhu, Sarkis and Lai (2007) found no significant relationships between external pressures (regulatory, market, and supplier pressures) and green supply chain initiatives (green purchasing, eco-design, and customer cooperation). Accordingly, this study investigates further the issues of drivers in the context

of Malaysia to determine the key drivers for green supply chain initiatives and gauge their exact effect on the level of green supply chain initiatives adoption. As explained in section 2.2, analysis of the literature indicates that there are nine basic drivers for green supply chain initiatives; regulations, customer pressures, expected business benefits, social responsibility, supplier pressures, competition, market demand, community pressures, and employee pressures. The purpose of this section is to analyze the interviews to explore the drivers for green supply chain initiatives in the context of Malaysia. The representative from SIRIM described the drivers for green supply chain initiatives in Malaysia as:

In Malaysia, green activities are for business reasons because most companies are multinational companies and most of them are Japanese, American or European based companies. These companies try to ensure that whatever products they export to Europe or to US will be accepted. Especially Japanese companies are very concerned of US or European legislations and try to comply with these legislations. So, Malaysian companies do green supply activities so as not to loose their business in Europe or probably in Japan. Most Malaysian companies have green purchasing committee dealing directly with customer and look to what is the customer requirement, and most customers come with specific requirement under green procurement list; nonhazardous metal, recycled content, energy efficiency, use of renewable resources or any other criteria that spelled out in green procurement list. Also, the government promotes green activities and gives financial incentives to the manufacturers to embark on green activities. The government, represented by department of environment, promotes a national environmental policy which contains 'green consumerism.' We notice that pressure groups like consumer associations and the media have indirect effect through the government authorities. For example, complaints from the media normally have strong effect on companies through stimulating politicians to exert pressures on companies and make them make changes. Most of the companies now coming from developed countries embrace in sustainable development principles and most of them declare that in their reporting, so they don't like to produce big impact to the environment. Companies, especially the listed ones, try also to reflect image of themselves that they are inline with the global trend of greening and they are not left behind. This works for the whole company, including subsidiaries, try to reflect that they are environmentally conscious organizations.

The above statement shows that the drivers that induce Malaysian companies to perform green practices are:

1. *Regulations*: Include regulations of export countries (EU, US, and Japan) (more influential) as well as regulations set by the Malaysian government to encourage green practices (e.g. tax reductions).
2. *Customer requirements*: Include environmental standards and specifications set by customer organizations for suppliers to comply with.
3. *Expected business gains*: Include expected costs savings from green practices and market opportunities for green products.
4. *Social responsibility*: Include moral obligation of a company to meet its responsibility towards the society in which it operates.

This means that there are four key drivers that motivate Malaysian firms to undertake green supply chain initiatives; regulations, customer requirements, expected business gains, and social responsibility. These drivers are consistent with the top four drivers identified from the literature; regulations, customer pressures, expected business benefits, and social responsibility. This means that there is a consistency between the findings from the literature review and findings from the interviews. From theoretical perspective, the effect of the four drivers can be explained in terms of the institutional theory. Regulations and customer pressures can be considered as coercive isomorphism because they focus on the use of rules, laws, and persuasion as basis for compliance. Social responsibility can be considered as normative isomorphism because it is based on expectations of the society that organization should perform appropriate or acceptable practices. Expected business benefits can be regarded as cultural-cognitive isomorphism because it is based on the rational desire of a firm to adopt initiatives that proved to have technical value (business benefits) in other organizations. The framework is shown in Figure 1.

Figure 1: Framework

RESEARCH METHODOLOGY

This study conducted a survey to obtain quantitative data for statistical testing of the hypotheses. The survey was conducted using mail questionnaire. Mail questionnaire method was employed in this study because of its advantage of covering wide geographical area with less time and cost (Sekaran, 2003). The unit of analysis of the study is the individual firm. The population of this study consists of all EMS ISO 14001 certified manufacturing firms in Malaysia. The term "firm" here refers to companies as well as individual units or sites within companies. ISO 14001 certified firms were selected because they are expected to be embarked in the adoption of green purchasing initiatives. This is supported by the studies of Darnall, Jolly and Handfield (2006), Sroufe, (2003), and Zhu, Sarkis, Cordeiro, and Lai (2008).

Table 1: *Summary of Empirical Studies on Drivers for Environmental Initiatives* **Drivers**

No	Study	Environmental Initiatives	RG	CUP	SUP	COM	MD	COP	SR	EBB	EMP
1	Alvarez-Gil, Berrone, Husillos and Lado (2007)	Reverse logistics	√	√							√
2	Kassinis and Vafeas (2006)	Reduction of toxic emissions at plant level.	√					√			
3	Rao (2006)	Green purchasing		√						√	
4	Williamson, Lynch-Wood & Ramsay (2006)	Monitoring of resource consumption and pollution.	√							√	
5	Ravi, Shankar, & Tiwari (2005)	Reverse logistics	√						√	√	
6	Simpson & Power (2005)	Environmental management activity	√	√							
7	Annandale, Morrison-Saunders, and Bouma (2004)	Pollution and waste control		√						√	
8	Forman and Jorgensen (2004)	Green purchasing, supplier environmental collaboration	√	√					√	√	
9	Buysse & Verbeke (2003)	Environmental strategy	√								
10	Lefebvre, Lefebvre and Talbot (2003)	EMS, environmental R & D, life cycle management.	√				√	√		√	
11	Murphy and Poist (2003)	Green logistics	√						√		
12	Rhee and Lee (2003)	Environmental strategy	√	√		√			√		
13	Thornton, Kagan & Gunningham (2003)	Pollution prevention	√						√		
14	Khanna and Anton (2002)	Corporate environmental management	√						√	√	
15	Perry and Singh (2002)	Voluntary environmental actions	√	√				√			√
16	Canning and Hanmer-Lloyd (2001)	Environmental adaptations to supplier-customer relationships.	√			√				√	
17	Christmann and Taylor (2001)	Self regulation of environmental performance	√	√							
18	Florida and Davidson (2001)	Environmental management	√						√	√	
19	Hui, Chan and Pun (2001)	EMS or green manufacturing	√						√		
20	Min and Galle (2001)	Green purchasing	√							√	
21	Preuss (2001)	Green purchasing	√						√	√	
22	Bansal and Roth (2000)	Corporate ecological response	√								
23	Foster, Sampson & Dunn (2000)	Safety committees and recycling programs	√	√					√		

No	Author	Topic	RG	CUP	SUP	COM	MD	COP	SR	EBB	EMP
24	Hall (2000)	Diffusion of environmental innovations from customers to suppliers	√	√							
25	Blumberg (1999)	Reverse logistics	√							√	
26	James et al. (1999)	Environmental strategy	√								
27	Carter and Carter (1998)	Green purchasing		√							
28	Carter and Ellram (1998)	Reverse logistics	√	√	√	√					
29	Henriques and Sadorsky (1996)	Environmental planning	√	√					√		
30	Levy (1995)	Environmental policies and procedures.	√						√		
	Number of occurrences		26	13	1	3	1	5	9	12	2
	Overall Percentages		87	43	3	10	3	17	30	40	7
	Percentages for studies on green supply chain initiatives (No. 1, 4, 6, 7, 8, 11, 13, 21, 22, 24, 25, 26)		82	45	9	18	0	0	27	54	9

Notes: √ indicates the study found the driver significant. Drivers: RG=Regulations; CUP=Customer pressures; SUP=Supplier pressures; COM=Competition; MD=Market demand; COP=Community pressures; SR=Social responsibility; EBB=Expected business benefits; EMP=Employee pressures. Highlighted studies investigate drivers for the green supply chain initiatives (green purchasing, eco-design, supplier environmental collaboration, customer environmental collaboration, and reverse logistics).

A sampling frame is a list of all elements in a population (Sekaran, 2003). For this study, the sampling frame represents all ISO 14001 certified firms in Malaysia. The sampling frame was obtained from SIRIM organization in addition to the Federation of Malaysian Manufacturers (FMM) directory 2007 of Malaysian manufacturers (FMM 2007). These two sources provided a sampling frame of 569 certified manufacturing firms in Malaysia by 2007. Given the small sampling frame of the study and the likelihood of low response from mail survey (Sekaran, 2003), all the 569 are included in the study. Thus, the sampling technique employed in this study is census. As such, the study made a mail survey of a total of 569 ISO 14001 certified firms in Malaysia. This study combines issues related to the environment (green issues) with business aspects (supply chain). Therefore, the appropriate person to get the required data from should ideally have knowledge about the two aspects.

ANALYSIS

The total population of the study is 569 firms. Given that this study is using consensus, all the 569 firms are used in the study. However, after excluding the 16 firms used for the pre testing of the questionnaire and the two firms used for the interviews, the population of the study becomes 551. Accordingly, a total of 551 questionnaires were mailed to the respondents. After two reminder letters in addition to telephone calls and e-mails, 132 completed questionnaires were received. The response rate is 24%.

Profile of Sample Firms and Respondents

The characteristics of responding firms are presented in Table 5. The table shows that about half (51.5%) of the firms belong to the electrical and electronics (E&E) industry. This is expected because E&E is the largest industry in Malaysia. The other half distributed between the chemicals, rubber and plastics, and metal and machinery industries. The table shows also that the newly established firms are few in the sample and most of the firms (75.8%) are old-aged (more than 15 years). Similarly, most firms are considered large firms (more than 250 employees) (about 70%). This is consistent with the ownership status of the firm which shows that MNCs account for about 70% of firms while Malaysian fully owned account for 30% of firms.

Regarding type of product, the data shows that more than half (57.6%) of the firms are producing industrial products while the rest produces consumer products. This indicates that most firms are suppliers to other firms rather than OEM. The data shows also that most firms (75.8%) have more than 10 suppliers which indicate the large supplier base of these firms. Regarding average relationship length with major suppliers and customers, the table reveals that more than 90% of firms keep long term relationships (more than 5 years) with their suppliers and customers. This gives additional evidence of the existence of relationship orientation in the Malaysian industry. With regard to the souring of

material inputs, the table shows that about half of the firms (49.2%) obtain their input from global sources, and the rest obtain them from domestic and regional sources. This can be linked to the multinational ownership of the firms with no restrictions to the local levels. Finally, more than half of the firms (54.5%) participate in industry, trade or professional associations that have interest in green issues.

Descriptive Analysis of Green Supply Chain Initiatives Drivers

Descriptive statistics of the four types of green supply chain initiatives drivers are shown in Table 1 below. The table reveals that the sampled firms have high sense of social responsibility (mean=4.29, standard deviation=0.47) towards the society in which they operate. The table reflects also that the firms tend to agree that there are business benefits from green supply chain initiatives (mean=3.77, standard deviation=0.49). The firms also tend to agree that there are customer pressures on their firms to adopt green supply chain initiatives (mean=3.76, standard deviation=0.69). Similarly, the firms agree, on average, that there are regulatory impositions and inducements on their firms (mean=3.71, standard deviation=0.59). The table generally indicates that the social responsibility is strong in the Malaysian firms and the firms generally view that there are expected business benefits from green supply chain initiatives and experience customer pressures and regulatory influences on their firms.

Table 1: *Descriptive Statistics of Green Supply Chain Initiatives Drivers*

Variables	Mean	Standard Deviation
Regulations	3.71	.59
Customer Pressures	3.76	.69
Social responsibility	4.29	.47
Expected Business Benefits	3.77	.49

Note: All variables used a 5-point Likert scale with (1= strongly disagree, 5= strongly agree)

The Effects of Drivers on Green Supply Chain Initiatives

Hypothesis one predicts that four drivers (regulations, customer's pressures, social responsibility, and expected business benefits) positively influence green supply chain initiatives. To test this hypothesis, a two-step hierarchical regression analysis was carried out. In step one, the analysis test the effect of control variables on dependent variable. In step two, the independent or predictor variables was introduced to test their marginal effect on the dependent variable. Table 2 presents the result of the two-step regression analysis of control variables and drivers on green purchasing. In the first step, only firm ownership type (Malaysian, Japanese, etc.) have significant effect on green purchasing. The control variables together explain about 23% of the total variation in green purchasing. The addition of drivers in step two explains additional 19% of green supply chain initiatives variance. This means that control variables and the drivers cumulatively explain 42% of the variance in green supply chain initiatives. The results showed that regulations have the most significant effect on green supply chain initiatives (β=.23, ρ<0.01), followed by customer pressures (β=.22, ρ<0.05), and expected business benefits (β=.17, ρ<0.10). However social responsibility shows no significant relationship with green supply chain initiatives.

Table 2: *Multiple Regression Result: The Effects of Control Variables and Drivers on Green Supply Chain Initiatives*

Variables	DV: *on Green Supply Chain Initiatives*	
	Step 1 Std. Beta	Step 2 Std. Beta
Control variables:		
Type of industry	-0.139	-0.077
Number of employees	0.137	0.126
Firm ownership	0.316**	0.201*
Number of suppliers	0.072	0.071
Participation in green associations	0.098	0.007
Model variables:		
Regulations		0.234**
Customer pressures		0.217*
Social responsibility		0.037
Expected business benefits		0.173[+]

F value	6.862**	8.993**
R^2	0.228	0.419
Adjusted R^2	0.195	0.373
R^2 change	0.228	0.191
F change	6.862**	9.224**

Note: $^+p<0.10$; $^*p<0.05$; $^{**}p<0.01$

DISCUSSIONS

Hierarchical regression analysis was used to test the hypotheses of the study. Initially, the analysis was utilized for testing hypotheses one which predicts that there are significant positive effects of the drivers on green supply chain initiatives. These results generally indicate that expected business benefits have the greatest influence on green supply chain initiatives followed by regulations and customer pressures, and finally social responsibility. This result aligns with large body of research that found that regulations are the major drivers for green purchasing (Hall, 2000; Min & Galle, 2001; Preuss, 2001; Walker, Sisto & McBain, 2008). In Malaysia, there are no regulations that dictate business organizations to perform green purchasing activities (GPNM, 2003). Therefore, the effect of regulations on green purchasing appears to be indirect. There are regulations set by regulatory bodies in Malaysia and other countries that prevent the use of hazardous or toxic elements in products, prevent pollution, and promote the use of recycled materials in products. In compliance with these regulations, firms try to ensure that whatever products are producing meet the standards set in the regulations. Therefore, firms adopt green purchasing initiative to guarantee continuous supply of green inputs that enable them to produce the green products. In sum, the results of the investigation of the drivers for green supply chain initiatives indicate that Malaysian firms tend to respond to regulations and customer pressures that require them to adopt green supply chain initiatives but the decision is based mainly on evaluating the benefits that return to the firms from adopting such initiatives. This is consistent with Amran and Devi (2007) study which concluded that Malaysian companies, in their performance of CSR, are concerned about ensuring their long term survival in terms of getting consistent contracts and maintaining good relationships with those who can provide them with business opportunities.

CONCLUSION

Environmental issues become a major concern for business as well as public organizations. Therefore, efficient policies need to be designed to alleviate these issues. However, proper design of these policies require proper understanding of the steps needed towards sustainability as well as barriers and obstacles facing greening activities. Much research and efforts need to be done to support the evolution of business activities towards sustainable development. This paper is an attempt to clarify the path towards that end and highlight steps to be taken by business organizations to make sustainable development a reality.

REFERENCES

Abdullah, A.R. (1995). Environmental pollution in Malaysia: trends and prospects. *Trends in Analytical Chemistry, 14*(5), 191-198.

Alvarez-Gil, M.J., Berrone, P., Husillos, F.J. and Lado, N. (2007). Reverse logistics, stakeholders' influence, organizational slack, and managers' posture. *Journal of Business Research, 60*(5), 463-473.

Anbumozhi, V. and Kanada, Y. (2005). Greening the production and supply chains in Asia: is there a role for voluntarily initiatives? *IGES Kansai Research Center Discussion Paper*, KRC-2005, No. 6E. Available online: http://www.iges.or.jp

APO (Asian Productivity Organization) (2004). *Eco-Products Directory 2004*. Asian Productivity Organization, Tokyo.

Banerjee, S.B. (2001). Corporate environmental strategies and actions. *Management Decision, 39*(1), 36-44.

Bansal, P. & Roth, K. (2000). Why companies go green: a model of ecological responsiveness. *Academy of Management Journal, 43*(4), 717-736.

Blumberg, D.F. (1999). Strategic examination of reverse logistics & repair service requirements, needs, market size, and opportunities. *Journal of Business Logistics, 20*(2), 141-159.

Bowen, F.E., Cousins, P.D., Lamming, R.C. and Faruk, A.C. (2001a). The role of supply management capabilities in green supply. *Production and Operations Management*, 10(2), 174-189.

Bowen, F.E., Cousins, P.D., Lamming, R.C. and Faruk, A.C. (2001b). Horses for courses: explaining the gap between the theory and practice of green supply. *Greener Management International, 35*, 41-60.

Canning, L. and Hanmer-Lloyd, S. (2001). Managing the environmental adaptation process in supplier-customer relationships. *Business Strategy and the Environment, 10*, 225-237.

Carter, C.R. and Carter, J.R. (1998). Interorganizational determinants of environmental purchasing: initial evidence from the consumer products industries. *Decision Sciences, 29*(3), 659-684.

Carter, C.R. and Ellram, L.M. (1998). Reverse logistics: a review of the literature and framework for future investigation. *Journal of Business Logistics, 19*(1), 85-102.

Curkovic, S., Sroufe, R. & Melnyk, S. (2005). Identifying the factors which affect the decision to attain ISO 14000. *Energy, 30*(8), 1387-1407.

Darnall, N., Jolley, G.J. and Handfield, R. (2006). Environmental management systems and green supply chain management: complements for sustainability? *Business Strategy and the Environment*, article in press, DOI: 10.1002/bse.557.

Darnall, N., Jolley, G.J. and Handfield, R. (2006). Environmental management systems and green supply chain management: complements for sustainability? *Business Strategy and the Environment*, article in press, DOI: 10.1002/bse.557.

DiMaggio, P.L. & Powell, W.W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*, 147-160.

Geyer, R. & Jackson, T. (2004). Supply loops and their constraints: the industrial ecology of recycling and reuse. *California Management Review, 46*(2), 55-73.

Goldsby, T.J. & Stank, T.P. (2000). World class logistics performance and environmentally responsible logistics practices. *Journal of Business Logistics, 21*(2), 187-208.

Guide, V.D.R., Harrison, T.P. & van Wassenhove, L.N. (2003). The challenge of closed-loop supply chains. *Interfaces, 33*(6), 3-6.

Hair, J.F., Anderson, R.E., Tatham, R.L. & Black, W.C. (1998). *Multivariate Data Analysis* (5th ed.). Prentice Hall Inc., Upper Saddle River, NJ.

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 Sarkis, Chapter 2, 25-37.

Handfield, R.B., Sroufe, R. & Walton, S.V. (2005). Integrating environmental management and supply chain strategies. *Business Strategy and the Environment, 14*(1), 1-19.

Handfield, R.B., Walton, S.V., Seegers, L.K. and Melnyk, S.A. (1997). 'Green' value chain practices in the furniture industry. *Journal of Operations Management*, 15(4), 293-315.

Hart, S.L. (1997). Beyond greening: strategies for a sustainable world. *Harvard Business Review, 75*(1), 66-76.

Hervani, A.A., Helms, M.M. and Sarkis, J. (2005). Performance measurement for green supply chain management. *Benchmarking: An International Journal*, 12(4), 330-353.

IPCC (2007). *Assessing key vulnerabilities and the risk from climate change.* Available at: http://www.ipcc-wg2.org.

IPCC (2007). *Climate Change 2007: The Physical Science Basis, Summary for Policymakers*. Available online: http://www.ipcc.ch/SPM2feb07.pdf.

Johansson, G. (2002). Success factors for integration of ecodesign in product development: a review of state of the art. *Environmental Management and Health, 13*(1), 98-107.

Klassen, R.D. & McLaughlin, C.P. (1996). The impact of environmental management on firm performance. *Management Science, 42*(8), 1199-1214.

Matos, S. & Hall, J. (2007). Integrating sustainable development in the supply chain: the case of life cycle assessment in oil and gas and agricultural biotechnology. *Journal of Operations Management*, article in press, doi:10.1016/j.jom.2007.01.013.

Matthews, D.H. (2003). Environmental management systems for internal corporate environmental benchmarking. *Benchmarking: An International Journal, 10*(2), 95-106.

MIDA (Malaysian Industrial Development Authority) (2007). Performance of the manufacturing and related services sectors 2005. Available at: http://www.mida.gov.my.

Min, H. & Galle, W.P. (2001). Green purchasing practices of US firms. *International Journal of Production and Operations Management*, 21(9), 1222-1238.

Mollenkopf, D.A. & Closs, D.J. (2005). The hidden value in reverse logistics. *Supply Chain Management Review, 9*(5), 34-43.

Murphy, P.R. and Poist, R.F. (2003). Green perspectives and practices: a "comparative logistics" study. *Supply Chain Management: An International Journal, 8*(2), 122-131.

Murphy, P.R. and Poist, R.F. (2003). Green perspectives and practices: a "comparative logistics" study. *Supply Chain Management: An International Journal, 8*(2), 122-131.

Netherwood, A. (1996). Environmental management systems. In Welford, R. (ed.). *Corporate Environmental Management: Systems and Strategies*. Earthscan Publications Ltd., London, chapter 3, pp. 35-58.

Nunnally, J.C. (1978). *Psychometric Theory*. New York, McGraw Hill.

Porter, M.E. & van der Linde, C. (1995). Green and competitive: ending the stalemate. *Harvard Business Review, 73* (5), 120-134.

Preuss, L. (2001). In dirty chains? Purchasing and greener manufacturing. Journal of Business Ethics, 34(3), 345-359.

Rao, P. (2002). Greening the supply chain: a new initiative in South East Asia. *International Journal of Operations and Production Management*, *22*(6), 632-655.

Rao, P. (2006). Greening of suppliers/in-bound logistics in the South East Asian context. In Sarkis, Chapter 11, 189-204.

Ravi, V., Shankar, R. and Tiwari, M.K. (2005). Productivity improvement of a computer hardware supply chain. *International Journal of Productivity and Performance Management, 54*(4), 239-255.

Richey, R.G., Genchev, S.E. & Daugherty, P.J. (2005). The role of resource commitment and innovation in reverse logistics performance. *International Journal of Physical Distribution & Logistics Management, 35*(4), 233-257.

Sarkis, J. (1998). Evaluating environmentally conscious business practices", *European Journal of Operational Research*, *107*(1), 159-174.

Sarkis, J. (ed.) (2006). *Greening the Supply Chain*. Springer, London

Sekaran, U. (2003). *Research Methods for Business: A Skill Building Approach*. John Willey & Sons, Inc., Singapore.

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. (2003). Effects of environmental management systems on environmental management practices and operations. *Production and Operations Management, 12*(3), 416-431.

Stock, J., Speh, T. & Shear, H. (2006). Managing product returns for competitive advantage. *MIT Sloan Management Review, 48*(1), 57-62.

Vachon, S. and Klassen, R.D. (2006a). Extending green practices across the supply chain: the impact of upstream and downstream integration. *International Journal of Operations & production Management*, *26*(7), 795-821.

Vachon, S. and Klassen, R.D. (2006b). Green project partnership in the supply chain: the case of package printing industry. *Journal of Cleaner production, 14*(6), 661-671.

Walton, S.V., Handfield, R.B. and 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.

Walton, S.V., Handfield, R.B. and 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.

WBCSD (2006). *Eco-efficiency*. Available at: http://www.wbcsd.org/DocRoot/

WBCSD (World Business Council for Sustainable Development) (1996) *Sustainable Production and Consumption: A Business Perspective.* Conches–Geneva, Switzerland: WBCSD.

WCED (World Commission on Environment and Development) (1987). *Our Common Future*. The Oxford University Press, New York.

Welford, R. (2000). *Corporate Environmental Management: Towards Sustainable Development*. Earthscan Publications Ltd., London.

Zhu, Q., Sarkis, J. and Lai, K. (2007). Green supply chain management: pressures, practices and performance within the Chinese automobile industry. *Journal of Cleaner Production, 15*(11-12), 1041-1052.

Zhu, Q., Sarkis, J., Cordeiro, J.J. & Lai, K. (2008). Firm-level correlates of emergent green supply chain management practices in the Chinese context. *Omega, 36*, 577-591.

Zsidisin, G.A. & Siferd, S.P. (2001). Environmental purchasing: a framework for theory development. *European Journal of Purchasing & Supply Management, 7*(1), 61-73.

Zsidisin, G.A. & Siferd, S.P. (2001). Environmental purchasing: a framework for theory development. *European Journal of Purchasing & Supply Management, 7*(1), 61-73.