



**GRADUATE SCHOOL OF BUSINESS (GSB)
UNIVERSITI SAINS MALAYSIA**

DECLARATION

I hereby declare that the project is based on my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at USM or any other institutions.

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**THE INVESTIGATION ON THE BARRIERS OF GREEN SUPPLY CHAIN
ADOPTIONS AMONG SMEs IN PENANG: THE ROLE OF BUSINESS STRATEGIC
ORIENTATION AS MODERATOR**

By

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Research report in partial fulfillment of the requirements for the degree of

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Sincerely,

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ABSTRAK

Dengan perkembangan yang pesat dan pertumbuhan industri, pemanasan di seluruh dunia dan penipisan sumber daya alam telah menjadi keprihatinan bagi masyarakat, kerajaan dan industri. Dengan itu, topik hijau menjadi isu yang penting. Walaupun kerajaan negeri Pulau Pinang telah berusaha untuk mempromosikan inisiatif hijau di Pulau Pinang, rantai bekalan hijau belum dilaksanakan secara meluas oleh industri di Pulau Pinang terutamanya industri kecil dan sederhana (IKS). Oleh kerana itu, kajian ini adalah untuk mengkaji halangan yang menghalang IKS di Pulau Pinang daripada melaksanakan inisiatif rantai bekalan hijau. Selain itu, kajian ini juga mengkaji kesan moderator orientasi perniagaan strategik dalam hubungan antara halangan dan inisiatif hijau rantai bekalan. Untuk mencapai tujuannya, pendekatan kaji selidik untuk industri berkenaan dilancarkan di kajian ini yang mana sampel daripada 92 responden IKS di Pulau Pinang telah dikumpul melalui kaedah kaji selidik. Analisis kaedah SPSS telah digunakan untuk analisa deskriptif dan regresi. Keputusan analisis menunjukkan bahawa pelaksanaan inisiatif hijau rantai bekalan oleh IKS di Pulau Pinang adalah rendah. Salah satu pencapaian rendah daripada inisiatif hijau rantai bekalan (pembelian hijau) mempunyai hubungan yang kuat antara halangan sumber daya, sikap dan halangan persepsi. Halangan teknikal juga menjadi faktor yang menghalang pelaksanaan rekaan untuk persekitaran oleh IKS di Pulau Pinang. Namun, kajian ini tidak dapat membuktikan dan meyakinkan untuk menyokong kesan moderator orientasi perniagaan strategik dalam hubungan antara halangan dan inisiatif rantai bekalan hijau. Dengan keputusan dan hasilan yang didapati daripada kajian ini, kerajaan dan industri kemungkinan akan mempunyai pemahaman yang lebih baik mengenai halangan-halangan yang dihadapi oleh IKS. Ini

membolehkan kerajaan dan syarikat untuk mengambil tindakan penambahbaikan untuk mendorong dan mempromosikan inisiatif rantaian bekalan hijau disepanjang rantaian bekalan.

ABSTRACT

With the rapid growth and development of the industries, global warming and depletion of natural resources have become a concern for the society, government and the industry. Because of that, green topic has become an important issue. Although Penang government has put heavy resources and efforts to promote and encourage green initiatives, green supply chain has not been widely adopted by the industries in Penang especially SMEs. Thus, the purpose of this study is to investigate barriers that hinder SMEs in Penang from adopting green supply chain initiatives. In addition, it also investigates the moderating effect of business strategic orientation on the relationship between the barriers and green supply chain initiatives. To attain its' objectives, questionnaire approach is adopted in this study and a sample of 92 respondents is collected through questionnaire method. SPSS statistical tool is used to test the descriptive and regression statistics. The result shows that the adoption of green supply chain initiatives by the SMEs in Penang is low. The reasons of low adoption of green supply chain initiative (green purchasing) are resource barrier and attitudinal and perception barrier. Technical barrier proves to be the factor that impedes the adoption of design for environment by the SMEs in Penang. However, the study found no convincing evidence to support the moderating effect of business strategic orientation on the relationship between the barriers and green supply chain initiatives. With the results and findings in this study, government and industry would have a better understanding of the barriers that faced by the SMEs. That allows government as well as big corporation to take corrective actions to drive and promote green supply chain initiatives across the entire supply chain.

CHAPTER 1

INTRODUCTION

1.0 Introduction

With the increasing awareness of the environmental issues among the consumers, businesses and government, that relatively boosted up the demand of green products. Therefore, organisations either government sectors or private sectors are required to implement the strategies to reduce environmental impacts of their products and services (Lewis & Gretsakis, 2001; Sarkis, 1995; Sarkis & Cordeiro, 2001). According to Hansmann and Claudia (2001), success in addressing environmental items may provide new opportunities for competitions and new ways to add value to core business programs. Therefore, market leaders in various industries have taken a step ahead to green their internal operations through ISO 14000 certification.

According to Handfield (2005), the ISO 14000 principle provides framework which guiding organisations to implement EMS that improves the environment performance. But, the framework is only within the organisation's operation boundaries instead of through the supply chain. Other than that, Beamon (1999) said that manufacturing firms must follow the basic principles established by ISO 14000 to extend to their suppliers in order to achieve the green supply chain principle. Therefore, by getting its own internal operation to be certified in ISO 14000 is only the first step for the respective organisation to participate in green initiatives. However, it does not ensure that the whole supply chain is participating in green supply chain initiatives. As a result, ISO 14000 is only limited to the implementation of EMS within the organisation's internal operation and it does not expand to the whole supply chain of the organisation. Who should take the responsibility and initiative to ensure that the whole

industry is practicing green initiatives to reduce environmental impact? Is that the market leader, government, industry or consumers' responsibility? Therefore, to green the whole supply chain is depend on the initiative of the organisation to either enforce the whole supply chain to be certified in ISO 14000 or the organisation itself to drive and guide their own suppliers towards the adoption of green supply chain initiatives. It is not an easy task to drive the whole supply chain to be certified in ISO 14000 especially small organisations which have limited resources. Hence, this study will look into the barriers that affecting SMEs to participate in green supply chain initiatives in the local context.

1.1 Background of Study

As the global climate has changed rapidly due to the global warming, manufacturing and production processes are viewed as the culprits in harming the environment, in the form of waste generation, ecosystem disruption and depletion of natural resources (Fiksel, 1996). It is necessary for the industry to react and transform the way of production systems operate towards sustainability. It can be achieved by extending the structure from one way to a closed loop supply chain, including supply chain operation designed for end of life products and packaging recovery, collection, and reused in the form of recycling and remanufacturing (Beamon, 1999).

Companies do not often change their businesses processes and this attitude allows inefficient processes to continue unabated causing unnecessary waste and pollutions. For example, ineffective processes in the US automotive industry allowed the innovative Japanese automakers to become market leaders. Businesses that want to transform to a green supply chain should take the opportunity to review all their business processes. It is to identify areas where adopting a greener outlook can actually improve their business. Organisations should

review each process along the supply chain to identify if a more environmentally sound approach will help to cure the inefficiencies that occurred.

Many companies in developed countries that have been gone through this exercise and have identified the processes where raw materials were wasted; resources underutilized and unnecessary energy used due to inefficient equipments. But according to Eltayeb and Zailani (2009), there are still a lot of companies in Malaysia are still behind and yet to adopt the green supply chain concept in their business strategy. Apart from that, Malaysian fully owned organisations have the lowest level participation of green supply chain initiatives compared to foreign based companies. One of the reasons that Malaysian owned organisations are having the lowest participation of green supply chain as the green purchasing is still a very new concept in Malaysia. Other than that, Lee (2008) found that a firm size is also an influence factor for organisation to practice green supply chain, bigger size organisation tend to be more willing to participate in green supply chain initiatives. According to Lee (2008), SMEs usually lack of the information resources or expertise to deal with environmental issues. Therefore SMEs can be a source of environmental risk and bottleneck in pursuing the goal of greener supply chain.

1.2 Problem Statement

With increased pressures for environmental sustainability, it is expected that the organisation will need to implement strategies to reduce the environmental impacts of their products and services (Lewis & Gretsakis, 2001; Sarkis, 1995; Sarkis & Cordeiro, 2001). Otherwise, organisation will loose its competitiveness in the market. Environmental impacts occurred at all stages of a product production processes and supply chain. Therefore, in order to reduce environmental impacts of a product, organisations have to ensure their own

production process and supply chain is practicing green initiatives. According to Rao and Holt (2005), greening supply chain not only allow organisations to achieve substantial cost saving, it would also enhance sales, market shares, exploit new market opportunities and stay competitive in the market which lead to greater profit margins. All these benefits contribute to economic performance of the organisation and also create job opportunities to the market which help the economic growth of the country. Although adopting green supply chain initiatives would allow organisation to enjoy all these benefits and contribute to economic performance of the organisation. But there are still a lot of organisations in Malaysia still have low involvement in the green initiatives. Under the pressure of global economy crisis, organisations are struggling to fight for survival. Obviously, the main focus for organisations is to be profitable and sustainable in the competitive market instead of green initiatives. Therefore, cost reduction program has become a key agenda especially for SMEs rather than green initiatives.

According to Eltayeb and Zailani (2009), local organisations in Malaysia have very low involvement in green initiatives compare to MNC (Multinational Company). Other than that, according to Wycherley (1999), small organisations have difficulty to drive its supplier or suppliers' supplier to involve in the green initiatives. Beside that, SMEs have difficulties in obtaining financial and technological resources with the purpose of tackling their business activities. Walker, Sisto and McBain (2008) identified various types of barriers which hinder the adoption of green supply chain. The barriers included costs, lack of legitimacy, regulations, poor supplier commitments and industry specific barriers. According to Lee (2009), adopting green management into daily business operations require more innovative approach to develop technological and organisational capabilities. Other than that, Wang and Ahmed (2009) found that organisations that in family business with strong family orientation tend to

be more reluctant to accept changes and adopt new initiatives. Therefore, organisations that under family business may have lower adoption in green supply chain initiatives. In addition, green management activities required a large amount of resources in a diverse nature. That showed that small organisations are facing various difficulties and barriers to adopt green supply chain initiatives.

According to Penang government official website (www.penang.gov.my), Penang generates about 1500 to 1600 tons of solid waste per day. MPPP and MPSP have spent RM57.6 million in solid waste management. Therefore, Penang government decided to make a big step that declared every Monday a “No Plastic Day” to all retail stores for Penang from 1st July 2009, and then further extended the “No Plastic Day” initiative to Tuesday and Wednesday from 1st January 2010. That shows that government has made the move to reduce the impact to the environment by reducing solid waste from the public. Based on the statistics from Malaysia’s Productivity report 2008, SMEs contributed RM100,299 million or 30.9% of total manufacturing output in year 2008. Therefore the success of SMEs is critical to economic growth of Malaysia in the future. With the increasing trend of global environmental protection awareness, SMEs in Malaysia will be out of the competition if green initiatives still not adopted as part of their business strategy. As some trading companies managed to import variety of items and things from other countries which the price is cheaper compare to our local made products. Apparently, this actually creates a suffocating environment for our local made products. Hence, SMEs must improve their competitiveness in order to compete in the competitive market. Other than that, there is not much green supply chain literature in Malaysian context available. Therefore, this study will focus on the barriers which impede SMEs in local context to adopt green supply chain initiatives.

1.3 Research Objectives

By referring to the problem statement as above, few research objectives are formulated:

- 1) To understand the barriers and the level of green supply chain initiatives adoptions by the SMEs in Penang.
- 2) To examine the significant level of the barriers that impeding SMEs to participate in green supply chain initiatives.
- 3) To analyze the moderating effect of business strategic orientation between the barriers and level of green supply chain initiatives adoptions.

1.4 Research Question

This study will try to answer the following research questions in order to achieve the research objective as above:

- 1) What are the barriers and the level of green supply chain initiatives adoption by the SMEs in Penang?
- 2) What is the significant level of each barrier that affecting local SMEs not to participate in green supply chain initiatives?
- 3) Does business strategic orientation moderate the relationship between the barriers and level of adoptions in green supply chain initiatives?

1.5 Significant of Study

This study will explore the barriers that impeding SMEs in Penang to adopt green supply chain initiatives. By understanding the reasons of SMEs are still par behind the level, it will allow the local SMEs along the supply chain, the Penang government and federal government to take further actions to improve and promote the awareness of green initiatives in the

industries. According to Eltayeb and Zailani (2009), local organisations in Malaysia have very low involvement in green initiatives compare to MNC (Multinational Company). By depending on the MNCs to drive the green supply chain initiatives on their suppliers would not be sufficient and effective enough to paint the whole picture. Local SMEs should be involved to take their part in the green supply chain initiatives in order to reduce environmental impact of their products and services.

1.6 Scope of Study

Based on the statistics in year 2009 from SMEInfo (www.smeinfo.com.my), 36% of the SMEs in Malaysia are manufacturing sector and most of the SMEs are in the upstream of the supply chain of the MNCs. It is vital to explore and understand the barriers that faced by the SMEs to green themselves as well as their supply chain. Due to some constrains and limitations in data collection, this study will only look into the manufacturing sector in Penang instead of all sectors in the whole Malaysia. The scope of this study will focus on the relationship of internal barriers and the three supply chain initiatives. Other than that, moderating effect in terms of business strategic orientation with regards to the level of adoption of green supply chain initiatives in their organisation and supply chain is also evaluated in this study.

1.7 Contributions of Study

By exploring and understanding the significant level of each barriers faced by the SMEs in Penang, this study will serve as the literature for organisations to have better understanding on the barriers faced by their suppliers to become green as well as green their downstream suppliers along the supply chain. Therefore the big organisations such as MNC that intend to

adopt green supply chain initiatives will be able to react and employing strategic actions to drive and promote green supply chain initiatives to their suppliers. Furthermore, this study will also allow government to take further actions to review and restructure regulations and policies which help to encourage SMEs to participate in green supply chain initiatives.

1.8 Definitions of Key Terms

The following are the key words and phrases used in this research with its definitions within the context of this document.

- i) Green Supply Chain – A set of endeavors or efforts undertaken by a firm to minimize negative environment effects associated with the entire life cycle of its products or services starting from design of product, acquisition of raw materials, product use, up to the final disposal of the product. (Zsidisin & Siferd, 2001)
- ii) Design for Environment – Design of product minimizing a product’s environmental impact during its whole life cycle from acquiring materials, to manufacturing, use, and ultimately to its final disposal without compromising other essential product criteria such as performance and cost. (Johansson, 2002).
- iii) Green Purchasing - An environmentally conscious purchasing initiative that tries to ensure that the purchased products or materials meets environmental objectives set by the purchasing firm, such as reducing sources of waste, promoting recycling, reuse, resource reduction, and substitution of materials (Carter, Ellram & Ready, 1998; Min & Galle, 2001; Zsidisin & Siferd, 2001).

- iv) Reverse Logistics - The return or take-back products and materials from the point of consumption to the forward supply chain for the purpose of recycling, reuse, remanufacture, repair, refurbishing, or safe disposal of the products and materials (Carter & Ellram, 1998; Stock 1998).
- v) Attitudinal and Perception Barrier – Negative attitude towards environmental initiatives, resistance to change, disbelieve of the benefits of environmental initiatives (Perron, 2005).
- vi) Information Barrier – No clear information regarding environmental benefits (Hemel & Cramer, 2002), unaware of the environmental legislation and the requirements (Simpson, Taylor & Barker, 2004).
- vii) Technical Barrier – Not able to find alternative technical solution due to lack of technical knowledge (Hemel & Cramer, 2002).
- viii) Resource Barrier – Lack of financial resources, human resources and time (Perron, 2005).
- ix) Business Strategic Orientation – Business strategic orientation can be classified into three clusters:

Family-oriented – The focus of the business decisions in relation to the family, like keeping ownership within the family, generating income to dependent families and maintaining family reputation (Handler, 1990).

Business-oriented – The focus of business decision is on the business side (Drozdow & Carroll, 1997)

Balance-oriented – Do not express clear preference on both business or family side, but are concerned to arrive at an appropriate balance between business and family issues (Birley, Ng & Godfrey, 1999).

1.9 Organisation of Remaining Chapters

This research is organized into five chapters, namely introduction, literature review, research methodology, data analysis and finally discussion and conclusion.

Chapter One provides general idea about this study which consists of introduction and overview of the study and that includes background of the study, problem statement, research objectives.

Chapter Two presents the review of literatures that has been undertaken with regards to green supply chain initiatives and the barriers. In addition, explain the concept of business strategic orientation. The theoretical framework and formulation of hypothesis are also discussed in the same chapter.

Chapter Three explains the research methodology which includes research design, sampling method, measurement of variables, development of questionnaire and methods of data analysis.

Chapter Four presents the results and findings of the study which includes analysis of the collected data.

Finally, chapter Five provides a discussion, implication and conclusion of the study. In addition, the limitation of the study as well as suggestions for future research is also presented in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter contains the literature review on the dependent variables, independent variables and moderating variables. Other than that, this chapter also discussed about the definition as well as the statistics of SMEs in Penang. This chapter consists of the review of SME in Malaysia and Penang, evolution of supply chain practice, green supply chain initiatives, consumer perceptions towards green and benefits and barriers of green supply chain adoption.

2.1 SME in Malaysia

SME in Malaysia have been defined according to size, turnover and activity. An enterprise is considered to be an SME based on annual sales turnover or number of full-time employees as indicated in table 2.1 and table 2.2.

Table 2.1:

SME Definition Based on Number of Full Time Employees

Sector Size	Services, Primary Agriculture and Information & Communication Technology (ICT)	Manufacturing, Manufacturing- Related Services and Agro-based industries
Micro	Less than 5 employees	Less than 5 employees
Small	Between 5 and 19 employees	Between 5 and 50 employees
Medium	Between 20 and 50 employees	Between 51 and 150 employees

Source: Secretariat to National SME Development Council

An enterprise that has less than five employees or annual sales turnover of less than RM200,000 is categorized under micro size SME. As for small and medium size SME, enterprise that in manufacturing, manufacturing related services and agro-based industries should have 5 to 50 employees (small size), 51 to 150 employees (medium size) or annual sale turnover between RM250 thousand and less than RM10 million (small size), RM10 million to RM25 million (medium size). On the other hand, an enterprise that in service, primary agriculture and information and communication technology (ICT) has lower limit in terms of number of employees and annual sales turnover.

Table 2.2:

SME Definition Based on Annual Sales Turnover

Sector Size	Services, Primary Agriculture and Information & Communication Technology (ICT)	Manufacturing, Manufacturing-Related Services and Agro-based industries
Micro	Less than RM200,000	Less than RM250,000
Small	Between RM200,000 and less than RM1 million	Between RM250,000 and less than RM10 million
Medium	Between RM1 million and RM5 million	Between RM10 million and RM25 million

Source: Secretariat to National SME Development Council

According to the Malaysia's Annual Productivity Report 2008, SMI (Small and Medium Industries) constitute 99.2% of total business establishment in Malaysia. Therefore, Malaysian government acknowledged the importance to develop the capabilities of SMEs sectors in order to broaden the sources of economic growth. The development of SMEs was

reflected in the Ninth Malaysia Plan (9MP: 2006 – 2010) and the Industrial Master Plan (IMP3: 2006 – 2020). In 2008, SMEs produced RM100,299 million or 30.9% of total manufacturing output. Most of the SMEs were involved in food and beverages (32.2%), chemicals and chemical products (17.2%), rubber and plastic products (10.1%), fabricated metal products (6.4%), and basic metals products (6.1%).

According to Business Times on 30th July 2009, Malaysia government has approved 9.5 billion investments in green energy. The investment from the global large solar cell manufacturer such as First Solar from US and Q-Cells from Germany has attracted the SMEs in Malaysia to get involved and become part of the supplier along the supply chain in green energy.

2.1.1 SME in Penang

According to Bernama (<http://webevents.bernama.com/bernama/v3/news.php?id=198959>), SMEs played an important role in Penang's economy since the 1970s when multinationals (MNCs) like Intel and AMD established their operations in the state. SMEs had been servicing MNCs in various capacities under the global supplier programme and services suppliers programme. That showed that the role of SME is significant to the growth of economy not only Penang but Malaysia as well.

Table 2.3:

Breakdown of SME in Penang by Business Sector

Business Sector	Number Of Companies	%
Manufacturing (incl. Agro Based)	710	49.62%
Manufacturing Related Service	154	10.76%
Mining And Quarrying	3	0.21%
Services (including ICT)	339	23.69%
Construction	64	4.47%
Primary Agriculture	25	1.75%
Others	136	9.50%

Source: Compiled from <https://secure.smeinfo.com.my/directory/index.php> (as of Sept 2009)

Table 2.3 breakdown the SMEs in Penang by business sector, the data was summarized from SME business directory as of September 2009 (<https://secure.smeinfo.com.my/directory/index.php>). The table indicated that manufacturing sector is the biggest sector among the business sectors in Penang.

2.2 Evolution of Supply Chain Practice

The concept of SCM (Supply Chain Management) has been increasingly discussed among academician and researchers as well as practitioners since mid 1980-s (Houlihan, 1988, Jones & Riley, 1985) and lately companies have also started to work accordingly to its principles. However, SCM could be seen in multiple contexts as the specifications and definitions about content and meaning of SCM vary widely. Harland (1996) strongly agreed that there is little consistency in the use of the term of SCM and little evidence of clarity of its meaning. Table 2.4 gives a brief overview of different understanding of SCM. In an attempt to systematize definitions and understandings, Bechtel and Jayaram (1997) identified four perspectives, which so far dominate in SCM literature. They are functional chain awareness,

logistics, and information and integration process. This is supported by Kathawala and Abdou (2003) that SCM has been poorly defined and there is a high degree of variability in people's minds about what is meant.

In regards with functional chain awareness, SCM covers the flow of goods from suppliers through manufacturers and distributors to the end users (Houlihan, 1988, Jones & Riley, 1985 and Langley & Holcomb, 1992). Whereas from the logistics perspective, "SCM is a technique that looks at all the links in the chain from raw material suppliers through various level of manufacturing to warehousing and distribution to the final customer" (Turner, Taylor & Hartley, 1994, p.52). Johannsson (1994, p.525) defined SCM from perspective information in which he stated "SCM requires all participant of the supply chain to be properly informed. With SCM the linkage and information flows between various members of the chain are critical to overall performance". Lastly, from the perspective integration process, SCM is defined as "the integration of business processes across the supply chain" (Cooper, Lambert & Pagh, 1997, p.2).

Table 2.4:

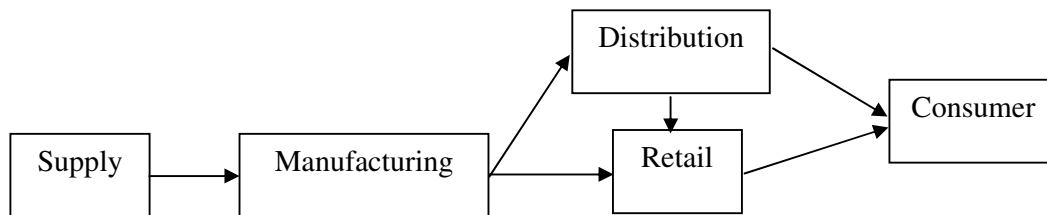
Understanding of Supply Chain Management (SCM)

Understanding (SCM is seen as ...)	Authors
Approach	Johannsson, 1994
Concept	Bechtel & Jayaram, 1997; Schary & Skerjott Larsen, 1995
Perspective	Ellram, 1991
Philosophy	Cooper, Lambert & Pagh, 1997; Lambert, Cooper & Pagh, 1998, Cooper & Ellram, 1993
Technique	Turner, Taylor & Hartley, 1994

Figure 2.1 illustrated the flow of supply chain which raw materials are manufactured into final products then delivered to customers via distributions, retails or both. According to Beamon (1999), traditional supply chain primary focused on optimizing the procurement of raw materials from suppliers and the distribution of products to consumers.

Figure 2.1:

Traditional Supply Chain



Source: Beamon (1999, p.336)

By combining various definitions discussed above, Brindley and Ritchie (2001), define SCM as “the management of material, information and financial flows through a network of organisations (i.e., suppliers, manufacturers, logistics providers, wholesalers /distributors, retailers) that aims to produce and deliver products or services for the consumers”. It includes the integration, coordination and collaboration of processes and activities across different functions such as marketing, sales, production, product design, procurement, logistics, finance, and information technology within the network of organisation and within the chain organisations. Besides these definitions, table 2.5 provides more definitions for SCM that synthesized from the literature.

Table 2.5:***Definitions of Supply Chain Management (SCM)***

Authors	Year	Definitions
Lummus & Vokurka	1999	All the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer, and the information systems necessary to monitor all of these activities
Lee	2000	Involves the flows of material, information, and finance in a network consisting of customers, suppliers and manufacturers
Mentzer et al.	2001	The systematic, strategic co-ordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole
Svensson	2002	The overall bi-directional dependencies of activities, actors, and resources on an operative, tactical, and strategic level between the points of consumption and origin in and between marketing channels in the marketplace
Simchi-Levi	2002	The series of companies which include suppliers, manufacturer, logistics providers that work together to deliver a value package of goods and services to the end customer
Hugos	2003	Is the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served

From the summary of the definition of SCM as illustrated in table 2.5, green initiatives were not in the picture of the supply chain management. That becomes a culprit in harming the environment in terms of waste generation, ecosystem disruption and depletion of natural resources (Fiksel, 1996). Therefore, there is a need to green the manufacturing system by changing the way of production system operates in order to reduce the impact to environment along the supply chain. The change of the traditional structure from one way supply chain to a

closed loop, including supply chain operations design for end of life product and packaging recovery, collection and reuse as defined by Zhu and Sarkis (2004).

The ISO 14000 principle provides framework which guiding organisations to implement EMS to improve environment performance only within the organisation's operation boundaries instead of throughout the supply chain (Bansal & Clelland, 2004; Handfield, 2005). According to Beamon (1999), in order to adopt the green supply chain, manufacturing organisations must follow the basic principles that established by ISO 14000 and further extended to the supply chain. Similarly, Zsidisin and Siferd (2001) described that green supply chain is application of environmental management principles to the entire customer order cycle. This including design, procurement, manufacturing, packaging, logistics and distribution. According to Sarkis (2006), green supply chain emerged from performing environmental management in the context of supply chains. Comparing the definitions of Supply Chain Management and Green Supply Chain Management, it is clearly shown that green supply chain involved not only integrating the manufacturing processes and distribution to customers. It also covers from the very beginning stage when the product is designed until the product is disposed. That shows that it requires a full integration and collaboration of the players along the product life cycle. Hoek (1999) summarized the players, activities and evaluation of greening efforts throughout the supply chain as shown in table 2.6.

Table 2.6:***Players, Activities and Evaluation of Green Initiatives throughout the Supply Chain***

	Upstream	Midstream	Downstream
Players	Raw material suppliers Part suppliers	Main suppliers Manufacturers	Wholesalers Importers / distributors Retailers
Green initiatives	Material selection Re-use of material	Design for environment Scrap, shred Transportation	Packaging Returns handling Returns shipment
Relation performance measure	Emission rates and energy efficiency per material % of virgin material	Volume of goods disassembled per hour Degree of utilization transport equipments	Amount of “air” in package Volume selected for recycling

Source: Adapted from Hoek (1999, p.133)

It is clearly showed in the table 2.6 that green supply chain involves the participation from every player along the supply chain. All of these players play an important role in greening the supply chain. Based on the concept of green supply chain, there is a wide range of various green supply chain initiatives which are practiced internationally. Eltayeb and Zailani (2009) reviewed and summarized twenty one literatures on green supply chain initiatives as shown in table 2.7.

Table 2.7:***Green Supply Chain Initiatives Based on Literature***

Source	Green Supply Chain Initiatives
Sarkis (1998)	Design for the environment, life cycle analysis, and reverse logistics.
Walton et al. (1998)	Design for the environment, green purchasing.
Hervani, Helms and Sarkis (2005)	Green design, green procurement, green distribution, and reverse logistics.
Beamon (1999)	Eco-design, Reverse logistics.
Carter and Carter (1998)	Green purchasing.
Min and Galle (2001)	Green purchasing
Preuss (2001)	Green purchasing
Rao (2002)	Green purchasing, supplier environmental collaboration.
Zhu, Sarkis & Lai (2007)	Green purchasing, eco-design, customer cooperation.

Rao (2006)	Green purchasing
Bowen et al. (2001)	Green purchasing, supplier environmental collaboration.
Canning and Hanmer-Lloyd (2001)	Environmental adaptations to supplier-customer relationships.
Hall (2000)	Diffusion of environmental innovations from customers to suppliers
Vachon and Klassen (2006a)	Environmental collaboration with suppliers and customers.
Vachon and Klassen (2008)	Customer and supplier environmental collaboration
Blumberg (1999)	Reverse logistics
Carter and Ellram (1998)	Reverse logistics
Ravi et al. (2005)	Reverse logistics.
Alvarez-Gil, Berrone, Husillos and Lado (2007)	Reverse logistics
Richey, Genchev and Daugherty (2005)	Reverse logistics.
Murphy and Poist (2003)	Green logistics

Source: Eltayeb & Zailani (2009)

Based on table 2.7, Eltayeb and Zailani (2009) concluded that the green supply chain initiatives can be generally classified into three major components:

- 1) Eco-design or design for environment
- 2) Green purchasing
- 3) Reverse logistics

These three green supply chain initiatives were selected as dependent variable in this study as Eltayeb and Zailani (2009) reviewed that these three green supply chain initiatives are most appropriate in the Malaysian context. Hence, organisations are required to incorporate these three elements into their corporate culture and formulating a strategy and practices in order to allow organisation to be the driver and initiator in green supply chain. Accordingly, the following sub sections will discuss further on each green supply chain initiatives. Although the population frame of the study by Eltayeb and Zailani (2009) was not focused on SME, the three green supply chain initiatives mentioned as above can still be

applied in this study as the SMEs in Penang under manufacturing sector are mostly the supplier or the supplier’s supplier of the big organisations.

2.2.1 Design for Environment

Design for environment (DfE) is a concept which reduces the impact to damage the environment of products or services across its life cycle. According to Lewis and Gretsakis (2001), the environmental impact of any product or material is “locked” into the product during the initial design stage when materials, processes are selected. Therefore design stage is very important to determine if a product life cycle creates impact to the environment. The impact of product life cycle is evaluated against various aspects, for example the alternative options for reducing waste and energy, recycling or elimination of product waste during manufacturing. Design for environment provides guidelines for the design engineer to examine the environmental friendly and soundness of a product over its entire life cycle (DeMondonca & Baxter, 2001). A comparison of the objectives between DFE and ISO 14000 by Demondoca and Baxter (2001) concluded that DFE is more comprehensive than ISO 14000. That also aligns with the finding from Bansal and Clelland (2004) and Handfield et al. (2005) that ISO 14000 standard does not provide sufficient components to support green supply chain approach. The difference can be clearly seen in the table 2.8 as below.

Table 2.8:

Comparison of the Difference between DFE and ISO 14000

Objectives	DFE	ISO 14000
Continuous improvement in environmental performance	√	√
Maintaining good public/community relations	√	√
Obtaining insurance at reasonable cost	√	√

Enhancing image and market share	√	√
Meeting vendor certification criteria	√	√
Improving cost control	√	√
Reducing incidents that result in liability	√	√
Demonstrating reasonable care	√	√
Conserving input materials and energy	√	√
Facilitating the receipt of permits and authorizations	√	√
Fostering development and sharing environmental solutions	√	√
Improving industry-government relations	√	√
Commitment to compliance with applicable regulations	√	√
Reduced consumption of material extraction	√	X
Reduced consumption of materials processing	√	X
Reduction of toxins containment	√	X
Reduction of wastes during manufacturing	√	X
Increase in energy efficiency	√	X
Recycling of fluids	√	X
Increase in product durability	√	X
Increase in product maintainability	√	X
Increased recycling of materials	√	X
Standardized material identification	√	X
Reduction of assembly and disassembly times	√	X
Reduction of waste treatment	√	X
Improvement in work conditions and safety	√	X
Reduced need for occupational health and safety measures	√	X

Source: DeMondonca and Baxter (2001, p. 55)

Hemel and Cramer (2002) summarized 10 most successful designs for environment principles and practice as below. Enhancing design for environment in SMEs does not only depend on finding solutions for technical problems, more important is economical factors and social factors such as the acceptance of environmentally improved products in the market.

- 1) Recycling of materials
- 2) High reliability / durability

- 3) Low energy consumption
- 4) Remanufacturing / refurbishing
- 5) Less production waste
- 6) Clean production techniques
- 7) Reduction in weight
- 8) Clean materials
- 9) Less / clean / reusable packaging
- 10) Recycled materials

Other than minimizing environmental impacts, products that consuming less materials or energy would definitely tend to be more profitable and competitive in the market. Thus, design for environment is an important practice to reduce impacts to environment from their products and manufacturing processes as well as a competitive advantage for an organisation to compete in the market.

2.2.2 Green Purchasing

Green purchasing means that purchasing or supply chain managers consider the issue of sustainability in their purchasing of inputs in addition to the traditional purchasing criteria of cost, quality, and delivery (Lambert & Cooper, 2000). Hamner (2006) suggested seven basic elements for green purchasing as below.

- 1) Product content requirements
- 2) Product content restrictions
- 3) Product content labeling or disclosure
- 4) Supplier questionnaires
- 5) Supplier EMSs

- 6) Supplier certification
- 7) Supplier compliance audit

By having all these elements in the SMEs' organisation require additional effort and resources.

According to Lee (2008), buyer is the most important influential stakeholder for the supplier to participate in green supply chain initiatives. That showed that green purchasing is one of the key elements for organisations to participate in green supply chain initiatives. However, Zsidisin and Hendrick (1998) concluded that purchasing managers are not the only driver to promote and influence the environmental supply chain involvement, it is the top management's responsibility to prioritize the environmental concerns and cascade through the entire organisation which involve procurement, logistics, warehousing practices, operations, marketing, and governmental agencies. Therefore, the green purchasing initiatives can be viewed in two perspectives which are internal and external. In terms of internal perspective, top management is the key driver to drive its organisation to take part in green supply chain initiatives by putting priority to drive all levels in the organisation. On the other hand, in external perspective, purchasing managers are the driver to drive its supplier along the supply chain to participate in green supply chain initiatives.

2.2.3 Reverse Logistics

According to Hanafi, Kara and Kaebernick (2008), reverse logistics consists of five main activities which are collection, inspection, separation, reprocessing and distribution. It is defined by Carter and Ellram (1998) as returning the end of life product or packaging from end user back to the supplier. The supplier can recycle, remanufacture, repair, repackaging, reclaim or safe disposal of the material as illustrated in figure 2.2 as below. Similarly, Stock (1998) explained that reverse logistics can also involve product return, source reduction,