Green Supply Chain Management in Manufacturing Small and Medium-sized Enterprises:

Perspective from Chang Chiang Delta

Thesis submitted in accordance with the requirements of the

University of Liverpool for the degree of Doctor in Philosophy

by

Xiangmeng HUANG

February 2013

Abstract

This research started from an interest in how small and medium-sized enterprises (SMEs) in the manufacturing industry within the geographical area of Chang Chiang Delta in China operate with respect to sustainability by developing green supply chain management (GSCM). Therefore, the aim of this study is to investigate what the pressures are for SME manufacturers to implement GSCM practices, and to examine the relationship between those practices and corresponding performance at a regional level in the context of Chang Chiang Delta in China. To accomplish this task, a range of literature is evaluated, focusing on GSCM theories and adoptions. This review reveals a research gap regarding SMEs' implementation of GSCM, to which this study responds.

The research is underpinned by an interpretive epistemology and a multi-method design. It is an exploratory and empirical study with two rounds of primary data collection gathered from SME manufacturers in the Chang Chiang Delta region of China, which contains the triangular-shaped territory of Shanghai, southern Jiangsu Province and northern Zhejiang Province, including the urban cores of five cities – Shanghai, Nanjing, Hangzhou, Suzhou and Ningbo. In addition, a qualitative case study is employed in this research to provide more detailed information of GSCM implementation in SMEs.

The results derived from both the questionnaire survey and the case study provide strong evidence that Chinese manufacturing SMEs have been under pressures relating to regulatory, customer, supplier, public and internal aspects from different stakeholder parties in terms of GSCM. In response to these pressures, SMEs have tried some GSCM practices, including green purchasing, eco-design, investment recovery, cooperation with customers and internal environmental management, and these practices are specific to the industrial sector considered in this study. But these practices do contribute to improving performance economically, environmentally and operationally.

From the literature review and the empirical findings, this research provides contributions to knowledge, as well as managerial implications. It contributes to knowledge by providing conceptual and empirical insights into how GSCM is viewed and developed among SME manufacturers, clarifying the conceptions relating to sustainability, and incorporating stakeholder theory and the theory of industrial ecology in examining GSCM development. This study also provides practical implications by providing suggestions and guidance to governments, the public, suppliers and customers across the chain, as well as the managers of SMEs, and proposing an optimised model for the selected case for improved GSCM performance.

Acknowledgement

In the first place, I am immensely indebted to my supervisor Dr. Boon Leing Tan for his kind and thoughtful supervision. He has not only guided me in this research but also provided me an example to follow in every sphere of life and has left a lasting impact on my life. I would like to attribute my success to his guidance and training. Once again I would like to thank him for everything he has done for me.

I also wish to express my sincere gratitude to Dr. Xiaoming Ding and Dr. Dong Li who were always very encouraging, who exploited every opportunity to help me, who asked great questions and gave the right guidance to both support and improve my work, and who were quick to help when I needed it.

I would like to thank my family for all support and belief they always give me. First of all, to my lovely parents who always believe in me and provide me such a great help to take care of my daughter. I am also most grateful to my husband who endured with me for doing a Ph.D., never giving up and always persevering. Besides doing a Ph.D., my daughter is the biggest harvest on the way. She was an embryo when I started my study and now she has already started her schooling in the kindergarten.

I also would like to extend my thanks to my buddy Zhenhuan Li and my friend Dr. Woonkian Chong Tristan who provided advices and support through the Ph.D. process at both a personal and professional level.

Many thanks to all people participated in this research for questionnaire fulfill and case study investigation. I am also thankful to Xi'an Jiaotong Liverpool University for providing me an opportunity to undertake this study by awarding me a scholarship. I really appreciate the generous support of the University of Liverpool without which this would have not been possible.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AIAG	Automotive Industry Action Group
ANOVA	Analysis of Variance
APIs	Active Pharmaceutical Ingredients
BBC	British Broadcasting Corporation
BFA	Bulk Flow Analysis
BOCOM	Bank of Communications
CAGR	Compounded Annual Growth Rate
CAP	per capita
CC	Cooperation with Customers
CCTV	China Central Television
CERFE	Centro di Ricerca e Documentazione Febbraio
COPD	Chronic Obstructive Pulmonary Disease
CP	Customer Pressure
CSCMP	Council of Supply Chain Management Professionals
CSR	Corporate Social Responsibility
DDT	dichloro-diphenyl-trichloroethane
df	Degrees of Freedom
DfE	Design for Environment
DfX	Design for X
DTI	Department of Trade and Industry
EC	European Commission
ECO	Eco-design
ECU	European Currency Unit
ELVs	End of Life Vehicles
ENP	Environmental Performance
EP	Economic Performance
EU	European Union
FDI	Foreign Direct Investment
FIEs	Foreign Investment Enterprises
GDP	Gross Domestic Product

GEMI	Global Environmental Management Initiative
GM	General Motors
GMP	Good Manufacturing Practices
GP	Green Purchasing
GSCM	Green Supply Chain Management
IBM	International Business Machine
ID	Internal Driver
IE	Industrial Ecology
IEM	Internal Environmental Management
INES	INdustrial EcoSystem
IR	Investment Recovery
ISO	International Standardization Organization
IUCN	International Union for Conservation of Nature
JIT	Just-in-Time
KMO	Kaiser-Meyer-Olkin
LCA	Life Cycle Assessment
LE	Large Enterprise
MEP	Ministry of Environmental Protection
MFA	Material Flow Analysis
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OP	Operational Performance
PCFs	Pharmaceutical Chemical Formulations
PM 2.5	Particulate Matter 2.5 index
PP	Public Pressure
R&D	Research and Development
RMB	Renminbi
RP	Regulatory Pressure
S.D.	Standard Deviation
SCM	Supply Chain Management
SDA	State Drug Administration
SEEP	Safety, Energy and Environmental Production

SEPA	State Environmental Protection Administration
SETAC	Society of Environmental Toxicology and Chemistry
SFA	Substance Flow Analysis
SFDA	State Food and Drug Administration
Sig.	Significance
SME	Small and Medium-sized Enterprise
SOE	State Owned Enterprise
SP	Supplier Pressure
SRI	Stanford Research Institute
SSCM	Sustainable Supply Chain Management
SSM	Sustainable Supply Management
TCMs	Traditional Chinese Medicines
US	United States
USD	United States Dollar
VDA	Verband der Automobilindustrie
WCED	World Commission for Environment and Development
WiCON	WiCON International Group
WTO	World Trade Organization

1. Introduction

1.1 Greening the supply chain in small and medium-sized enterprises (SMEs)

1.1.1 Development of green supply chain management (GSCM)

The past decade has seen the unequivocal demand and development of supply chain management (SCM), and competition between enterprises has come to centre around SCM, with intensifying rivalry among businesses and rapid advances relating to Internet technology, production techniques, logistics systems, and so on, in the global market. Simultaneously, an increase in environmental consciousness has resulted in a gradual increase in ideas of environmental protection and resource conservation in the context of SCM around the world.

The term “supply chain management” was first introduced by Oliver and Webber in the early 1980s (Delfmann and Albers, 2000). The concept has traditionally been regarded as a process of converting raw materials into final products which will then be transferred to the end users. In addition to this focus on tangible product flow, some researchers have also stressed the intangible value of the information flow through the supply chain, which includes an emphasis on market needs exchange, trust building, product development, supplier base reduction, strategic positioning leverage and operating efficiency improvement (Berry et al., 1994; Bowersox et al. 2002) within the enterprise and across the chain, which leads to a more complex supply chain structure. Furthermore, Welford (2002) proposed that the supply chain relationship has definitely become more critical in today’s globalised world, in light of the growing notion of environmental responsibility from all over the world. Actually, it is important to note that we are entering into an era where green issues and

sustainability have become an important element in business practices.

In the face of increasingly fierce global competition, enterprises, especially multinational and large enterprises, are continually looking for strategies to improve their supply chain systems for the purpose of cutting costs, improving quality and productivity, as well as achieving sustainability in the long run. For instance, the Kentucky plant of Toyota Motor Manufacturing uses returnable plastic containers to ship over 90% of its materials and parts from over 170 suppliers. It employs these reusable plastic containers and pallets to meet the specifications of the Automotive Industry Action Group (AIAG) for maximum cube space utilisation in truck trailers, and to minimise the environmental impact on local landfills. The container system works well with the just-in-time (JIT) operation applied, and helps to achieve cost-efficiency in the plant (Wu and Dunn, 1995). Another example can be seen in the pharmaceutical giant Novartis. Novartis carries out a profit-risk analysis for its core production systems, and the analysis results are widely released to the public. Moreover, it develops a target report system called Safety, Energy and Environmental Production (SEEP) for monitoring and auditing, which is able to obtain 90% of the real-time emission information from all of the enterprise's branches around the world. In addition, Novartis emphasises the responsibilities of its employees for better environmental performance (Narasimhan and Carter, 1998).

1.1.2 Going green in China

No country has moved up the economic ladder as fast as China since the reform and opening era of 1978. The country's high annual economic growth has made it a major global producer and consumer of goods during recent decades. For example, the number of cars manufactured in China increased from 42,000 in the late 1990s (Gallagher, 2006) to 8.8 million by 2007 (Associated Press, 2008); and the number grew to 13.79 million in 2009 which made China to be the largest auto consumption country (BOCOM, 2010). Moreover, according to Fergusson (2006), the consumption

of air conditioners in China rose rapidly, with the figure tripling from 2002 to 2006. In 2011, China became the largest room air conditioning manufacturer with 70 million conditioner sold in the domestic market (Bahuet, 2012).

Besides a growth in domestic power consumption resulting from the reform and opening policy, China has attracted an increasing number of foreign direct investment (FDI) since the late 1970s. The investment was modest through the 1980s, but rocketed from 1992 when Deng Xiaoping made his southern journey. Palmisano (2006) claimed that foreign enterprises established over 60,000 manufacturing plants in China between 2000 and 2003, and that the amount of FDI climbed to $75 billion per annum by 2006. Further, China exceeded the United States to become the world's largest recipient of FDI in the first six months of 2012 with a amount of flows totaled $ 59 million (Perkowski, 2012).

However, the increasing rate of growth gave rise to severe environmental contamination in China, which has now become one of the most polluted countries in the world: according to the World Bank (2001), 16 out of the 20 most contaminated cities on earth are in China. The consequences of this are incredibly serious. For example, according to Laumer (2007), 750,000 premature deaths are considered to have been caused by the deteriorating air pollution in the country. In addition, acid rain has impacted more than half of the cities in China, and the drinking water has become polluted as a result of industrial production processes (Shi, 2005). It is also estimated that chronic obstructive pulmonary disease (COPD) associated with air pollution caused 1.3 million deaths annually in China (Nordqvist, 2010).

In light of this economic development and environmental deterioration, the language of environmentalism has become more popular in China. According to Sun (2008), China’s State Environmental Protection Administration (SEPA) became the Ministry of Environmental Protection (MEP) in 2008, which also indicates a green thread from

central government arising from an acknowledgement of the increasing environmental issues. A series of policies and programmes have been put forward over recent years, such as a green credit policy to put constraints on bank loans to energy-consuming and pollution-intensive enterprises, a green securities programme to set requirements for those enterprises which enter into the Chinese capital market for environmental information disclosure, and so on. The green guideline for China's enterprises is thus becoming increasing more detailed.

Simultaneously, multinational enterprises have been making tremendous advances in environmentally friendly manufacturing in China. For example, the Chinese subsidiary of Nike has made great progress in reducing the solid waste generated by its footwear production. Such waste has diminished by one-third since the financial year 2000, which indicates a reduction of one hundred grams of solid waste per pair of shoes. Furthermore, Nike China has continued to maximise its use of recycled and reclaimed materials, and over 80% of all solid waste generated in production was reused in the manufacturing process for other products and applications in the financial year 2006. All of these efforts towards environmentally friendly production have also resulting in cost decreases and improvements to profits for the enterprise, which has helped Nike to increase its competitiveness in the Chinese market (AmChamChina, n.d.).

Furthermore, joining the WTO (World Trade Organization) has exerted more environmental pressures on Chinese enterprises, which has led their supply chains to become more complex and diverse. Chinese manufacturing exporters who have become a link within the supply chains of their overseas customers have had to green their businesses in order to meet the environmentally challenging requirements. For example, Fortune 500 enterprises like IBM and Xerox have stipulated the need for their Chinese suppliers to implement environmental management systems for ISO 14001, while Ford, GM and Toyota require their Chinese suppliers to have ISO 14001 certifications (GEMI, 2001). As a result, an

increasing number of Chinese enterprises are putting strategies in place to improve their supply chain systems for the purpose of cutting costs, increasing productivity and improving their environmental image.

While large enterprises have been developing the capabilities needed to achieve a triple bottom line, small and medium-sized enterprises (SMEs) are often believed to lack the knowledge, expertise, skills, finances and human resources to make the desired changes (Lee, 2008). However, given the huge number of SMEs around the world, there is a growing need to consider the business case for their sustainability. This will be discussed in the next section.

1.1.3 SMEs

Definition of an SME

SMEs play a significant part in the economic prosperity of many countries (Kailer and Scheff, 1999; Barry and Milner, 2002; Rao et al., 2003; Palmer, 2005). Although SMEs and their developments are clearly important to a country's economy, however, the definitions of SMEs vary (Do et al., 2006; Eikebrokk and Olsen, 2007; Mohibul and Alejandra, 2008). Hillary (2000) categorises the definitions of SMEs into two groups: operational definitions and theoretical definitions. Operational definitions are used for working purposes, to provide a cut-off level in the awarding of subsidies or to develop special policies, for instance, while theoretical ones are employed to characterise the different sectors (see Table 1.1 and Table 1.2), but have the limitation of being incapable of taking the undeniable importance of the sector's diversity into account. According to Hillary (2000), the definitions of SMEs are very blunt instruments when understanding the variety of businesses in the sector.

Table 1.1 Selected operational definitions of SMEs

Function of definition	Maximum no. of employee	Turnover (ECU[a] million)	Maximum balance sheet (ECU million)	Other criteria for information	Source
Statistics on SMEs					European Commission Directorate General XXIII and Organization for Economic Cooperation and Development (OECD)'s Working Body for SMEs
Micro-sized enterprises	1-9				
Small-sized enterprises	10-99				
Medium-sized enterprises	100-499				
Large-sized enterprises	⩾500				
State financial aid to SMEs				Maximum 25% of capital to be owned by big enterprise (with exception)	European Commission Directorate General XXIII
Small-sized enterprises	50	5	2		
Medium-sized enterprises	250	20	20		
Annual account					European Commission Directorate General XXIII
Small-sized enterprises	50	4(5)	2(2.5)		
Medium-sized enterprises	250	16(20)	8(10)		
Government grants					Department of Trade and Industry (DTI)
Small-sized enterprises	100				
Medium-sized enterprises	250-500				

a. ECU : European Currency Unit

Based on: Hillary (2000)

Table 1.2 Selected theoretical SME definitions

Term/Issue	Definition	
Small and medium-sized enterprises	Enterprises with fewer than 500 employees, whose capital is less than ECU 75 million and of which less than one-third may belong to a larger company (Gondrand, 1992)	
General definition of a small firm	A small firm is an independent business, managed in a personalized way by its owner or part-owners, and with a small market share (Bolton Report 1971)	
More specific definition	Manufacturing	Maximum 200 employees
	Retailing	Turnover up to £50,000 per annum
	Wholesale trades	Turnover up to £200,000 per annum
	Construction	Maximum 25 employees
	Mining/quarrying	Maximum 25 employees
	Motor trades	Turnover up to £100,000 per annum
	Miscellaneous services	Turnover up to £50,000 per annum
	Transport	Maximum 5 vehicles
Update of turnover figures from the Bolton Report to 1983 figures	Update of turnover figures from the Bolton Report to 1983 figures (Sengenberger et al., 1990)	
	Retailing	Turnover up to £315,000 per annum
	Wholesale trades	Turnover up to £1260,000 per annum
	Motor trades	Turnover up to £630,000 per annum
	Miscellaneous services	Turnover up to £315,000 per annum
Best indicator of small enterprise	Major policy decisions are taken by one or two persons who usually own, manage and risk their own money in the business (Clarke, 1972)	
General definition	A small firm is one that has a small share of its market, is managed in a personalised way by its owner or part-owner and not through the medium of an elaborate management structure and which is too small to have access to the capital market for the public issue or placing of securities. A branch of a large company cannot be a small firm, because, although it is a small and may even be independent with regards to decision making, it still has access to capital and technical assistance from the parent company (Bannock, 1981)	
Business format franchising – a form of small business	The franchise not only sells the franchiser's product or service but does so in accordance with precisely laid-down procedures. In return the franchiser provides the franchise with assistance, e.g. training, marketing, management, research and development, in carrying on his/her business; however, like any other small business, the franchisee provides the capital for his/her business, but agrees to run the business in accordance with the franchiser's guidelines (Stanworth et al., 1983)	
Problems with the Bolton Report definition of small firms	If a small firm, in statistical and organizational terms, was the sole supplier of particular goods to a large company, the small firm would have 10% of the market share but would still be considered by many as small. Possibly because the market share of the firm has grown beyond the stage of smallness but the ownership and management are still highly centralised (Chestermann, 1982)	

Based on: Hillary (2000)

In the context of China, 99.7% of all its companies were SMEs by the end of 2007, and these accounted for over 68% of the country's export (Lauren, 2009). According to Jun Ma (2012), Deputy Director of the state council development research center for enterprise, SMEs currently account for over 98% of the total enterprises, contributing to 85% of the new job opportunities in the domestic market, and accounting for 75% of the new product development, 65% of invention patents, 60% of GDP and 50% of tax revenue in China. However, according to Li (2011), the rapid development of SMEs in China has resulted in the difficulty in obtaining these data. Consequently, in recent years, there is no accurate statistic in terms of total numbers of SMEs, population of employees, annual profits, geographic distributions, industrial distributions, and so on. There are numerous new SMEs established, registered or unregistered, and there are also numerous shut down everyday. Therefore, this point might explain why only earlier data have been obtained (China Statistics Press, 1999-2003; China Statistics Press, 2006; China International Association of Small and Medium Enterprise, 2006) while with absence of recent statistics.

In addition, according to Hall (2001), the definition of SMEs in China is fairly complicated because it has been developed based on several factors, such as industry category, number of employees, sales and assets, and it has changed several times over the past 60 years. Moreover, Chinese SMEs experienced a series of radical and thorough reforms to restructure their ownership in the last decade of the twentieth century (Sun, 2000). The Chinese government released a standardised definition of Chinese SMEs in 2003 so as to identify official criteria for SMEs, and these standards have been applied until recently. On 4 July 2011, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Finance and the State Statistics Bureau of the Chinese government formally introduced "The Provision of Small and Medium Sized Enterprises Standard" and a standard definition of Chinese SMEs (Lan, 2011), as shown in Table 1.3.

Table 1.3 SME definitions in China

Type	Small			Medium		
	Employees	Annual Sales (million RMB)	Total Assets (million RMB)	Employees	Annual Sales (million RMB)	Total Assets (million RMB)
Manufacturing	≤300	≤30	≤40	300-2000	30-300	40-400
Building	≤600	≤30	≤40	600-3000	30-300	40-400
Wholesale	≤100	≤10		100-500	10-150	
Retail	≤100	≤30		100-200	30-300	
Transportation	≤500	≤30		500-3000	30-300	
Mail	≤400	≤30		400-3000	30-300	
Lodging and Catering	≤400	≤30		400-800	30-150	

Based on: State Economic and Trade Commission (2011)

Therefore, the sample selected for this study will include Chinese manufacturing enterprises that have fewer than 2,000 employees, annual sales of less than 300 million RMB, and total assets of less than 400 million RMB.

Understanding the development of SMEs

It is hard to identify any studies that describe or introduce the general development of SMEs globally. This may be because SMEs are not regarded as a problem or as having high potential, considering the differing political moods and theoretical positions on SMEs around the world (Ayyagari, et al., 2007). However, their contributions towards economic growth and employment are clear.

In fact, Pillath et al. (2002) offer some explanation for the complexity of the development of SMEs. Firstly, SMEs experience great difficulties in development because their limited size gives them less access to resources and knowledge, which in turn leads to insufficient finances and innovation opportunities. Secondly, however, their small size gives them greater flexibility and entrepreneurial dynamics, which provides more opportunities for them in the market. The first, pessimistic, view of SMEs may result in them receiving special focus and support from governments or educational institutions, for instance; the second, optimistic, perspective indicates

the advantages SMEs have with respect to market entry and business start-ups. Thus, SMEs are believed to play an extremely important role in promoting the economic development of a country, and their contributions are obvious and salient in terms of increasing GDP and employment. Table 1.4 shows the percentage of SMEs in terms of total employment, and GDP, for a selection of countries.

Table 1.4 Percentage of SMEs in terms of total employment and GDP

Nation	GDP/CAP (USD)	SME250 (%)	SMEOFF (%)	SME_GDP (%)
Argentina	7,483.77	70.18	70.18	21.80
Australia	20,930.40		50.60	15.30
Austria	29,619.35	66.10	66.10	10.45
Azerbaijan	558.29	5.34	5.34	47.20
Canada	19,946.50		58.58	11.75
Chile	4,476.31	86.00	86.50	27.60
Colombia	2,289.73	67.20	67.20	30.05
Czech Republic	5,015.42	64.25	64.25	12.35
Germany	30,239.82	59.50	70.36	12.80
France	27,235.65	67.30	62.67	12.10
Indonesia	963.33		79.20	
Japan	42,520.01	71.70	74.13	11.10
Korea Republic	10,507.69	76.25	78.88	38.00
Mexico	3,390.17	48.48	48.48	38.50
Netherlands	27,395.01	61.22	58.50	12.65
Norway	33,657.02		61.50	11.30
Philippines	1,099.31	66.00	66.00	16.45
Russian Federation	2,614.38	13.03	13.03	34.30
Singapore	22,873.66		44.00	13.00
Sweden	27,736.18	61.30	56.50	13.80
Switzerland	44,716.54		75.25	8.55
Thailand	2,589.83	86.70	86.70	71.00
Taiwan, China	12,474.00	68.60	68.60	16.50
United Kingdom	19,360.55	56.42	56.42	10.40
United States	28,232.07		52.54	12.20
Vietnam	278.36	74.20	74.20	
South Africa	3,922.60		81.53	
Zambia	418.93	36.63	36.63	

Note:

1. **GDP/CAP** is the real GDP per capita in US dollars.

2. **SME250** is the share of the SME sector in the total formal labor force in manufacturing when 250 employees is taken as the cutoff for the definition of an SME.

3. **SMEOFF** is the share of the SME sector in total formal labor force in manufacturing when the official country definition of SMEs is used, with the official country definition varying between 100 and 500 employees.

4. **SME_GDP** is the SME sector's contribution to GDP (The official country definition of SME is used)..

Based on: Ayyagari, et al. (2007)

SMEs in China

Industrial enterprises in China have not arisen as a product of market forces, but rather as a creation of the pre-1979 Soviet-style command economy. They could not be regarded as business organisations at that time, as they were simply factories under the direct supervision of central and local government industrial bureaus. SMEs have been struggling in a market dominated by large state-owned enterprises (SOEs) for a long time, and were initially regarded as a supplement to the state and collective industries. They were forced to build close relations with the local bureaucracy and operate under a high degree of informality because of restrictions on and biases against them in the early days. With the improvement of decentralisation and strong bureaucratic incentives to promote local and regional development, SMEs faced great opportunities for cumulative growth in the 1980s. The number of SMEs soared in China with the development of the socialist market economy; especially after the reform and opening up policy was adopted by the country in the late 1970s (Zhang, 2005).

Several factors may have contributed to the later prosperity of SMEs in China (Chen, 2006). Firstly, rural and urban reforms carried out by central and local governments promoted the fast growth of SMEs. The rural reforms have re-established the family farming system and raised the prices of agricultural products, while the enhanced productivity has provided sufficient initial capital for the establishment of numerous small firms in rural areas. Moreover, the urban reforms have gradually released resources to the market, making it possible for SMEs that were not covered by plans to obtain access to the materials they needed. Secondly, a large market for consumer goods was left unaddressed prior to the 1980s as a result of the heavy industry-oriented development strategy pursued by the nation under the centrally planned economies system, which provided SMEs with a perfect opportunity to fill the gap. Thirdly, China is a country with abundant labour. Increasing involvement in the national and international supply chain, which resulted from opening up to foreign trade, also allowed SMEs to develop by taking advantage of the country's

relatively abundant and cheap labour force.

Due to the increased opportunities for development, the total number of SMEs has been increasing in recent years. Table 1.5 shows the evolution of the SME sector in China over the period between 1999 and 2005, with a steady rise in the overall number. Table 1.6 presents the number of SMEs, and their total assets, contributions to total output value, sales revenues and employment for 2005.

Table 1.5 Number of employees and gross industrial output value of industrial enterprises in China, 1999-2003

	1999		2000		2001		2002		2003	
	Number of employees	Gross industrial output value, current prices	Number of employees	Gross industrial output value, current prices	Number of employees	Gross industrial output value, current prices	Number of employees	Gross industrial output value, current prices	Number of employees	Gross industrial output value, current prices
Size										
Large	7,864	31,582.21	7,983	38,303.21	8,589	44,815.99	8,752	51,128.32	1,984	48,914.24
Medium	14,371	9,857.21	13,741	10,689.81	14,398	18,217.90	14,,571	14,189.19	21,617	47,065.22
Small	139,798	31,267.62	141,161	36,680.64	148,269	38,090.58	158,234	45,458.97	172,591	46,291.76
Total	162,033	72,707.04	162,885	85,673.66	171,256	101,124.47	181,557	110,776.48	196,222	142,271.22

Note: Values are shown in units of 100 million RMB.

Source: China Statistics Press (1999-2003).

Table 1.6 Main economic indicators of industrial enterprises in China, 2005

	Number of employees	Gross industrial output value, current prices	Revenue from principal business	Total profits	Annual average number employed (10,000 persons)
Size					
Large	2,503	95,078.32	6,615.29	6,801.42	1,582.42
Medium	27,271	83,738.56	4087.70	4,210.33	2,216.49
Small	242,061	65,967.36	4092.66	3,790.78	3,097.04
Total	271,835	244,784.24	14,835.65	14,802.53	6,895.95

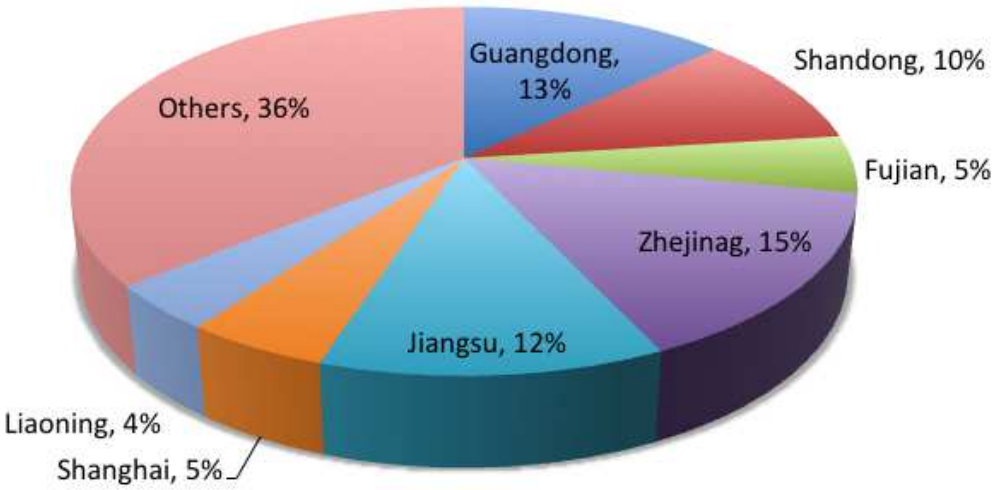
Note: Values are shown in units of 100 million RMB.

Source: China Statistics Press (2006).

It is worth mentioning that the early stages of development, privately owned SMEs played an active role in absorbing workers that had been laid off or dispersed from both SOEs and urban collective enterprises (Chen, 2006). According to statistics from the Information Office of the State Council (2004), nearly 19 million workers who were laid off from SOEs were re-employed by private SMEs between 1998 and 2003.

The distribution of SMEs in China is highly unequal in terms of provinces or regions around the country. Some regions, notably the three eastern coastal provinces - Guangdong, Jiangsu and Zhejiang, have such a high concentration of SMEs. The next largest concentrations are in Shandong and Shanghai, both of which are also on the eastern coast. The distributions of SMEs by region in 2005 can be seen in Figure 1.1.

Figure 1.1 Distributions of SMEs by region in 2005



Based on: China International Association of Small and Medium Enterprises (2006)

This study focuses on SMEs from the region of Chang Chiang Delta, which mainly covers Zhengjiang, Jiangsu and Shanghai, and contains 32% of all the SMEs in China. The salient prosperity of the SMEs in this area provides the initial research basis for this study.

Recent years have seen an increasing number of policies and programmes to promote the SME sector in China. For example, in June 2002, China introduced the "SME Promotion Law, 2006-2010", which includes measures intended to dismantle institutional barriers that would hinder the development of privately owned SMEs. The legislation also promoted a greater level of scientific and technological innovation, as well as spurring upgrades within SMEs (Chen, 2006).

With the boosting effect of these policies, as well as the increasing opportunities arising from the market at home and abroad, the number of SMEs rose dramatically in China, and is continuing to do so. According to Tian (2010), the number of registered SMEs was 4,942,000 by the end of 2008. Of these, 36.7% were from the manufacturing industrial sector, which is the focus of this study, as explained in the following section.

SMEs within this research

It should be emphasised that the SMEs on which this research project focuses are from the manufacturing industry. Industries are commonly classified into three sectors, including the primary sector, the secondary sector and the tertiary sector. The primary sector of industry includes agriculture, mining and raw material extraction; the secondary sector consists of manufacturing; and the tertiary sector is made up of service provision. Occasionally the quaternary sector of industry is referred to; this consists of intellectual services such as research and development (Tao and Jiang, 1999). The enterprises and SMEs considered in this research are all from the manufacturing industry, which processes physical products and is closely linked with SCM. This will be discussed further in section 2.2.1.

While the policies have contributed to the expansion of SMEs, they still have to face a number of difficulties in their development. For example, their small size may constrain them from achieving economies of scale due to the high cost of inputs like equipment, raw materials, finances and other services. In addition, their size limits their competitiveness against large enterprises (LEs) in the domestic market, and their opportunities to access the global market. They also face difficulties relating to the adoption of organisational functions like training, market intelligence, logistics and technology. As a result, they may be unable to take advantage of market opportunities that require large volumes, homogeneous standards, and regular supply. Furthermore, competition between enterprises now relates less to prices and

more to innovation and upgrades, which require improvements to products, processes, technologies and organisational functions including design, production, logistics, marketing, and so on, which exert great pressures on SMEs as they usually lack the resources to meet these needs effectively. With the increasing concerns about environmental issues and sustainability for industries, whether SMEs can survive and improve under such pressures remains an interesting topic to explore theoretically and practically.

1.1.4 SMEs and GSCM

In fact, as discussed above, many larger businesses have been pioneers in embracing the concept of GSCM, and have been the focus of numerous studies (Henriques and Sadorsky, 1996; Wycherley, 1999; Zhu and Sarkis, 2004; Zhu et al. 2010; De Giovanni and Vinzi, 2012). In contrast, very few studies have been carried out on SMEs. who, due to various constraints, have found that it is significantly difficult to adopt GSCM strategies effectively. Crals and Vereeck (2005) agreed in many respects with Hilton (2000), pointing out that SMEs face a variety of difficulties in taking environmental concerns into consideration in their production processes, including the lack of resources, time, money, capabilities, skills and knowledge, and flexibility. This is probably why there is such a lack of literature internationally on GSCM among SMEs, and also provides an opportunity for the study to contribute to the GSCM knowledge cap with empirical evidences.

It is commonly believed that GSCM has many benefits to an enterprise, large or small, like cost reduction and integration in a participative decision - making process with suppliers which helps enhance environmental innovation (Rao, 2002; Bowen et al., 2002). Furthermore, Duber-Smith (2005) identified ten reasons for a SME to adopt green supply chain such as target marketing, sustainability of resources, lowered costs/ increased efficiency, product differentiation and competitive advantage, competitive and supply chain pressures, adapting to regulation and reducing risk,

brand reputation, return on investment, employee morale, and the ethical imperative. As SMEs are expected to gain numerous benefits from their GSCM development, it is interesting to find out whether they have been recognized by Chinese SMEs as the impetus for GSCM.

It is encouraging to see that large Chinese enterprises, like Guitang Group and Shuanghui Group, have been the focus of investigations regarding GSCM (Zhu and Sarkis, 2004, 2006; Zhu, et al., 2007). However, the situation within Chinese SMEs is unclear. With the integration of the global economy, the formation and development of industry chain as well as industry integration, GSCM within Chinese SMEs had become a very important factor within market competition. Therefore, the question arises as to what actions SMEs in China are taking in terms of GSCM.

It is believed that customers often provide stimuli to improve their SME suppliers within supply chains; thus the capabilities that could enable SMEs to be aligned with the requirements of customers which usually are large buying firms were claimed (Lee and Klassen, 2008). With such capabilities such as assets, technologies, and skills, SMEs are expected to respond in a timely and decisive manner to the various environmental requirements of its customers. There are many multinational enterprises that have effectively implemented GSCM within the Chang Chiang Delta, among which many are listed in the Fortune 500; and a large number of SMEs in this area have been or will become involved in their businesses as suppliers. As a result, such SMEs are or will become links within the supply chain. Therefore, it is necessary to investigate such SMEs within this area in order to identify what problems or restrictions are influencing their development with respect to GSCM, and try to propose some suggestions for them to improve their development.

Table 1.7 summarised the existing literature of green supply chain towards SMEs worldwide from the year 2007 to date, which indicates a research cap for this study in terms of research focus, research sample from different geographic area, research

methodology. For example, some GSCM drivers for SMEs have been discussed; such as the influence from the buyers in terms of environmental requirements and support as customer pressures (Lee, 2008; Lee and Klassen, 2008, Holt and Ghobadian, 2009), government involvement like motivating policies or legislation for GSCM (Lee, 2008), GSC readiness including slack resources and organizational capacities that SMEs have possessed (Lee, 2008) and internal drivers (Studer, et al. 2008; Holt and Ghobadian, 2009). But Studer et al. (2008) argued that the more important effect is the direct and short-term benefits like cost reduction from GSCM rather than other drivers. Further, among the barriers for SMEs with regard to GSCM, resource (Wooi and Zailani, 2010 and suppliers (Mathiyazhagan et al., 2013) were emphasized. There were also GSCM practices have been identified, such as cleaner production, green logistics or reverse logistics (Rao, 2007), and managers' involvement (Clarke-Sather et al., 2011). It is also important to note that different GSCM practices are resulted from different types of industries (Rao, 2007; Chun et al., 2012; Mathiyazhagan et al., 2013). The relationship between GSCM practices improving corporate performances were also proved, including the promotion of corporate image, increase of customer value and loyalty, reduction of customer complaints, product conformity to global standards, and increase of sales revenue, procurement efficiency and competitiveness (Lai et al., 2012); but Lee et al. (2012) claimed the non-statistical significance between the two variables.

Based on the discussion about previous studies on GSCM and GSCM for SMEs, it is clear that this research is novel as no GSCM study has been carried out amongst SMEs in the Chinese context, especially for the specific territory area of Chang Chiang Delta given the significance and importance of SMEs within this area towards the economic development as discussed in the section above; no study has focused the whole picture of GSCM for SMEs within a specific territory, including the pressures (why SMEs should green their supply chains), practices (how SMEs have initiated their GSCM) and performances (what could be brought to SMEs with their GSCM

implementation); no study has adopted a multi-method approach for investigation into SMEs on their GSCM. Thus, the necessity and the importance of this research is emerging.

Table 1.7 Latest existing literature of GSCM for SMEs worldwide (2005-2013)

Researchers	Research focus	Research Methodology	Main findings
Rao (2007)	Cleaner production, greening of inbound/outbound logistics, reverse logistics for SMEs in Philippine	Questionnaire survey (142)	SMEs in Philippine have carried out different phases of green supply chain but in a heterogeneous manner in terms of different industrial sectors.
Lee (2008)	GSCM drivers (buyer influence, government involvement, GSC readiness) for SMEs in Korea	Questionnaire survey (126)	Buyer environmental requirements and support were positively linked to their suppliers' willingness to participate in green supply chain initiatives. The government can play an important role in motivating these suppliers. The more slack resources and organizational capabilities SMEs had, the more willingly they were to participate in those initiatives.
Lee and Klassen (2008)	GSCM capabilities for SMEs in South Korea	Case study (7 SMEs)	Buyers' GSCM initiated which enabled the improvement of suppliers' environmental capability and internal championing of environmental concerns also urged SMEs to acquire resources outside for GSCM; thus, synergistic linkage emerged in supportive buyer-supplier relationships, resource acquisition and capability development
Studer et al. (2008)	GSCM incentives among SMEs in Hong Kong	Interviews (59)	It finds that most existing efforts, such as environmental support programmes and award schemes, do not have a great impact on the environmental and social performance of Hong Kong's SMEs. The majority of SMEs simply cannot be expected to take an active interest in environmental and CSR issues unless it is mandatory. Besides, incentives that promise direct, short-term benefits are likely to have the greatest effect.
Holt and Ghobadian (2009)	GSCM practices and pressures among SME manufacturers in the UK	Questionnaire survey (60)	1) UK SME manufacturers perceived the greatest pressure to improve environmental performance through legislation and internal drivers and the least influential pressures were related to societal drivers and supply chain pressures from individual customers 2) they were focusing on internal, higher risk, descriptive activities, rather than proactive, external engagement processes in terms of GSCM practices
Wooi and Zailani (2010)	GSCM barriers among SMEs in Malaysia	Questionnaire survey (185)	The resources barrier is the key barrier that impedes the adoption of GSCM initiatives among SMEs in Malaysia
Clarke-Sather et al. (2011)	Indicators of sustainability towards SME in the USA	Case study (1)	The SME's managers applied the developed method to create, select, and weight sustainability indicators to help answer a strategic planning decision – where to locate operations and facilities in an expanding supply chain.
Chun et al. (2012)	GSCM awareness towards manufacturing SMEs development in Korea	Questionnaire survey (75)	The findings shown green business practices are affected by types of industry, but not by the awareness of green SCM and current cost reduction activities.
Lai et al. (2012)	GSCM process for textile SMEs in Taiwan	Case study (1)	The result shows that the green supply chain creates external effects including the promotion of corporate image, increase of customer value and loyalty, reduction of customer complaints and product conformity to global standards. It also generates internal effects with the increase of sales revenue, procurement efficiency and competitiveness
Lee et al. (2012)	GSCM practices towards business performances for SMEs in Korea	Questionnaire survey (233)	The most anticipated finding of the study was a direct link between GSCM practice implementation and business performance. However, no statistical significance was found. Instead, significant indirect relationships were found between GSCM practice implementation and business performance through mediating variables of operational efficiency and relational efficiency.
Mathiyazhagan et al. (2013)	GSCM barriers for Indian auto component manufacturing SMEs	Questionnaire survey (10)	The ISM (Interpretive Structural Modeling) approach helped to understand the identified 26 barriers from literature, from which the supplier barrier is the dominant one. The findings also indicated that different Indian auto component manufacturing industries have differing barriers for the implementation of green supply chain management.

1.2 Thesis objective

The objective of this research is to explore the current situation regarding GSCM among manufacturing SMEs in the Chang Chiang River Delta region of China. This research is expected to contribute to the international debate on how sustainability in the supply chain can be achieved in practice at a regional level and among SMEs. More specifically, the research aims to identify what the pressures are for delivering such green activities, and to examine performance as the outcomes of GSCM practices. In this sense, the results of the study will aid in increasing understanding in terms of GSCM in the Chang Chiang Delta region, which is economically advanced with a well-developed manufacturing industry, which sources, manufactures, packages and transports products to other nations and regions worldwide. In particular, the external and internal aspects of implementing GSCM and the implications of GSCM strategy will be explored. This is distinct from earlier studies conducted among LEs, which are more interested in sustainable development and more capable of GSCM implementation. This study examines a wide range of aspects and issues that SMEs might encounter when considering GSCM. The application of theories and concepts regarding environmental management, sustainability, CSR and stakeholder theory is also analysed in terms of GSCM at a regional level, which will help to contribute to the novelty and initiative of this research. Besides the focus on SMEs within Chang Chiang Delta which is one of the most important area in terms of economic development in China, the research sample focus of manufacturing industry, the multi-methods strategy with both qualitative and quantitative data, as well as analytical approaches like ANOVA and factor analysis used in the research project might help to contribute to the current body of knowledge in GSCM.

The primary research questions include the following:

1. How does “green” relate to SCM for SMEs?
2. What are the current pressures of GSCM on SMEs in Chang Chiang Delta
3. What initiatives are SMEs in Chang Chiang Delta using to green their SCM for

sustainability?

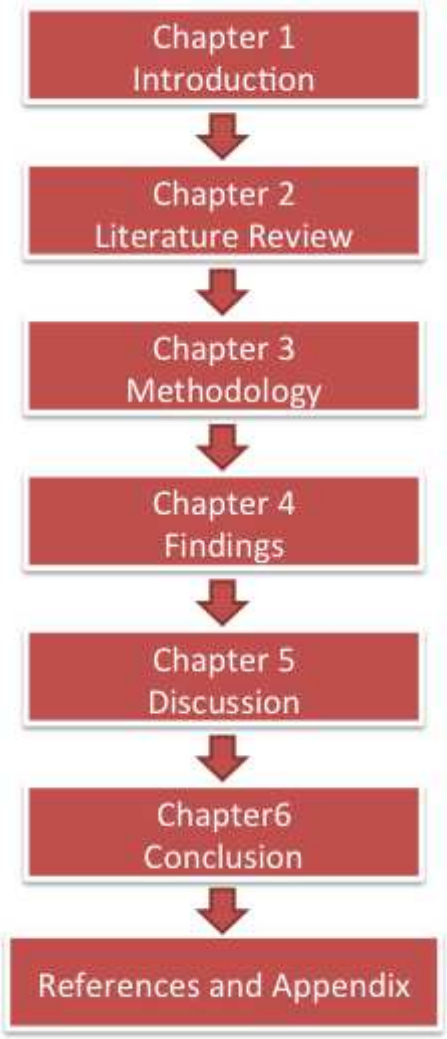
4. How are the GSCM practices used by SMEs in Chang Chiang Delta related to GSCM performance?

The primary research questions outline the conceptual features of SCM. In response to these questions, the core focus of this thesis will be on the manufacturing industries in the Chang Chiang Delta region of China, which contains the triangular-shaped territory of Shanghai, southern Jiangsu Province and northern Zhejiang Province, including the urban cores of five cities – Shanghai, Nanjing, Hangzhou, Suzhou and Ningbo. The Chang Chiang Delta is one of the most important engines of China's economy in terms of economic growth, productivity and per capita income. This research aims to identify the pressures of GSCM for SMEs in Chang Chiang Delta, and examine the GSCM practices of SMEs in this area; it will then evaluate the effectiveness of these GSCM implementations among SMEs in this area by looking at their performance improvements. In addition, some recommendations will be proposed for SMEs that are striving for sustainability in the Chang Chiang Delta region.

1.3 Thesis structure

This thesis is organized into six chapters. Its structure is shown in Figure 1.2.

Figure 1.2 Thesis structure



The current introductory section has presented the emergence of GSCM worldwide, and briefly introduced examples of GSCM initiatives from large/multinational enterprises in order to provide a general sense of GSCM. The development of GSCM in China has also been presented, with reference to the major contributing factors which can explain development, including the increased FDI to the country; the country's economic development, which has seen increasing domestic demand; the environmental contamination caused by the economic improvements and resulting in the implementation of government policies concerning environmental protection, and increased involvement in the global economic supply chain since China's entry to the WTO. It has been suggested that Chinese SMEs are facing higher levels of GSCM

pressures due to their collaborations with multinational or domestic LEs. SMEs have also been clearly defined in this chapter.

Chapter 2 consists of a literature review, which addresses the fact that SCM is viewed as a mechanism by which to respond to sustainable management, with all its environmental, economic and social concerns, and thus enhance corporate performance in terms of both profitability and sustainability. The chapter reviews the theories that form the conceptual framework under which to study GSCM, including corporate social responsibility (CSR), stakeholder theory, industrial ecology (IE), life cycle assessment (LCA) and design for environment (DfE). The pressures, practices and performances of GSCM are outlined and reviewed as the key facets and research footholds from which to formulate the research questions for this study, with specific reference to manufacturing SMEs. From here, hypotheses are proposed.

Chapter 3 introduces the research philosophy employed in this study. In order to achieve the research goals, a research methodology consisting of both quantitative and qualitative methods is used, as outlined in this chapter. In addition, the chapter details the guidelines and preparation used for the data collection, which includes a pilot test conducted before the main study of questionnaire survey in order to identify any need to adjust the questions asked. The analytical techniques applied for this research are then highlighted. In addition, the chapter explains that a case study a pharmaceutical SME is investigated and discussed in more detail with respect to GSCM, which forms the qualitative data. The remainder of the chapter reflects on the research methodology chosen, including triangulation, reliability, validity, representativeness and ethical issues. The proposed timing for the main activities of this research is also outlined in the chapter.

Chapter 4 comprises the primary data and qualitative analysis sections of the thesis. First, the data are analysed by calculating the means and standard deviations and using factor analysis, Pearson’s correlation and regression, and summarising the

findings and results of the online questionnaire survey by exploring the pressures, practices and performances of GSCM among Chinese manufacturing SMEs in the region of Chang Chiang Delta. The case study is then conducted; this considers a medium-sized pharmaceutical enterprise in terms of GSCM, and demonstrates the real status quo of GSCM development and deficiencies in China in the context of an operational SME.

Chapter 5 discusses and analyses the main findings of both the questionnaire survey and the case study presented in the previous chapter in order to answer the research questions. In addition to conducting general discussions on GSCM pressures, practices and performances, a new model is proposed based on the findings and discussions by which manufacturing SMEs an efficiently adopt GSCM for sustainability. In this way, the thesis aims to provide a useful strategy regarding GSCM for SMEs in practice in order to fill the research gap.

Finally, Chapter 6 concludes the research findings and the activities undertaken throughout the thesis. This study is significant in setting the research context for the region of Chang Chiang Delta, which has been regarded as one of the world's factories with the prosperity of manufacturing and SMEs. The integration of quantitative and qualitative data leads to useful contributions regarding SCM with respect to sustainable management. Implications arising from achieving sustainability through the supply chain are discussed, the limitations of the research are indicated, and the directions of future research are highlighted.

2. Literature Review

2.1 Introduction

The previous chapter outlined the structure of this thesis. In this chapter, section 2.2 discusses the green development of SCM, and clarifies SCM theory and how it links to sustainability for concrete GSCM, which is helpful with respect to answering the first research question of this study (How does the broad concept of green development relate to SCM?). The purpose of the literature review is to identify the knowledge gap for which further research is required. Though an extensive literature review on CSR is normally encouraged, an initial project boundary linking CSR to this study will be discussed in section 2.3.

Next, section 2.4 discusses stakeholder theory and its applications to this research project, followed by a discussion of the GSCM pressures induced under this theory in section 2.5. In section 2.6, the theory of industrial ecology is covered, with emphasis on the two main tools employed in this study: DfE and LCA. The GSCM practices and performances examined in this research are further discussed in section 2.7 and section 2.8, which provides a linkage to both DfE and LCA. Section 2.9 seeks to explain the relationships between these GSCM practices and performances, and existing evidence from other researchers. In section 2.10, a new research framework of GSCM is established in order to answer the first research question of this project. Section 2.11 provides a discussion and a summary of the research hypotheses, and summarises the chapter itself.

2.2 GSCM

The process of “greening” a supply chain involves adopting sustainable management into an enterprise’s SCM in order to improve its environmental, economic and social performances and to achieve sustainability in the long run. Therefore, a study of

GSCM should begin with an investigation into the relationship between sustainability and SCM.

2.2.1 SCM

SCM is believed to be a promising area through which to achieve sustainability. According to Wycherley (1999), businesses attempt to lower their negative environmental and social impacts through SCM.

Definitions

The term "supply chain management" was first introduced by Oliver and Webber in the early 1980s (Delfmann and Albers, 2000). Different academics view the term from a range of orientations, however, and there is little consistency in terms of the understanding and use of the concept – SCM has been variously referred to as an approach, concept, perspective, philosophy, technique and so on. However, Croom et al. (2000) claimed that although there is increasing research interest in SCM, much of the work has been done as empirical studies, such as field studies or case studies. They emphasised that more importance should be attached to the development of SCM theory.

The definition of SCM also has yet to be standardised worldwide. It has been pointed out that the most important reasons for the lack of a specific definition may be "the multidisciplinary origin and evolution of the concept" (Croom, et al, 2000). Indeed, there are dozens of SCM definitions can be found from a large amount of literature. Although they vary from each other due to different focuses, they often overlap for some parts.

The Council of SCM Professionals is the world's leading source for the supply chain professions; the organisation defines SCM as follows (CSCMP, n.d.):

> Supply chain management encompasses the planning and management of all

activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.

Berry et al. (1994, pp.20) provide the following definition:

> Supply chain management aims at building trust, exchanging information on market needs, developing new products and reducing the supplier base to a particular OEM (original equipment manufacturer) so as to release management resources for developing meaningful, long term relationship.

Moreover, according to Bowersox et al. (2002, pp.5):

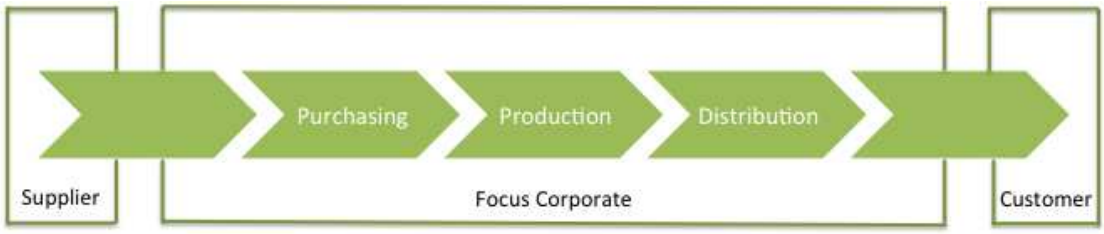
> Supply chain management consists of firms collaborating to leverage strategic positioning and to improve operating efficiency. For each firm involved, the supply chain relationship reflects strategic choice. A supply chain strategy is a channel arrangement based on acknowledged dependency and relationship management. Supply chain operations require managerial processes that span across functional areas within individual firms and link trading partners and customers across organizational boundaries.

Although each of these definitions has a different focus (CSCMP's definition emphasises the tangible material flow through the "chain" for demand and supply; Berry et al. focus on the relationship between the links – i.e. companies – within the "chain"; while Bowersox et al. pay much attention on the strategy and the operational choices when the "chain" works), they share at least one thing in common; they value the external environment of a company.

Paradigms

The above are only three examples of the SCM definitions, and it is clear that they share something in common and simultaneously have a different emphasis. Actually, according to Delfmann and Albers (2000), Bechtel and Jayaram (1997) identified the four definitive paradigms of SCM in terms emphasis. These include: the functional chain awareness school (Houlihan, 1988), the linkage/logistics school (Turner, 1993), the information school (Johannsson 1994) and the integration/process school (Cooper et al., 1997) (Figure 2.1, 2.2, 2.3 and 2.4). Each of these paradigms focuses on a different direction, and consequently could be adapted to different situations.

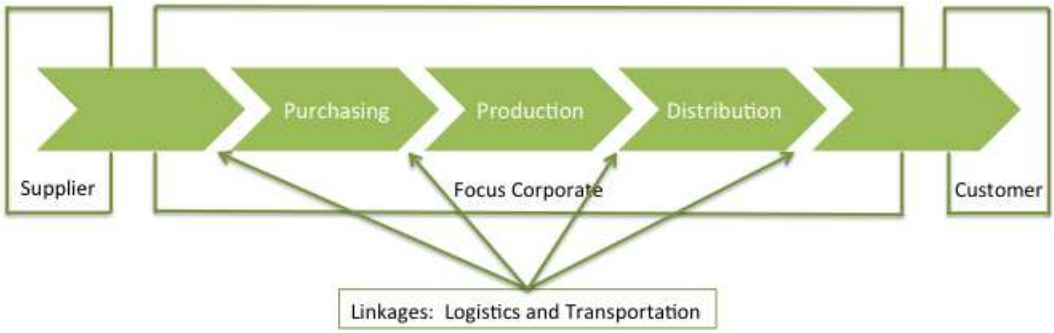
Figure 2.1 Houlihan's Functional Chain Awareness School



Based on: Delfmann and Albers (2000)

Houlihan (1988) defines SCM as managing the flow of goods from supplier to manufacturer and distributor, and then to the end user. This model emphasises the flow of materials flow through the chain and argues that adding value to a product is achieved by different actors and fuctions from the very beginning to the end of the chain.

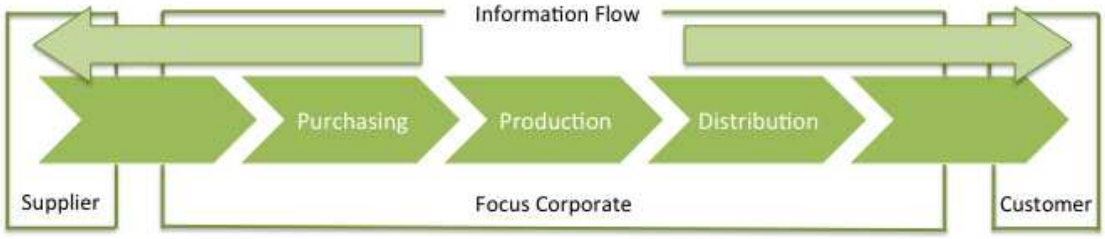
Figure 2.2 Turner's Linkage/Logistics School



Based on: Delfmann and Albers (2000)

Here, SCM is defined as a “technique” by which to monitor all the links of the chain from the supplier to the ultimate customer through different levels of the manufacturing, warehousing and distribution processes (Turner, 1993). The model emphasises gaining competitive advantages from excellent linkage management between each functional area during the flow of goods.

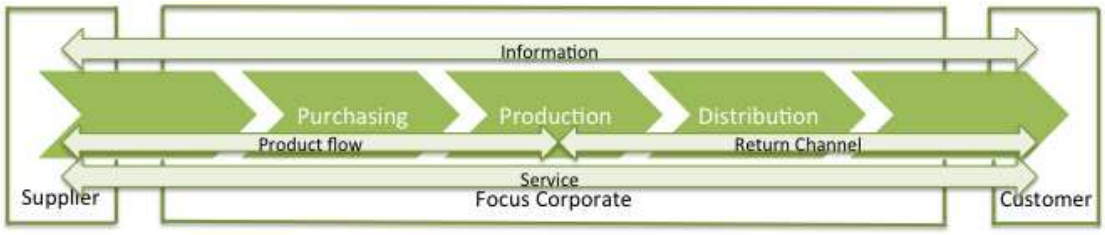
Figure 2.3 Johannsson's Information School



Based on: Delfmann and Albers (2000)

Besides the goods flow in the supply chain, SCM is defined as the flow of information through all the participative parts of the chain and all the parts are expected to be appropriately informed (Johannsson, 1994). However, this kind of information flow cannot be confined to one direction as in the case of the goods flow; it should also move in the opposite direction. Thus, un-directional or bi-directional flows of information are required through the supply chain.

Figure 2.4 Cooper, Lambert and Pagh's Integration/Process School



Based on: Delfmann and Albers (2000)

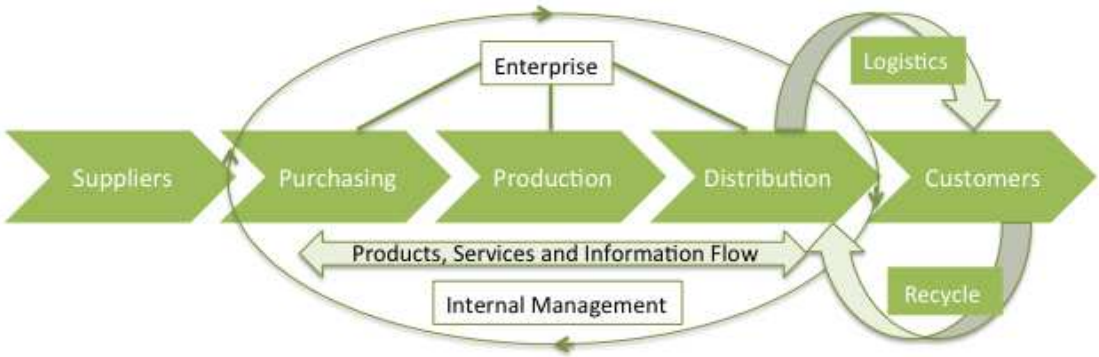
In the integration/process school, SCM is defined as the integration of all the business processes through the supply chain, which horizontally breaks the blocks

between linkages to enable the flow of goods and information. It advocates the products, services and information provided to the end users through the original suppliers which can help to add value for customers and other stakeholders (Cooper et al., 1997).

Conception of SCM in this study

The focus of this research is on how SMEs employ the concept of sustainability to green their SCM through a range of important activities across the whole supply chain; therefore, the integration/process school of SCM is adopted in the research. The SCM framework used in this study is shown in Figure 2.5. It can be defined as the integration activities and processes that take place among the network of all facilities across the whole chain to transform raw materials into final products, to deliver these products to customers, and then to recycle them.

Figure 2.5 SCM framework of this study

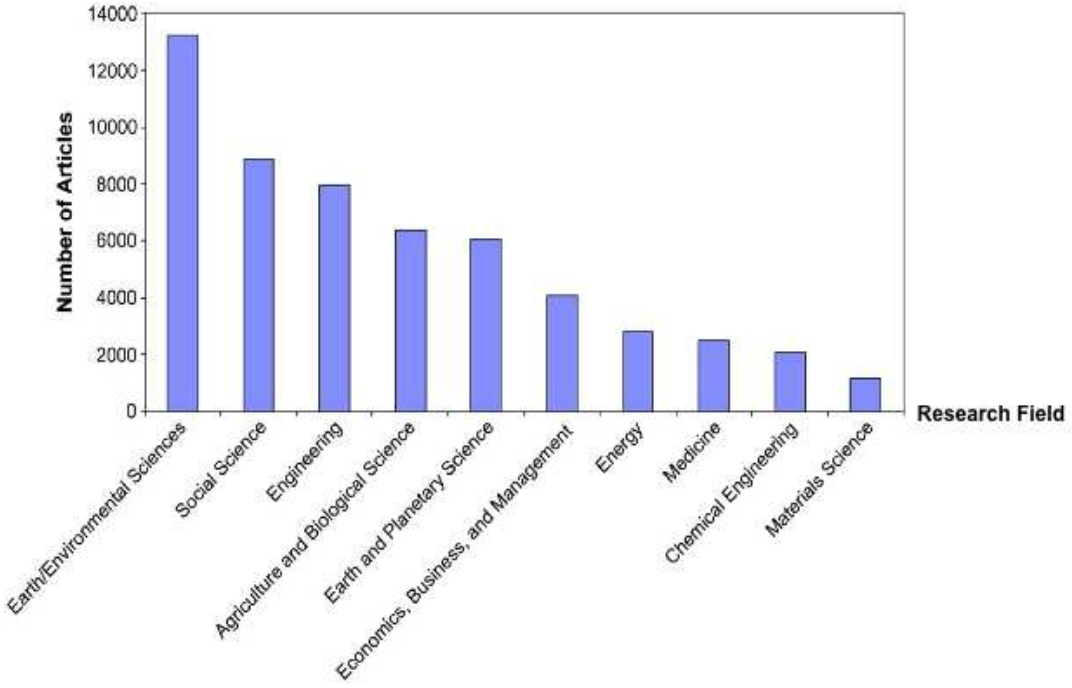


2.2.2 Sustainability

Sustainability has become a common topic of discussion amongst policy makers, journalists, scientists, academics and citizens in many parts of the world and in various research fields. In order to show a sense of the development of sustainability and its interdisciplinary characteristics, Linton et al. (2007) provided a summary of the number of articles in different study fields which discuss sustainability or sustainable management, based on statistics from Scopus from 6 August 2006

(Figure 2.6).

Figure 2.6 Number of articles in different study fields discussing sustainability or sustainable management



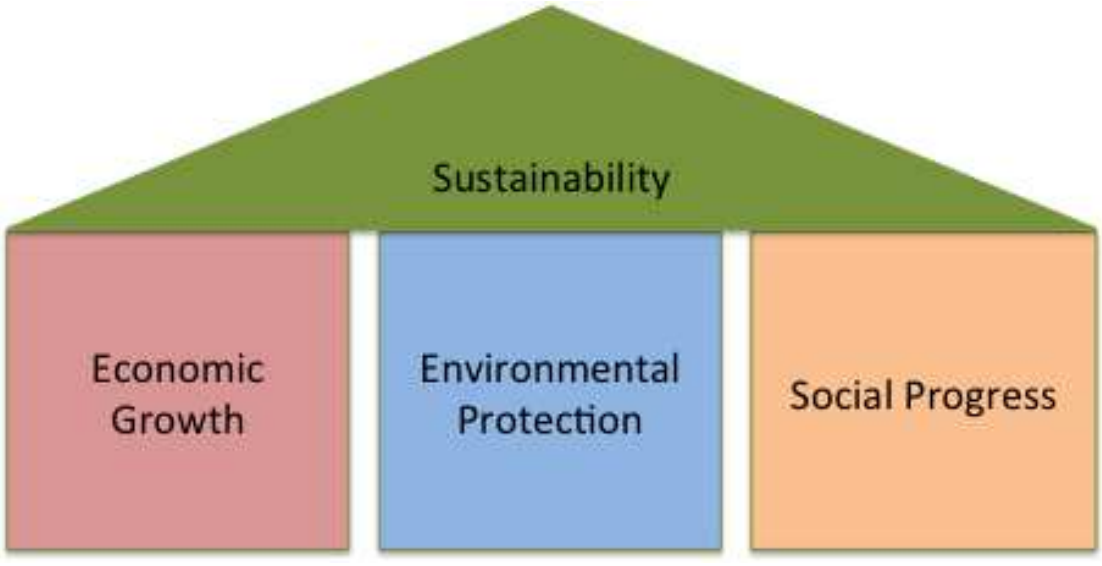
Based on: Linton et al. (2007)

According to Adams (2006), the idea of sustainability dates back more than half a century to the mandate adopted by the International Union for Conservation of Nature (IUCN) in 1969. The conception was then extended as a key topic in the United Nations Conference on the Human Environment in Stockholm in 1972. During the next several decades, the core discussion on the development of sustainability progress took place within the World Conservation Strategy of 1980, the Brundtland Report of 1987 and the United Nations Conference on Environment and Development in Rio in 1992. It is worth noting that involvement from governmental and non-governmental parties, as well as engagement from businesses, also made contributions to the development of sustainability and sustainable management in these decades.

Bagheri and Hjorth (2007) argue that sustainability is an evolutionary process of

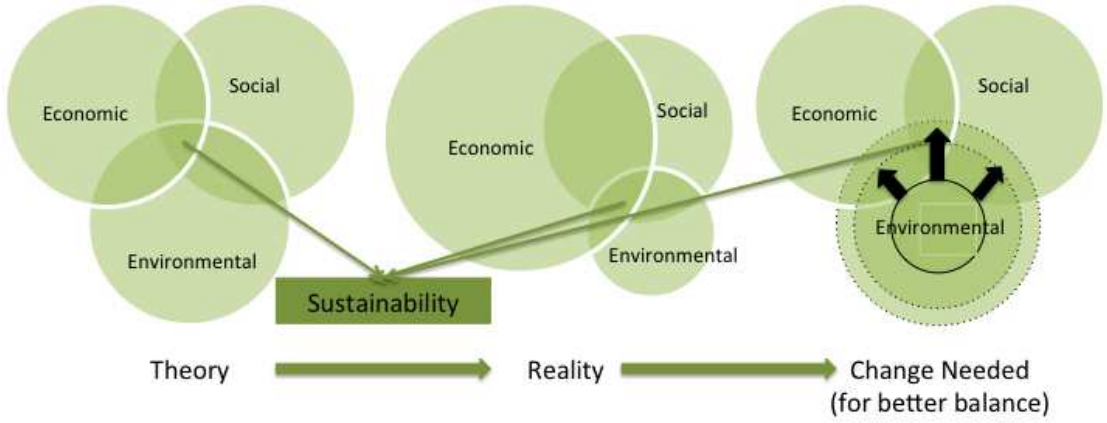
understanding, knowledge and management, rather than a fixed definition. According to Linton et al. (2007), the concept of sustainability has been transmitted from many ancient cultures to more recent economic- and management-related topics, and the number of management studies concerning sustainability dramatically increased between 1990 and 2005, increasing by 30 times. However, the most far-reaching and widely accepted definition of sustainability comes from the famous Brundtland Report, also known as the book of Our Common Future (WCED, 1987). Sustainability is appropriately using resources so as to achieve developments that meet the needs of the present without compromising the ability of future generations to meet their own needs. The vagueness surrounding this definition are obvious but understandable, given that it captures the three central dimensions of sustainability – environmental, economic and social issues. The three dimensions have been defined in different ways, as "pillars" (VDA, 2002) (Figure 2.7), or "overlapping circles" (IUCN, 2005) (Figure 2.8).

Figure 2.7 The three pillars of sustainability



Based on: VDA (2002)

Figure 2.8 The overlapping circles of sustainability



Based on: IUCN, 2005

It is argued in the IUCN (2005) report that attention has been demanded from governments, communities and businesses all over the world to respond to the sustainability challenge to a certain degree. Furthermore, the improvements of environmental legislation by governments, the increasing public awareness of environmental and social concerns, and the growth of CSR within enterprises has also been emphasised as initiatives for sustainability and for a greener globe.

2.2.3 Linking sustainability to supply chains

From SCM to GSCM

Based on the discussions on SCM and sustainability above, it is possible to conclude that if an enterprise decides to pursue sustainability within its supply chain, the flows, operations and activities within the chain will be improved and result in simultaneous economic, environmental and social gains for the enterprise; the supply chain thus becomes green, so the process of integrating sustainability into the supply chain can be called green supply chain management. Actually, Groznik and Erjavec (2012) discussed the difference between green SCM and sustainable SCM (SSCM) as different buzzwords that have been used in a great deal of research in the field. By providing some ten definitions of both GSCM and SSCM, as well as a few examples which are very close to our lives like bicycle and digital reader, they believe

that SSCM addresses the three economic, environmental and social dimensions, while GSCM only emphasises the adoption of environmental issues into SCM. However, many have proved that GSCM can help to improve economic performance by reducing cost via advanced technologies, and that social progress can be made through such innovations as well (Zhu and Sarkis, 2006). Therefore, this study argues that GSCM integrates environmental concerns into the operations of the supply chain of an enterprise, thereby obtaining economic, environmental and social achievements simultaneously because the three dimensions experience interactions without isolation within SCM.

A brief history of GSCM

However, Sarkis et al. (2011) pointed out that the idea of cutting production waste, which is the core issue of GSCM or sustainability nowadays, was first addressed in the literature in the early 20th century, and was not initially proposed for environmental, but for economic reasons, because waste indicates economic loss (Lai and Cheng, 2009). For example, the concept of JIT manufacturing was initially vertically employed by Henry Ford within the automotive supply chain as a best organisational practice, and the integration between JIT and SCM aimed solely to improve operational efficiency and reduce waste at that time (Sarkis et al., 2011).

Like the environmental aspects of manufacturing waste, industrial pollution was not a mainstream topic for direct discussion or investigation among management or economics scholars during the early days. For instance, Pigou (1920) proposed the concerns of industrial pollution as one of the externalities which should be managed in the form of taxes. Early decades also saw philosophical developments within discussions on the intrinsic value of the natural environment (Leopold, 1933). Discussions on environmental issues began to develop in the period that followed, and it is generally accepted that the first milestone in this regard came in the form of Rachel Carson's book *Silent Spring* in 1962 (Sarkis et al., 2011). This has been widely

credited as helping to launch the environmental movement in the United States during the 1960s and 1970s. In it, Carson criticised chemical DDT and its detrimental effects on the environment, particularly on birds and humans; this was believed to facilitate the ban of the pesticide in 1972, as well as stimulating the implementation of other regulations from the US Environmental Protection Agency. Alongside this increasing criticism, especially from those in the industry, a debate regarding regulatory policies to limit economic growth was also occurring (Lytle, 2007). As a result, the topic of the relationship between industries and the environment was picked up, and has since developed into an increasingly mature state by both economists and environmentalists.

Following these early contributions in the field of GSCM, some also highlighted early acknowledgements of industrial metabolism, with pollutions, waste and even global climate change caused by greenhouse gas emissions (Ayres and Kneese, 1969; Ayres, 1978). Schaper (2002) summarised the development of green issues over the past 50 years, as shown in Table 2.1.

Table 2.1 The development of green issues

Time	Development
1960s	Environmental concern emerging from some developed countries
1970s	Government policy initiatives and businesses excluded initially
1980s-1990s	Sustainability acceptance and innovations from senior business managers and entrepreneurs
2000s	Fast growing and more systematical research from scholars

Based on: Schaper (2002)

As far back as early 1990s, the increasing intensity of global competition pressured a number of large multinational enterprises to begin to appreciate the need to work collaboratively with their suppliers and customers throughout the supply chain (Roy and Whelan, 1992). Frankel et al. (2008) also believe that a growing number of enterprises even attempted to adopt more proactive initiatives in their supply chains

in an effort to foster environmental sustainability. Simultaneously, the relationship between SCM and environmental concerns began to attract the attention of more scholars and businessmen, and considerable research was conducted to identify the relationship between green issues and SCM (Schaper, 2002).

Early GSCM studies have a primarily industrial ecological focus (Common and Perrings, 1992; Jelinski et al., 1992). Later investigations are more managerial, and concerned with different perspectives through the supply chain, including socially responsible purchasing (Drumwright, 1994), reverse logistics (Barnes, 1982; Pohlen and Farris, 1992) and green/environmental logistics (Szymankiewicz, 1993; Murphy et al., 1994). Unlike the narrative and conceptual build-up on GSCM, recent research has shown increasing interest from scholars and practitioners in more empirical cases around the world (Zhu et al., 2005; Holt and Ghobadian, 2009; Tseng et al. 2009; Zhu et al. 2010; Luthra et al., 2011).

Definitions of GSCM

With the growing popularity of investigations on GSCM, many scholars began to propose their own definitions. According to Gilbert (2001), supply chain greening involves a series of actions to integrate environmental elements into purchasing decisions and long-term relationships with suppliers of enterprises. Zsidisin and Siferd (2001) also emphasise the environmental concerns in greening a supply chain, defining it as a set of SCM policies, activities and relationships that pay close consideration to the natural environment when an enterprise distributes its resources. In addition, Srivastava (2007) stated that environmental awareness should be integrated into SCM throughout the whole process, from the design and material selection stage of the product up until delivery to the end user, or even to the end-of-life management of the product. Recently, Testa and Iraldo (2010) also claimed that GSCM is an increasingly expanded strategy by which to gain better environmental performance.

The above definitions provide important insights into the environmental focus in a green supply chain. However, given the complexity of interactions among all three dimensions – economy, environment and society – the definition of GSCM used in this study is defined as follows: GSCM is the integration of environmental concerns into the SCM activities of an enterprise with the purpose of achieving economic, environmental and social improvements.

GSCM and sustainability

As discussed above, GSCM is different from SSCM in terms of taking only environmental considerations into the process, rather than all three perspectives. The study agrees with Groznik and Erjavec (2012) on this matter, but emphasises the sustainable improvements/sustainability potentials contributed by GSCM (Figure 2.9).

Figure 2.9 Conception of GSCM

This understanding of the relation between GSCM and sustainability is similar to the model for sustainable supply management proposed by Ageron et al. (2012), in which the green supply chain is viewed as one of the blocks from which to build a sustainable supply management system (see Figure 2.10). Greening the supply chain within an enterprise or in a global context is used as a strategy to achieve sustainable development.

Figure 2.10 Relation between GSCM and sustainability

Based on: Ageron et al. (2012)

Therefore, linking sustainability into supply chains does not necessarily involve integrating all economic, environmental and social concerns into SCM, but rather using integrations of environmental issues into SCM to obtain GSCM as an approach for achieving sustainability.

2.3 Corporate social responsibility

CSR is widely credited as a key for sustainability (Málovics, et al. 2008; Ageron et al. 2012); it allows enterprises to integrate social, environmental, and economic concerns into their values and operations with transparency and accountability.

2.3.1 Development of CSR

CSR definitions

CSR was defined as an "obligation" when first introduced by Bowen in 1953. Carroll (1979) agreed with Bowen in this, and conceptualised the obligation into three main

types, including economic obligations (e.g. productivity and economic viability), legal and ethical obligations (e.g. local legislative compliance and acknowledging norms and values) and philanthropic obligations (e.g. proactively giving back to society). He defined CSR as a model that extends corporate performance beyond traditional economic and legal considerations to include ethical and discretionary responsibilities (Carroll, 1999). CSR is also defined as the enterprise's obligation to use its resources in ways that benefit society, through committed participation as a member of society, taking into account society at large, and improving the welfare of society at large independently of direct gains for the company (Kok et al., 2001).

However, the European Union (EU) has been contributing to the global debate on CSR by emphasising its voluntary nature, defining it as "a concept whereby companies decide voluntarily to contribute to a better society and a cleaner environment" (pp.4) and "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis" (pp.6) (European Commission, 2001). This definition clearly points out that enterprises should integrate economic, social and environmental concerns into their business strategies, their management and their operations, going beyond compliance and investing more in human, social and environmental capital. Vogel (2005) considers CSR in the same way by characterising it as practices that improve the workplace and benefit society in ways that go above and beyond what enterprises are legally required to do. Moreover, he highlights the potential of CSR for individuals by enabling "citizens to both express their values and possibly influence corporate practices, by 'voting' their preferences through what they purchase, whom they are willing to work for, and where they invest" (Vogel, 2005, pp. 3-4). Thus, CSR is not only a demand for enterprises, but is also relevant to consumers and the public.

The definition of CSR used in this study is illustrated in Figure 2.11 based on the understanding of definitions above, and the history of CSR development will be

discussed in the following section.

Figure 2.11 CSR conception

Introduction of CSR

The term CSR was proposed in the early 1950s when Bowen (1953) characterised it as the obligation to comply with policies, to make decisions and to follow lines of actions in conformity with the objectives and values of our society. The following decade saw the further evolution of the concept (Davis, 1960; Fredrick, 1960; McGuire, 1963; Walton, 1967). It is notable that early scholars including Bowen used "businessmen" in defining or referring to CSR, since Davis (1967) broadened the concept to include enterprises as legal entities. From then on, the word "businessmen" referred to not only the owner of an enterprise but also the managerial power of the enterprise, thus will excavate the cost of every socially personal commitment. However, the practice of attributing cost is not as easy as it seems in theory. Faick and Heblich (2007) provide an example of a manager-led enterprise to explain the complexity of identifying commitment and the cost of the "obligation" in terms of CSR. As the legal representatives in a manager-led enterprise, the managers would take social commitment actions in their role as agents of the principals, without undertaking the costs of those social conducts.

CSR opposed

In 1970, Milton Friedman, a Nobel Prize winner, rejected the theory of CSR altogether. Friedman (1970) pointed out that managers are obliged by contract to shareholders in a free economic system, and that their fundamental task is to maximise the value and profit of the enterprise. Therefore, managers can distribute resources for the best possible use (from their perspectives), and efficient application and their actions are only constrained by legal economic rules. Commitments to general social interests that go beyond the basic guidelines are in breach of this postulate of maximising gains; so such commitments should not be adhered to. However, Friedman was not against working towards the betterment of society. He did argue that managers should make contributions in this regard as private individuals, at their own expense, not as agents of their principals at their principals' expense. This lead to a belief that businesses were too concerned with their financial results, and making profits seemed to be their sole target without any concerns or obligations to solve the problems of the world (Ackerman, 1975; Reinhardt, 1999).

Actually, there is a precondition for Friedman's assumption; that is, property rights are completely assigned and external effects are ruled out by definition in the best possible legal framework. Thus, enterprises or individuals do not have to assume responsibility and undertake commitment to society because the basic order of society has been designed and assigned to facilitate desirable conduct. Thus, the conclusion is that there is no need for CSR, based on these assumptions. However, the reality is not as straightforward as this.

Persistence of CSR

It is widely acknowledged that a perfect basic order within society is never valid in real life, and a great number of factors hinder the accomplishment of this (Faick and Heblich, 2007). The primary understanding is that institutions are designed to react to dynamic social needs, where a regulation gap results from the delay between a change in social preferences and the corresponding institutionalisation of these.

Accordingly, there is an increasing demand for enterprises to fill this gap, as they are assumed to be able to do it more easily than governing entities can. For example, Kofi Annan (2001), at the American Chamber of Commerce, called for CSR from enterprises by stating, "Business is used to acting decisively and quickly. The same cannot always be said of the community of sovereign States. We need your help – right now".

Moreover, with the development of economic globalisation, enterprises are now confronted with various laws and standards instead of being subject to just one national regulation. There is no world government, no supranational legal framework and no adequate authority to sanction global market disruption to internalise global external effects. Thus, it is necessary for enterprises, especially multinational ones, to contribute to filling this regulation gap with their CSR.

Actually, according to Faick and Heblich (2007), social commitment does not go against Friedman's assumption regarding profit maximisation, because, first, an enterprise can regard its commitment as a long-term investment, and second, all enterprises agree on closing the regulation gap as individual entities can help to make it a collective commitment. Furthermore, the active role of enterprises in ensuring socially desirable conduct helps to make up for the absence of a perfect basic order. Therefore, CSR is necessary. The external effects which cannot be internalised seem to be considered within the theoretical framework of stakeholder theory put forward by Freeman (1984) in his book *Strategic Management: A Stakeholder Approach*, which will be discussed in the next section.

Demand for CSR

The demand for CSR can be driven by three forces, including the demands of business partners, high expectations of the public and increasing awareness of customers.

Firstly, as discussed above, globalisation plays an extremely important role in the demand for CSR. Globalisation has accelerated the social movement and intensified the social relations between business partners; thus, supply chain relationships are becoming increasingly critical in business success. If an enterprise in the chain, usually a large multinational one, implements CSR, the effects will diffuse through the chain and every enterprise in the supply chain will probably be required to display some level of CSR.

The second demand is from the public. Many researchers have confirmed that the public's demands and expectations on businesses are higher than ever before (Ottman, 1998; Welford, 2002; Lewis, 2003). For example, according to Environics (1999), a survey conducted in 26 countries worldwide with more than 25,000 individuals showed that nearly 60% of the participants ranked labour practices, business ethics, responsibility to society at large and environmental impacts as factors which influence their views of enterprises.

The increasing awareness of environmental protection and CSR issues among consumers can be regarded as the third source of demand for CSR. Research show a rising number of consumers taking environmental issues into consideration when making purchasing decisions, with the figures on this rising from 14% of consumers in 1992 to 26% in 1995 (Martinsons, et al. 1997), and to 38% in 2003 (Lam et al. 2003). In addition, the statistics show that the proportion of consumers who value CSR as an important element in making purchasing decisions rose from 24% in 1997 to 38% in 2003 (Dawkins, 2004).

2.3.2 CSR in SCM

Although globalisation helps to enhance achievements across supply chains and contribute to the demand for CSR, CSR issues surrounding SCM have only emerged in

recent years within theoretical developments and empirical studies (Carter and Jennings, 2002a; Roberts, 2003; Seuring et al., 2006; Maloni and Brown, 2006; Klassen and Awaysheh, 2006).

Theoretically, as discussed above, SSCM and GSCM can be simply defined as the management of supply chains in which all three dimensions of sustainability, namely economic, environmental, and social, are taken into account (Seuring et al., 2006). Enterprises can adopt CSR in order to show some accountability for the social and environmental impacts arising along their supply chains, and to integrate ecological and social aspects into their decision making and actions along the chains. Moreover, according to Wolters (2003), the role supply chain relationships plays in the global market is becoming more and more critical in accessing low labour costs and outsource channels from developing countries. As a result, SMEs, as upstream producers in these countries, are required to take responsibility for sustainability as a whole within the supply chains.

Although CSR considerations have recently been taken into account by supply chain practitioners, social and environmental responsibility conceptions in the supply chain are becoming increasingly important (Murphy and Poist, 2002). Empirical studies have identified supply chain CSR categories as: environment, diversity, human rights, philanthropy and safety (Carter and Jennings, 2002a, Carter and Jennings, 2002b). With more concerns about CSR along the supply chain and within SCM, researchers have focused on the issues surrounging environmental risks (Batterman and Amann, 1991; Buck de et al., 1999; Quinn, 1999; Carter and Dresner, 2001; Qio et al., 2001), labour practices (Emmelhainz and Adams, 1999; Rivoli, 2003; Roberts, 2003), procurement (Haynes and Helms, 1991; Razzaque and Hwee, 2002, Carter and Jennings, 2002a, Carter and Jennings, 2002b), and affirmative action purchasing (Carter et al., 2000).

Moreover, enterprises tend to expand their responsibility for products beyond their

sales and delivery locations (Bloemhof-Ruwaard et al., 1995) and ask for CSR or GSCM of their partners across the supply chains (Emmelhainz and Adams, 1999; Kollk and Tudder, 2002). However, it is pointed out that LEs have drawn more attention from researchers to date in terms of CSR, compared to SMEs (Lepoutre and Heene, 2006). Thus, the exploration of relations and potentials between CSR and SMEs is a gradually emerging field.

2.3.3 CSR and SMEs

It is argued by Perrini et al. (2007) that the reason for the insufficient focus on the CSR involvement and contribution of SMEs stems from the fact that SMEs are always deemed to lack the resources to implement CSR effectively. However, an increasing number of studies, papers and reports on CSR in SMEs have suggested that SMEs in particular need to be engaged in CSR due to their rapid but steady development, their remarkable contributions to economic growth and employment, and their irreplaceable role in local communities (European Commission, 2001; Department of Trade and Industry, 2002a, 2002b). For example, a qualitative study carried out by CERFE Group and the European Commission's Directorate-General for Employment and Social Affairs perceived that CSR has a central nature with regard to the structure of an enterprise, and that it in itself is an emerging trend in SMEs (CERFE, 2001).

In addition, researchers are interested in SME characteristics and approaches to CSR (Commission of the European Communities, 2002; Department of Trade and Industry, 2002a; Hemingway and Maclagan, 2004), and the benefits obtained from the adoption of CSR practices (Jenkins, 2006; Murillo and Lozano, 2006; Vives, 2006). Moreover, some authors have summarised the research on CSR in SMEs (Thompson and Smith 1991; Spence, 1999; Lepoutre and Heene, 2006). With regard to the research methodologies, both quantitative empirical research (CERFE, 2001; Department of Trade and Industry, 2002b; Roberts et al., 2006) and qualitative case studies (Castka et al., 2004; Murillo and Lozano, 2006) have been conducted.

It is notable that although the focus on CSR in SMEs has grown wider, the contributions have mainly come from studies in developed countries, with only a few exceptions (e.g. Enderle, 2004; Vives, 2006; Maloni and Brown, 2006; Ciliberti, et al., 2008; Devi and Hemant; 2009; Jarutirasarn and Aiyeku, 2010; Vancheswaran and Gautam, 2011; Fatoki and Chiliya, 2012). But the limited research carried out in developing countries shows that SMEs are scarcely aware of existing standards, such as the environmental protection regulations, for example (Hamann et al., 2005). In addition, the findings from research initiatives in developing countries point out that pressure from supply chain partners, and customers in particular, within developed countries are the main driver for SMEs to adopt a CSR strategy (Hamann et al., 2005; Vives, 2006). However, customers are only one set of stakeholders who exert pressures to SMEs to pursue CSR or sustainability, based on Freeman's stakeholder theory. Thus, the following section will discuss stakeholder theory, and identify the pressures placed on SMEs to employ GSCM.

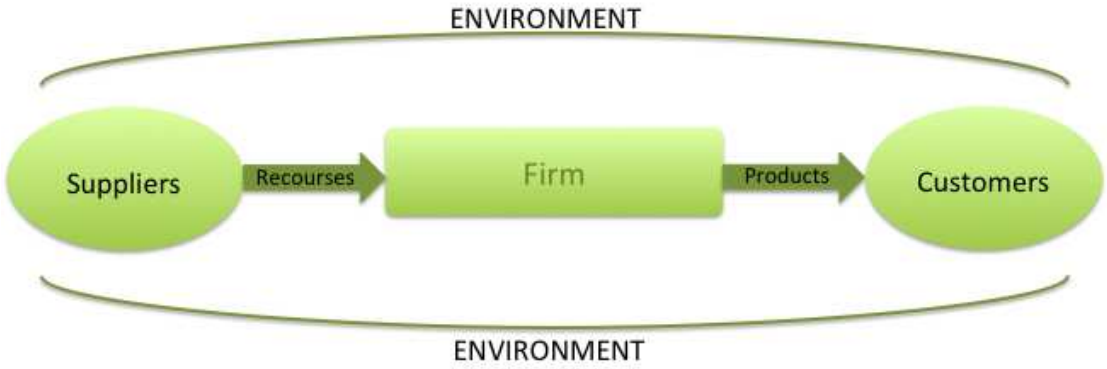
2.4 Stakeholder theory

2.4.1 Freeman's stakeholder theory

Richard Edward Freeman, who is known as the father of stakeholder theory, published his book *Strategic Management: A Stakeholder Approach* in 1984. This book attempted to address the “principle of who or what really counts” for the success of an enterprise (Freeman, 1984, pp.46). In response to the concerns of managers who were being confronted with unprecedented levels of environmental turbulence and change, Freeman (1984) confirmed that the “good old days” of only worrying about products and services were gone, as was a simple form of management that concentrates on efficiency and effectiveness within a product-market framework. Figure 2.12 shows the production view of an enterprise, under which the owner-manager-employee need only think about satisfying suppliers and customers to make a business successful. Figure 2.13 depicts the way

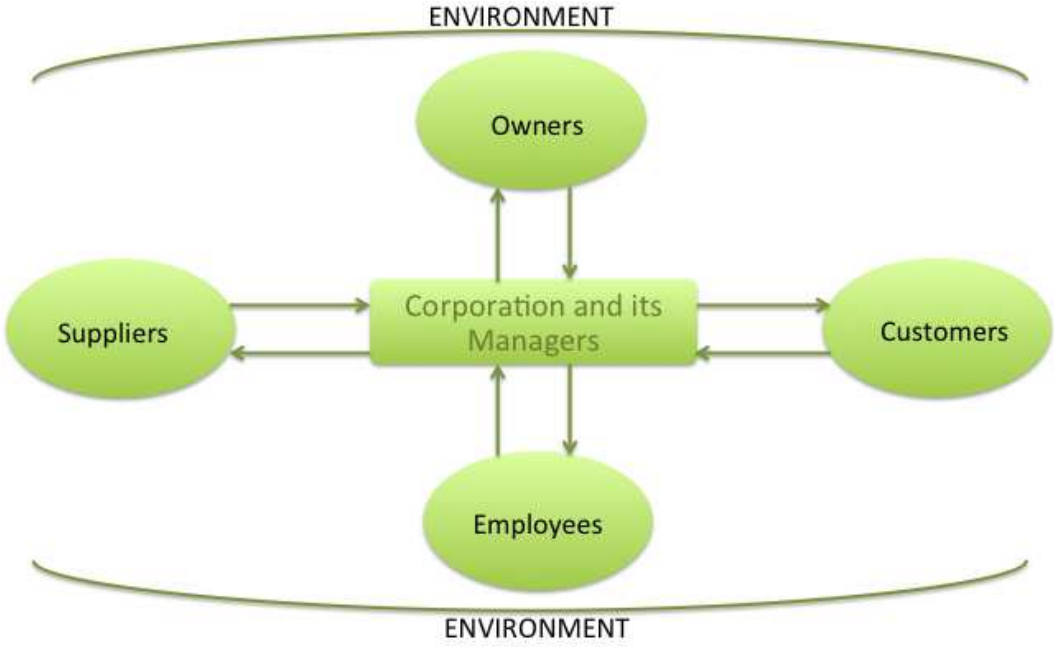
in which managers of an enterprise are expected to simultaneously satisfy the interests of all groups of owners, employees and their unions, suppliers and customers in order to be successful. Freeman (1984) argued that enterprises (managers) were facing a need for a new system of management that would create value for all stakeholders including customers, suppliers, employees, communities and financiers who are shareholders – including banks – in tandem. Furthermore, stakeholders can come from both internal and external sources; this will be discussed later in this section.

Figure 2.12 Production view of an enterprise



Based on: Freeman (1984)

Figure 2.13 Management view of an enterprise



Based on: Freeman (1984)

2.4.2 Definitions of stakeholders

Necessarily, the question of who stakeholders are should be addressed at this point. Freeman (1984) gave two definitions of a stakeholder. Initially, he stated that a stakeholder is a "group of people who can affect or can be affected by the achievement of the organization's objectives" (Freeman, 1984, pp.46); he later updated this to "those groups who are vital to the survival of the organization" (Freeman, 2004, pp.58). However, the first definition of stakeholders was proposed in 1963 by the Stanford Research Institute (SRI), as "those groups without whose support the organization would cease to exist" (quoted in Freeman, 1984, pp. 31). It is believed that Freeman's definitions are more balanced and much broader than that of SRI (Friedman and Miles, 2006), because all individuals, both outside and inside the firm, as well as groups, may consider themselves to be stakeholders of an organisation, without the firm considering them to be such. A number of other stakeholder definitions have also been identified in the literature (Suklev, 1997; Ulhoi, 1997; Walker, 2000). No matter which language these definitions are written in, however, they all indicate that any individual or group that is directly or indirectly impacted by the activities of an enterprise is a stakeholder. In fact, different

enterprises experience different levels of environmental turbulence, and this suggests that identifying who an organisation's stakeholders are should be considered an important task.

2.4.3 Identifying stakeholders

As situations vary for different enterprises, Frooman (1999) identifies three main attributes for enterprises to better satisfy their stakeholders: urgency, legitimacy and power. This takes into account the different levels of attention paid by enterprises to stakeholders. In order to position their stakeholders, enterprises should answer the following questions (Frooman, 1999; Crosbie and Knight, 1995):

- Who are they? (This question concerns the stakeholder attributes)
- What do they want? (This question concerns stakeholders' objectives)
- Have their needs been audited?
- How are they going to try to get their needs met? (This question concerns the stakeholders' means)
- What strategy has been adopted to meet their concerns or to manage a constructive dialogue with them?
- How can their satisfaction be maximised overall?

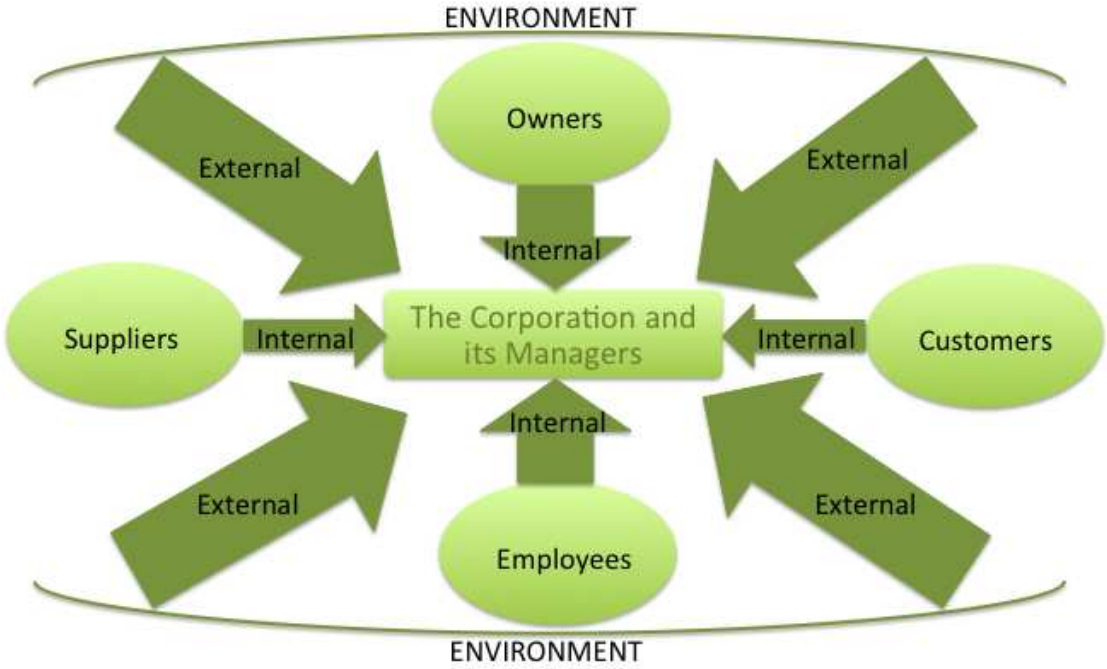
In addition, Mitchell et al. (1997) propose that enterprise should use public affairs and social responsibility approaches to identify their stakeholders, while Ulhoi (1997) suggests considering secondary, as well as primary, stakeholders and related opportunities and threats to identify and prioritise stakeholders.

2.4.4 Internal and external stakeholders

From Freeman's point of view, stakeholders arise from both internal and external changes to the enterprises (1984). Internal stakeholders includes owners, customers, employees and suppliers, while external stakeholders refers to governments, competitors, consumer advocates, environmentalists, special interest groups and

media, which originate in the inconspicuous area labelled “environment” and affect the ability of the enterprise to cope with internal change. Some examples of external changes include the expansion of government activities, an increase in foreign competition, the 1960s environmentalist movement associated with the publication of Rachel Carson’s *Silent Spring* in 1962 (see section 2.2.3) and the formation of the Environmental Protection Acts, the growth of groups concerned with special interests such as gun control or abortion, and also the increasing importance of the media in business. Figure 2.14 shows the internal and external changes that impact an enterprise, indicating a simple framework of stakeholder theory.

Figure 2.14 Internal and external changes view of an enterprise



Based on: Freeman (1984)

Enterprises are deemed to produce externalities which can affect many parties, both internal and external, to the enterprises (Freeman, 1984). Externalities often cause stakeholders to increase pressures on companies to reduce negative impacts and increase positive ones. The capabilities of an enterprise play a critical role in responding to these pressures (Roome and Wijen, 2006). It is also important to note

that it was support by Freeman (1984:12) who argued that all suppliers, owners, customers and employees could be viewed as the internal changes as they had "relatively more comfortable relationships" with the corporation than those external changes which would produce uncertainty and discomfort. But suppliers and customers are regarded as the external sources of pressures in this research project as argued as Handfield et al. (1997), Zhu and Sarkis (2004), and Delmas and Montiel (2007).

Internal stakeholder pressures for environmental concerns

The primary group of internal stakeholders are employees because they are often the initiators and recipients of an enterprise's proactive environmental activities (Hanna et al., 2000; Daily and Huang, 2001). However, the precondition for employee commitment to an enterprise's environmental performance is that they must have support from management. Zhu et al. (2008) argued that support and leadership from top-level managers is vital to ensure understanding of and commitment to environmental issues across the enterprise hierarchy, which further helps to guarantee the adoption of new environmental programmes and update the enterprise's environmental strategy over time. In fact, managerial attitudes and views (Cordano and Frieze, 2000), managerial interpretations (Sharma, 2000), and environmental values and leaders (Egri and Herman, 2000) all influence management decisions regarding environmental activities (Fernandez et al., 2003; Sharma, 2000). Thus, as internal stakeholders, managers as well as employees play a significant role in the adoption of environmental operational practices.

The pressures from employees and managerial stakeholders to proactively implement environmental management practices can create a virtuous cycle which leads to additional pressures from internal stakeholders. According to Reinhardt (1999), if there is a prevalence of environmental concerns throughout an enterprise, it is more likely to recruit talented applicants who have a strong preference to work

in enterprises with proactive environmental management philosophies.

External stakeholder pressures of environmental concerns

Unlike internal stakeholders, external stakeholders do not have control of critical organisational resources (Sharma and Henriques, 2005); however, they do have the capacity to regulate or mobilise public opinions in favour of, or in opposition to, the environmental practices of an enterprise (Freeman, 1984). There are a number of external stakeholder groups, including customers, government regulators, shareholders, and society in general represented by non-governmental organisations (NGOs).

Regulatory parties and government are the most significant external stakeholders when it comes to environmental issues (Freeman, 1984; Backer, 2007), and are typically associated with coercive pressures (Zhu and Sarkis, 2007). Enterprises must comply with environmental regulations, or face the threat of regulators levying legal action, penalties and fines. Failure to yield to regulatory stakeholders will damage the enterprise's public image and customer relations. Enterprises can conduct organisational training of proactive environmental practices as one means by which to alleviate these regulatory threats and risks. In fact, initiatives on proactive environmental practices may help enterprises to form collaborative relationships with government and explore more non-regulatory ways in which government can encourage greater environmental improvements (Darnall et al., 2008) and to provide more opportunities to build trust between enterprises and regulators (Hoffman, 2000). Additionally, Backer (2007) argued that there also exist some less coercive regulatory pressures. For example, some advocating pressures may come in the form of voluntary initiatives for matters such as pollution prevention. Thus, the pressures from regulatory stakeholders should be addressed in this study.

Other external stakeholder pressures come from NGOs or bodies and the community

(Eesley and Lenox, 2006), which can be viewed as public stakeholders. These stakeholders include, but are not limited to, environmental groups, neighbourhood groups, the media and labour unions (Hoffman, 2000). These groups are believed to be able to mobilise public opinion in favour of or against the environmental strategy of an enterprise (Roome and Wijen, 2006; Benn et al., 2009). If the enterprise fails to submit to the pressures of public stakeholders, it risks enduring public protests (Hoffman, 2000). Furthermore, community and public stakeholders may publicise information which could persuade consumers to favour the products of competitors that have demonstrated a stronger regard for the environment. Therefore, it seems that public stakeholders can provide a "social license" for an enterprise to operate in the market, and the pressures originating from those stakeholders also play an important role in influencing the decision-making process for the enterprise (Gunningham et al., 2004).

Supply chain stakeholders, including customers and suppliers, can affect the implementation of environmental practices within an enterprise; especially those stakeholders who require their suppliers to adhere to certain practices for the improvement of their environmental performance (Lee and Klassen, 2008; Zhu and Sarkis, 2004). For instance, customers tend to ask for their suppliers to provide documentary evidence of their compliance with all environmental regulations, such as ISO 14000 (Delmas and Montiel, 2007). Pressures originate from customers because they like to ensure that their purchases meet environmental quality standards and, by doing so, reduce environmental liabilities associated with final product development (Handfield et al., 1997).

There is another group of external stakeholders who are also sometimes regarded as internal ones; these are called shareholders. These shareholders might be the most fundamental stakeholders for an enterprise because they financially invest in the enterprise. In order to yield to the pressures from these shareholders, enterprises should make every effort to maximise their value (Reinhardt et al., 2008). Apparently,

enterprises' environmental concerns have nothing to do with their shareholders; however, proactive environmental practices have been shown to improve financial and production performance for them (Montabon et al., 2007; Zhu and Sarkis, 2004). Furthermore, both Goldstein and Wiest (2007) and Reinhardt (1999) conclude that the reduction of risks and liability from proactive environmental practices contributes to shareholder value. Therefore, shareholder pressures undertaken by enterprises in terms of environmental issues can help to protect investments against environmental liabilities, and even help to improve their financial performance.

2.5 Pressure and drivers for GSCM in SMEs

Based on stakeholder theory, there are several pressures for enterprises, especially SMEs, to employ GSCM or initiate GSCM practices where environmental concerns are integrated into their supply chain operations.

It is notable that a number of authors have studied the drivers, determinants, incentives or pressures of GSCM in order to decipher the difficulties enterprises face when adopting GSCM practices (Huang and Tan, 2010; Huang et al., 2012b). Moreover, the four terms might be interchangeable with regard to different studies before or after and pressures and drivers were used in this research project; pressures are those from external stakeholders and drivers are from internal stakeholders as discussed in previous paragraphs. For example, Henriques and Sadorsky (1996) identified four important environmental stakeholder groups which could exert pressures on enterprises to adopt GSCM practices: regulatory stakeholders, organisational stakeholders, community groups and environmental organisations, and the media. In addition, Zhu and Sarkis (2006) identified several drivers or pressures, including regulations, marketing, suppliers and competitors, and internal factors, for Chinese enterprises to employ GSCM practices. However, according to Lee (2008b), few studies have specially investigated the relationships between SMEs and the pressures of GSCM initiatives which are employed by LEs.

Therefore, it gave the researcher a motivation to investigate into SME suppliers in South Korea is to find out the drivers behind SMEs adoption of green supply chain practices. The study identified three possible drivers, including buyer SCM practices, government involvement and internal readiness of suppliers, and confirmed that all three factors positively facilitate the adoption of GSCM initiatives among South Korean SMEs. Table 2.2 illustrates several existing studies which focus on identifying the driving forces for enterprises to apply GSCM. This research will take into account all the pressures covered by existing studies.

Table 2.2 Existing literature on GSCM pressures or drivers, and their links to this research

Researcher	Paper Title	Drivers/Pressures identified	Drivers/Pressures Referred to in this Research
Henriques and Sadorsky (1996)	*The Determinants of an Environmentally Responsive Firm: An Empirical Approach*	pressures from regulatory stakeholders, organisational stakeholders, community groups and environmental organisations, and the media	regulatory pressures, internal management drivers, public pressures
Zhu and Sarkis (2006)	*An Inter-sectoral Comparison of Green Supply Chain Management in China: Drivers and Practices*	regulations, marketing, suppliers and competitors, and internal factors	regulatory pressures, customer pressures, supplier pressures, internal management drivers
Rao (2007)	*Greening of the Supply Chain: An Empirical Study for SMEs in the Philippine Context*	customer pressure and the desire to avoid potential export limitations	customer pressures
Lee (2008)	*Drivers for the Participation of Small and Medium-sized Suppliers in Green Supply Chain Initiatives*	buyer supply chain management practices, government involvement and internal readiness of the suppliers	customer pressures, regulatory pressures, internal management drivers

Accordingly, the pressures that will be examined in this research are external forces including (1) pressures from regulations, which are self-disciplined and set by governments or accepted organisations; (2) pressures from customers in the supply chain, which include increasing requirements from the downstream industries nationally and internationally, including in relation to imports and exports; (3) pressures from general public, which arise from the growing consciousness of consumers and the rising expectations of society; and (4) pressures from suppliers, which stem from integration and collaboration with these suppliers; and (5) the internal drivers that arise from the internal recognitions, support, cooperation and

initial achievements of GSCM within the enterprise.

2.6 Industrial ecology theory

With the aspiration for sustainability, and pressures from stakeholders in terms of environmental concerns, industrial enterprises require a new conceptual framework for understanding the impacts of industrial systems on the environment, in order to design and promote new industrial systems that are less damaging to the environment. Thus, industrial ecology (IE) takes advantage of the opportunity to identify and then implement strategies to reduce the environmental impacts of products and processes associated with industrial systems, with the ultimate goal of sustainability.

2.6.1 Emergence of IE

IE was proposed when two trains of thought gained a solid foothold with respect to sustainable development (Triandis, 2000). One was that the minimisation of waste and emissions in individual process steps or products would not contribute to an overall reduced environmental impact. The other was that money could be made through a reduction of waste, emissions, and resource utilisation. These two thoughts generated a variety of concepts or theories that activated the debate on sustainable development in industries. One of these theories is IE, which focuses on the renewal of industrial systems.

2.6.2 Definitions of IE

Graedel and Allenby (1995) described IE as a systematic strategy that is deliberately and rationally entrusted with a desirable carrying of capacity, given continued economic, cultural, and technological evolution. The concept puts emphasis on an integrated point of view between an industrial system and its surroundings, without isolation. It is a scientific approach by which enterprises/industries/manufactures can

optimise the material cycle from raw material, to finished material, to components, to product, to salvage product, and to ultimate disposal, and factors which can be optimised include resources, energy, and capital. Moreover, according to Ehrenfeld (2000), IE tries to understand the intricacy of energy and material flows in an industrial system and identify the rules that manage robustness and resiliency in such a system. This attempt leads to the development of instruments for designing more effective technologies and institutional structures for the growth and development of an organisation. Both definitions above show that IE aims to provide the technological and scientific basis for a desirable path towards global sustainability. IE is deliberate, precipitous and potentially quite costly and disastrous (Graedel and Allenby, 1995). Therefore, IE is regarded as the science of sustainability (Allenby, 1999).

Ehrenfeld (1997) maintained that IE can take many forms. For some, it is an emerging, powerful and analytic framework which is capable of capturing the systematic and dynamic characteristics of socio-economic systems. For others, it is a metaphor that leads to a new vocabulary for talking about and making sense of the world, which indicates that it is paradigmatic in nature. Different institutional models of organised social behaviour can be illustrated with or without the adoption of IE (Figure 2.15 and Figure 2.16), using a set of structures resting on a paradigmatic foundation in which dominant beliefs and social norms are contained.

Figure 2.15 Paradigmatic structure of current dominant social system

Based on: Ehrenfeld (1997)

Figure 2.16 Paradigmatic structure of IE-based social system

Based on: Ehrenfeld (1997)

According to Ehrenfeld (1997), under the paradigmatic structure of the current dominant social system (Figure 2.15), goods and services are produced in line with market demand, which can lead to negative impacts on the natural world. Within the paradigmatic structure of the IE-based social system (Figure 2.16), on the other hand, IE can serve as a means by which to improve positive knowledge about the

"socio-technological-natural" system, particularly with respect to material and energy flows. Thus, the natural world is more directly connected with social thinking and action, which are not employed in Figure 2.16. As a matter of fact, Ehrenfeld's (1997) view puts emphasis on the strong and direct connection between society and the natural environment under the IE framework.

Cohen-Rosenthal (2004) argued that IE, at a minimum, is to do the least damage possible on industrial and ecological systems through the optimised circulation of materials and energy. He stressed that the essence of IE involves getting the highest value use from the least dissipation of resources. Based on the hierarchy of material use and reuse in production, Cohen-Rosenthal (2004) further proposes many resource strategies for lower input of materials and energy, such as designs for duality, disassembly, demanufacturing and recycling, energy conversion and so on. According to Giurco et al. (2011), IE emphasises circular resource flows, which suggests that products and by-products should be reused, repaired, recovered, remanufactured or recycled.

Giurco et al. (2011) and El-Haggar (2007) agree with Erkman (1997) that IE explores the possibility of operating in an industrial system as in a natural ecosystem, with more effective distribution of materials, energy, and information flows. Many also recognise this, pointing out that there are lessons regarding the way to run industrial systems, based on the ecology of natural systems (Frosch and Gallopoulos, 1989; Ehrenfeld, 2003; Spiegelman, 2003).

Additionally, Coˆte´ and Cohen-Rosenthal (1995) summarised a number of definitions from the early literature on IE, indicating that there is no standard definition of IE. However, no matter how IE is understood and defined, there are three key aspects that have gained wide acceptance (Erkman, 1997):

1. It is a systemic, comprehensive, integrated view of all the components of the industrial economy and their relations with the biosphere.

2. It emphasises the biophysical substratum of human activities, i.e. the complex patterns of material flows within and outside the industrial system, in contrast with current approaches, which mostly consider the economy in terms of abstract monetary units, or, alternatively, energy flows.
3. It considers technological dynamics, i.e. the long-term evolution (technological trajectories) of clusters of key technologies as a crucial (but not exclusive) element for the transition from the actual unsustainable industrial system to a viable industrial ecosystem.

2.6.3 Goals of IE

Keoleian and Menerey (1994) assume that the primary goal of IE is to promote sustainable development at the global, regional, and local levels and they propose three key categories of goals, including sustainable use of resources, ecological and human health, and environmental equity.

Sustainable use of resources

Industries rely on a steady supply of resources like energy and raw materials, but resources are finite. Human beings have long tried to find alternatives to diminishing resources; however, no one can be sure that substitutes will continue to be found in abundance. Thus, depletion of non-renewable resources and degradation of renewable resources must be minimised in order to supply industries in a long run. As a result, IE is expected to promote the sustainable use of renewable resources, and the minimal use of non-renewable ones.

Ecological and human health

Human beings are only one component in the complex ecosystem, and their behaviours, particularly industrial activities, may result in negative effects to the entire system. In addition, human health depends on the health of the other components of the ecosystem. Therefore, it is important for IE to ensure that

industrial activities do not cause catastrophic disruptions to ecosystems or slowly degrade their structure and function, thereby jeopardising the planet's life support system.

Environmental equity

A primary challenge for sustainability is to achieve inter-generational, as well as inter-societal, equity. Depleting natural resources and degrading ecological health in order to meet short-term objectives can endanger the ability of future generations to meet their needs. Moreover, inter-societal inequities also exist, as evidenced by the large imbalance of resource use between developing and developed countries. For example, developed countries currently use a disproportionate amount of resources in comparison with developing nations. Thus, IE is supposed to balance the inequity, both vertically and horizontally, in terms of inter-generational and inter-societal sustainability.

Sisaye (2012) agrees in several respects with Keoleian and Menerey (1994) on the goals of IE. However, he particularly emphasises human behaviour, which involves cooperation, competition, conflict, and interdependence in managing sustainable development within the IE framework.

2.6.4 Types of IE

Boons and Baas (1997) also addressed the problem of coordinating the activities of different economic actors in an IE system, and argue that the choice of the optimisation domain can give birth to different types of IE, establishing different boundaries.

Product life cycle

From the perspective of product life cycle, the boundary of an industrial ecosystem is drawn around its economic participants, including producers and consumers, who

are connected with a specific product. Drawing the boundary in this way corresponds with the development of a life cycle assessment methodology which attempts to analyse the environmental impact on the system. For example, den Hond and Groenewegen (1993) argued that the automotive product chain has been quite active in this respect. The cooperation between producers and suppliers, as well as between organisations in the postconsumer phase, has developed around the product across the chain.

Material life cycle

The perspective of the material life cycle is similar to the product-oriented viewpoint; the boundary can be drawn around actors dealing with a specific material. The steel, plastics and platinum industries are all good examples (Frosch and Gallopoulosl, 1989).

Geographical area

The geographical area perspective draws a boundary of a kind of enterprises alliance system in terms of resources recycling, which excludes the consumption of ultimate products within the system due to the increasing geographical separation between the production and consumption of those ultimate products. Boons and Baas (1997) introduced an IE system in the Rotterdam industrial area, called the INdustrial EcoSystem project (the "INES" project). This was an initiative to enhance cooperation among enterprises in the Rotterdam area with respect to sharing and reusing each other's waste and effluents in their production processes. The INES project is believed to be effective and efficient in terms of both energy reduction and cost-saving. Other examples of industrial ecosystems are the Bumside Industrial Park in Halifax (Canada), the Industrial Symbiosis approach in Kalundborg (Denmark) and the Green Region programme in the Storstroem area (Boons and Baas, 1997).

Sectoral

Enterprises from the same industry can form an industrial ecosystem because of the similarities in their activities. Therefore, contributions within this type of IE do not come from the input-output relations between enterprises, but from the establishment of common principles in terms of environmental concerns as restrictions. An example of this can be seen in the famous Responsible Care Program within the chemical industry (King and Lenox, 2000).

Miscellaneous

Besides those IE systems/approaches with clear boundaries, there are several examples that are not concerned with a specific boundary due to the bilateral relations developed between enterprises which have found a buyer for a by-product of their production process (Boons and Baas, 1997). Table 2.3 summarises the different types of IE and their respective organisational implications.

Table 2.3 Summary of the different types of IE and the corresponding organisational implications

Industrial ecology types	Organisational implications
Sector	Organisations for coordination are available
	Competitive dependency precludes extensive cooperation
	Limited interrelatedness as aimed for in industrial ecology
Product/material, life cycle	Intermingling of competitive and symbiotic dependency; fewer barriers to cooperation
	Coordinative institutions are not available
	Cognitive/institutionally complex to determine the right actions
Geographical area	Dependency is not automatically present, and must then be based solely on industrial ecology
	Authoritive coordination institutions are available (regional governments and/or industrial organisations)
	Separate consumption/production
	Top-down or interdependent approach
Miscellaneous	Bottom-up approach
	Local optimisation
	No rationale
	Dependency is not automatically present, and must therefore be based solely on industrial ecology

Based on: Boons and Baas (1997)

2.6.5 Barriers to IE

Although IE is believed to have a variety of potentials for sustainability, there are still some barriers with respect to its implementation. Wernick and Ausubel (1997) categorise these barriers into five groups, including technical, market and information, business and financial, and regulatory and regional strategies.

Technical barriers

Technologies are one of the main challenges for the development of an IE approach. Innovations are highly required to prevent waste at source or convert it into money. Moreover, although it is helpful to overcome technical barriers by recovering materials from residues, it is not adequate for stimulating a further improvement in terms of waste use in the economy. In addition, technology cannot assist in reducing costs and increasing quality without supporting regulations and information transparency.

Market and information barriers

Without direct governmental interference, the markets for waste materials will ultimately rise or fall based on their economic vitality, where waste materials can be exchanged like other commodities. However, markets are sophisticated information-processing machines and their strengths lay largely in the richness of the informational feedback available. Thus, it is significantly difficult for IE to develop due to the insufficient accessibility of information and the flexibility in the market.

Business and financial barriers

Individual enterprises play a key role in adopting innovations in order to enhance their environmental performance as basic economic units. Enterprises view environmental issues to varying degrees in their decision-making process. Those with high employee acceptance of environmental concerns strongly affect the adoption of new technologies and practices to improve their environmental performance.

Furthermore, the enterprise's financial ability is a vital consideration when adding environmental costs, such as a budget for disposal treatment, into their accounting systems. Therefore, the enterprise's ideology and financial capacity may play a role in constraining the development of IE and environmental performance.

Regulatory barriers

It is widely believed that environmental regulations can greatly help enterprises to appreciate the environmental dimensions of their operations. They are expected to respond to local, national, and international regulatory structures for potentially improved environmental performance. However, some doubts have been proposed in relation to the fact that agreements on hazardous waste can greatly restrict the transport of wastes across state and national boundaries, which may reduce opportunities for the reuse and recycling of residues (European Commission, 2012).

Regional strategy barriers

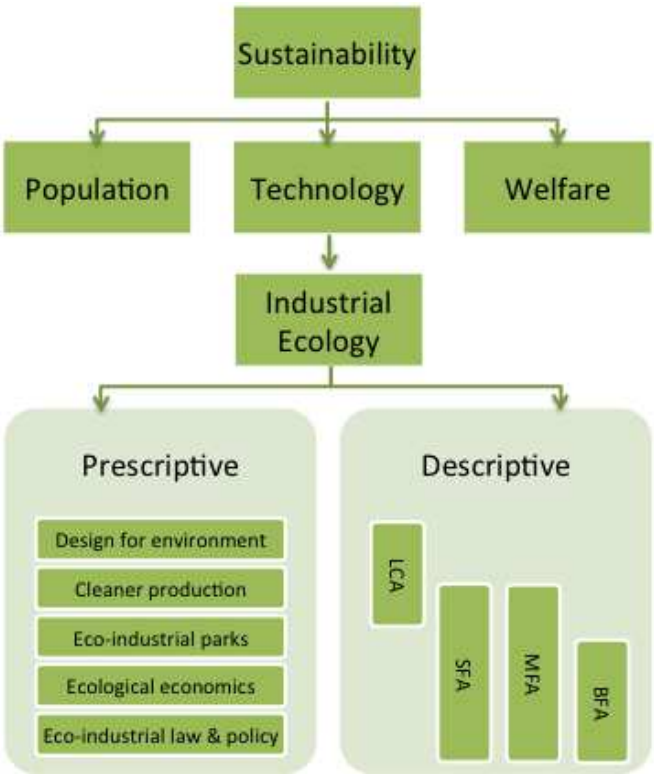
Geographic area may also provide a sensible basis for IE. Enterprises tend to form spatial clusters in specific geographic regions due to the high accessibility to raw materials, convenience in terms of transportation, availability of technical expertise, and closeness to markets. This is particularly true for those enterprises which require large resource inputs and generate extensive waste quantities. Moreover, there is an increasing trend for enterprises to locate close to their principal customers for reasons of cost reduction. Consequently, this regional strategy may have negative impacts in the mobility and availability of materials, leading to limited development within industries.

2.6.6 Tools of IE

To overcome the barriers to IE, some tools have been suggested to help pursue sustainability. Biswas (2012) argues that LCA, Industrial symbiosis, cleaner production strategies, eco-efficiency strategies, green chemistry and biomimicry are some of the

sustainable development solutions within the IE framework. Furthermore, Reuter et al. (2005) characterise the tools of IE into two categories, including prescriptive approaches and descriptive approaches. Prescriptive approaches involve the analysis of the influence of technical, economic, political, regulatory, and social factors on the flow, use, and transformation of resources, available external inputs. Some examples of prescriptive approaches to IE include such as design for environment (DfE), cleaner production, eco-industrial parks, ecological economics and eco-industrial law and policy. Descriptive approaches involve analysis of the flows of materials and energy in industrial and consumer activities, and of the effect of these flows on the environment, and include LCA, substance flow analysis (SFA), material flow analysis (MFA) and bulk flow analysis (BFA). Figure 2.17 shows the categories of IE in the broader framework of sustainability.

Figure 2.17 IE approaches and examples of their applications (tools)



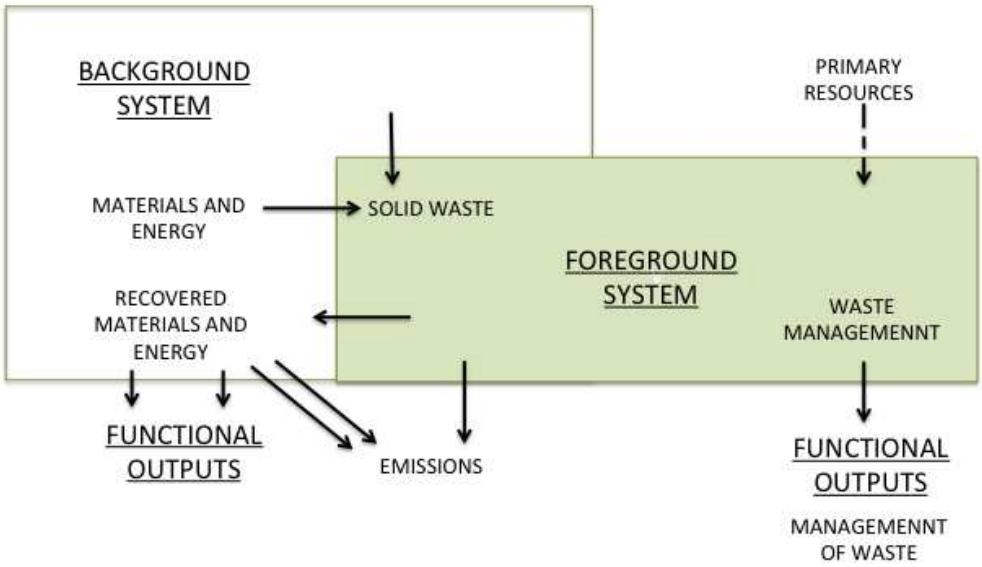
Based on: Reuter et al. (2005)

Both LCA and DfE will be discussed in more detail in the following part of this section.

LCA

LCA is viewed as a method of evaluating the environmental consequences of a product or process "from cradle to grave" (Vigon et al., 1993; Baumann and Tillman, 2004). The Society of Environmental Toxicology and Chemistry (SETAC) defines LCA as a process for evaluating the environmental burdens associated with a product, process, or activity (SETAC, 1993). The US EPA also proposes a definition of LCA, describing it as a tool by which to holistically evaluate the environmental consequences of a product or activity across its entire life (Vigon et al., 1993). A standard approach has been developed to applying LCA to waste management, and this technique has gained wide acceptance (e.g. Weitz et al., 1999; Clift et al., 2000; McDougall et al., 2001), where it is important to apply rigorous methodology and careful system definition to ensure correct accounting with respect to the benefits of recovering materials and energy from waste. The approach is shown schematically in Figure 2.18.

Figure 2.18 System boundaries for application of LCA to waste management



Based on: Clift et al. (2000)

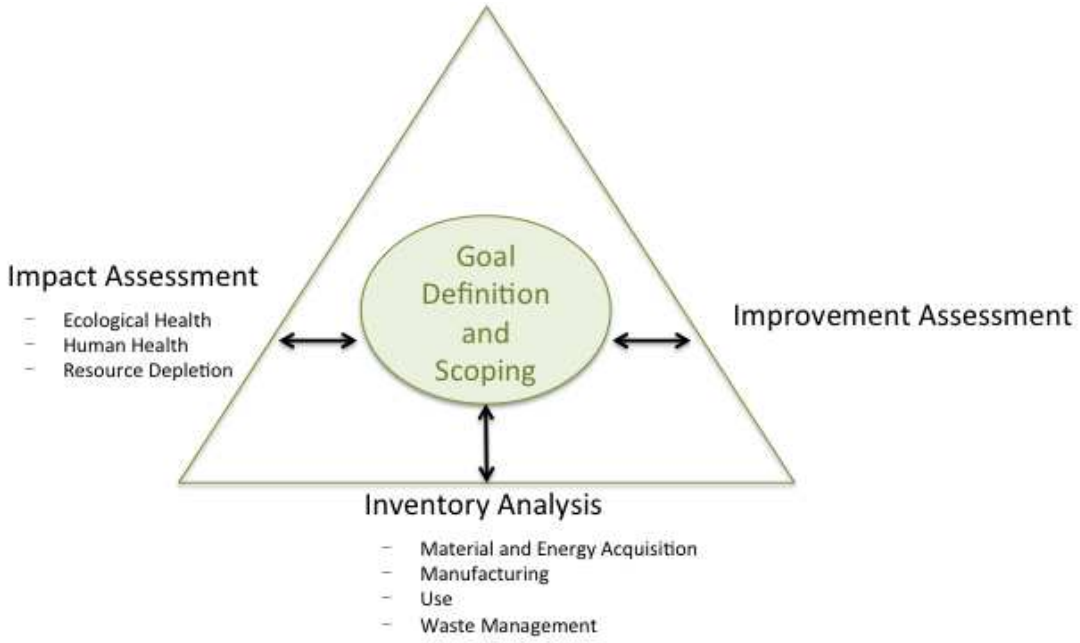
SETAC (1993) also identified three key components of LCA, including inventory analysis, impact analysis and improvement analysis (see Figure 2.19). These can be described as follows:

1. Inventory analysis — identification and quantification of energy and resource use and environmental releases to air, water, and land.

2. Impact analysis — technical for the qualitative and quantitative characterisation and assessment of the consequences on the environment.

3. Improvement analysis — evaluation and implementation of opportunities to reduce environmental burden.

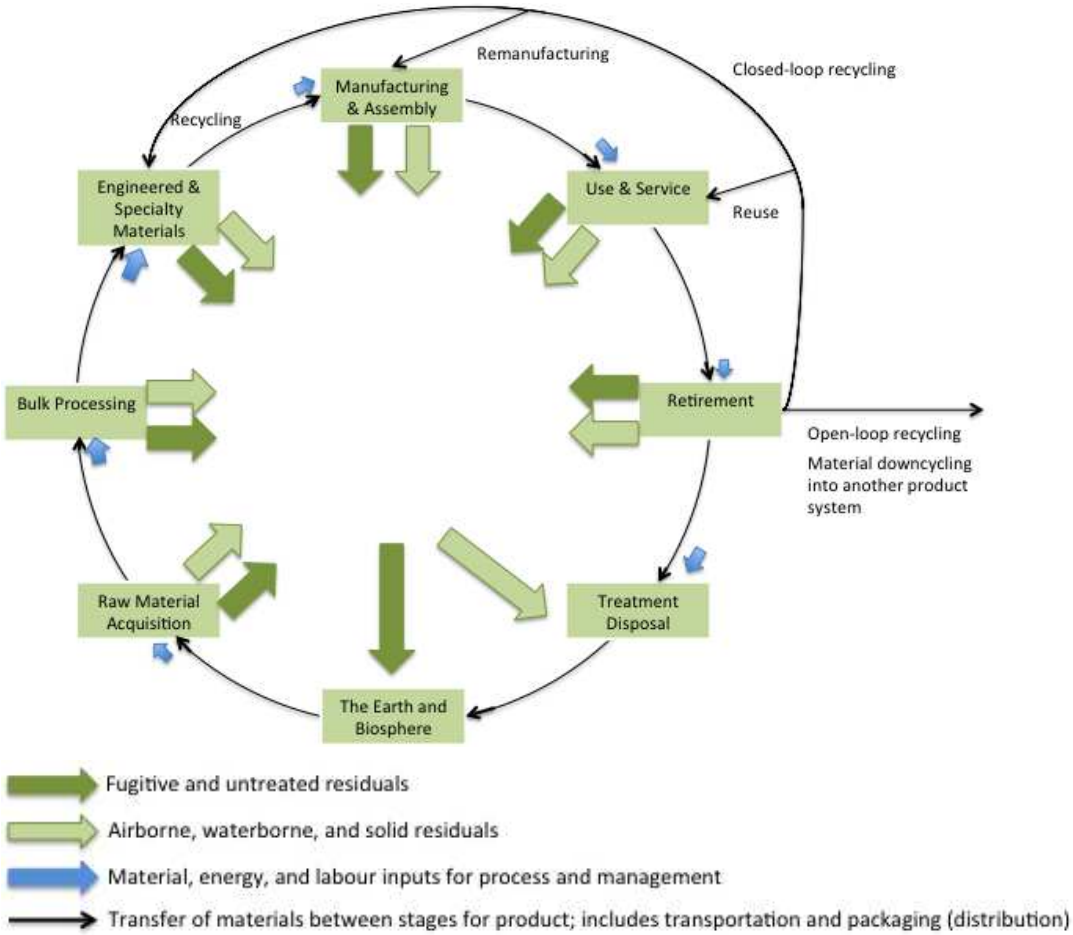
Figure 2.19 Technical framework for life cycle assessment



Based on: SETAC (1993)

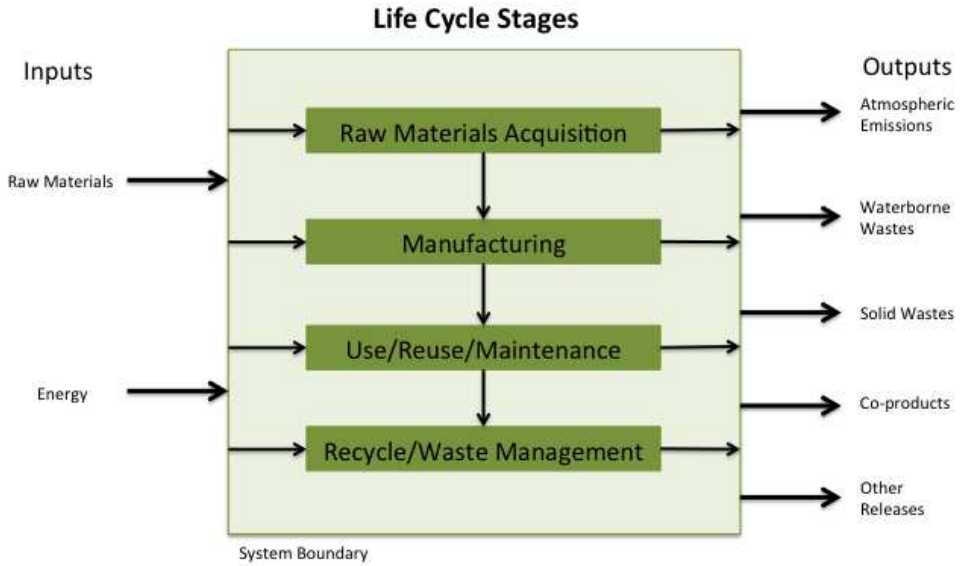
Keoleian (1993) presented the product life cycle system as shown in Figure 2.20. Moreover, Vigon et al. (1993) illustrated a process flow by indicating the material and energy inputs and outputs for the product system, as indicated in Figure 2.21. A template of a detailed flow diagram for each subsystem is also shown in Figure 2.22 (Vigon et al., 1993).

Figure 2.20 The product life cycle system



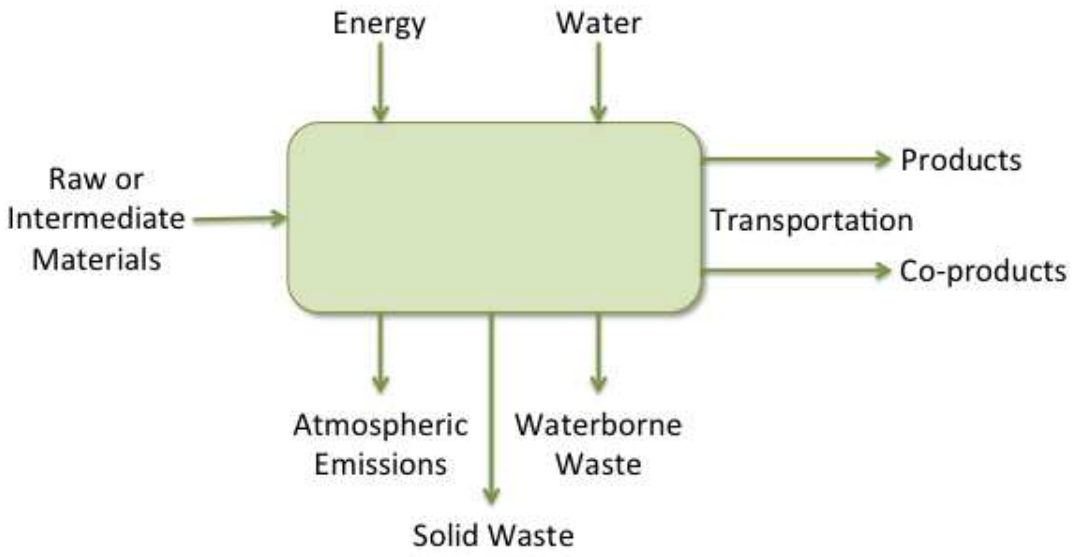
Based on: Keoleian (1993)

Figure 2.21 Process flow diagram



Based on: Vigon et al. (1993)

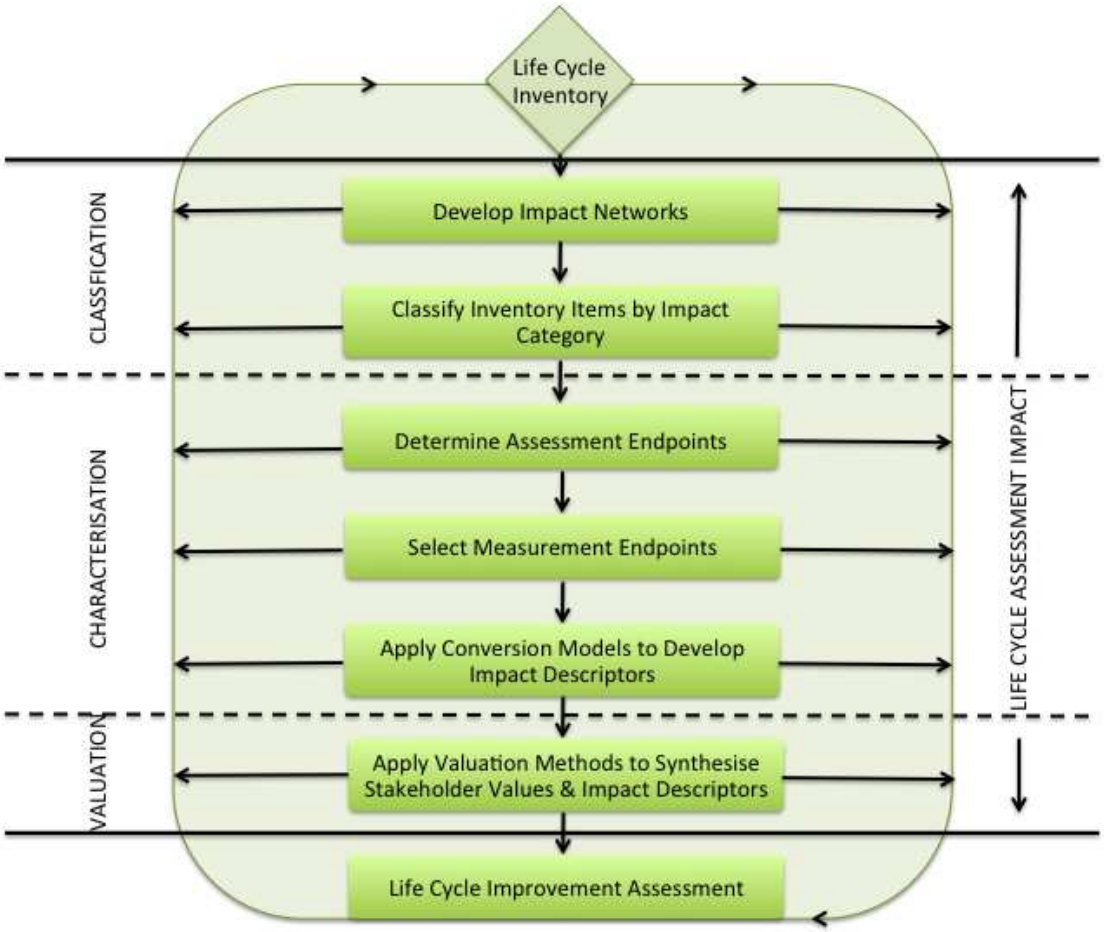
Figure 2.22 Flow diagram template



Based on: Vigon et al. (1993)

Given the three key elements in an LCA, the environmental burdens should be identified in the inventory analysis, and the impacts then evaluated. The impact analysis aims to determine the severity of the impacts and rank them, as depicted in Figure 2.23 (The arrows in this figure demonstrate that the flow from the inventory analysis to improvement assessment is not necessarily linear as the sequence involves interrelationships and feedback loops among the major components). As the figure shows, the impact analysis has three steps: classification, characterisation, and valuation. In the classification stage, impacts can be further grouped into four categories, including resource depletion, ecological health, human health, and social welfare. Once the assessment endpoints have been determined, the conversion models are employed to quantify the environmental burden with the quantification of impacts, which can be ranked. Within the final stage of an LCA, the improvement analysis should correspond with the results of the inventory and/or impact assessment by designing strategies to reduce the identified environmental consequences.

Figure 2.23 Impact assessment framework



Based on: Keoleian et al. (1995)

Verschoor and Reijnders (1999) considered the life cycle inventory strategy used by Proctor and Gamble to enhance its environmental improvement of several products. For example, one of its LCA practices applied to hard-surface cleaners showed that heating the water used for the product resulted in a significant percentage of total energy use and air emissions related to cleaning. Based on the information released in the assessment, some solutions to reduce the negative impacts were identified, such as designing cold-water and no-rinse formulas and educating consumers to use cold water.

With the real cases of LCA from developed enterprises, Vigon et al. (1993) claim that LCA can be applied both internally and externally, namely, within an enterprise and between/among enterprises. From the internal perspective, LCAs are expected to

help establish the principles for product design, identify the critical impacts in the life cycle of products, and improve the environmental performance of new production systems, such as by diminishing resources and reducing emissions in industrial ecosystems. As for the external applications, the results and findings from LCAs are useful in that they allow comparisons of the environmental profiles of alternative materials, processes, products, approaches, and so on. LCAs are also believed to promote the launch of policies and eco-labelling programmes.

However, Keoleian et al. (1995) summarised the barriers and difficulties in the applications of LCA, especially for SMEs, as shown in Table 2.4.

Table 2.4 General difficulties and limitations of LCA implications

Goal Definition and Scoping
Costs to conduct an LCA may be prohibitive to small firms. Time required to conduct LCA may exceed product development constraints, especially for short development cycles. Temporal and spatial dimensions of a dynamic product system are difficult to address. Definition of functional units for comparison of design alternatives can be problematic. Allocation methods used in defining system boundaries have inherent weaknesses. Complex products (e.g., automobiles) require tremendous resources to analyse.
Data Collection
Data availability and access can be limiting (e.g., proprietary data). Data quality concerns such as bias, accuracy, precision, and completeness are often not well-addressed.
Data Evaluation
Sophisticated models and model parameters for evaluating resource depletion and human and ecosystem health may not be available, or their ability to represent the product system may be grossly inaccurate. Uncertainty analyses of the results are often not conducted.
Information Transfer
Design decision-makers often lack knowledge about environmental effects. Aggregation and simplification techniques may distort results. Synthesis of environmental effect categories is limited because they are incommensurable.

Based on: Keoleian et al. (1995)

Leaving aside the limitations and problems with LCA, it is a desirable tool to identify and then implement strategies by which to reduce the negative environmental impacts of specific products and processes for IE.

DfE

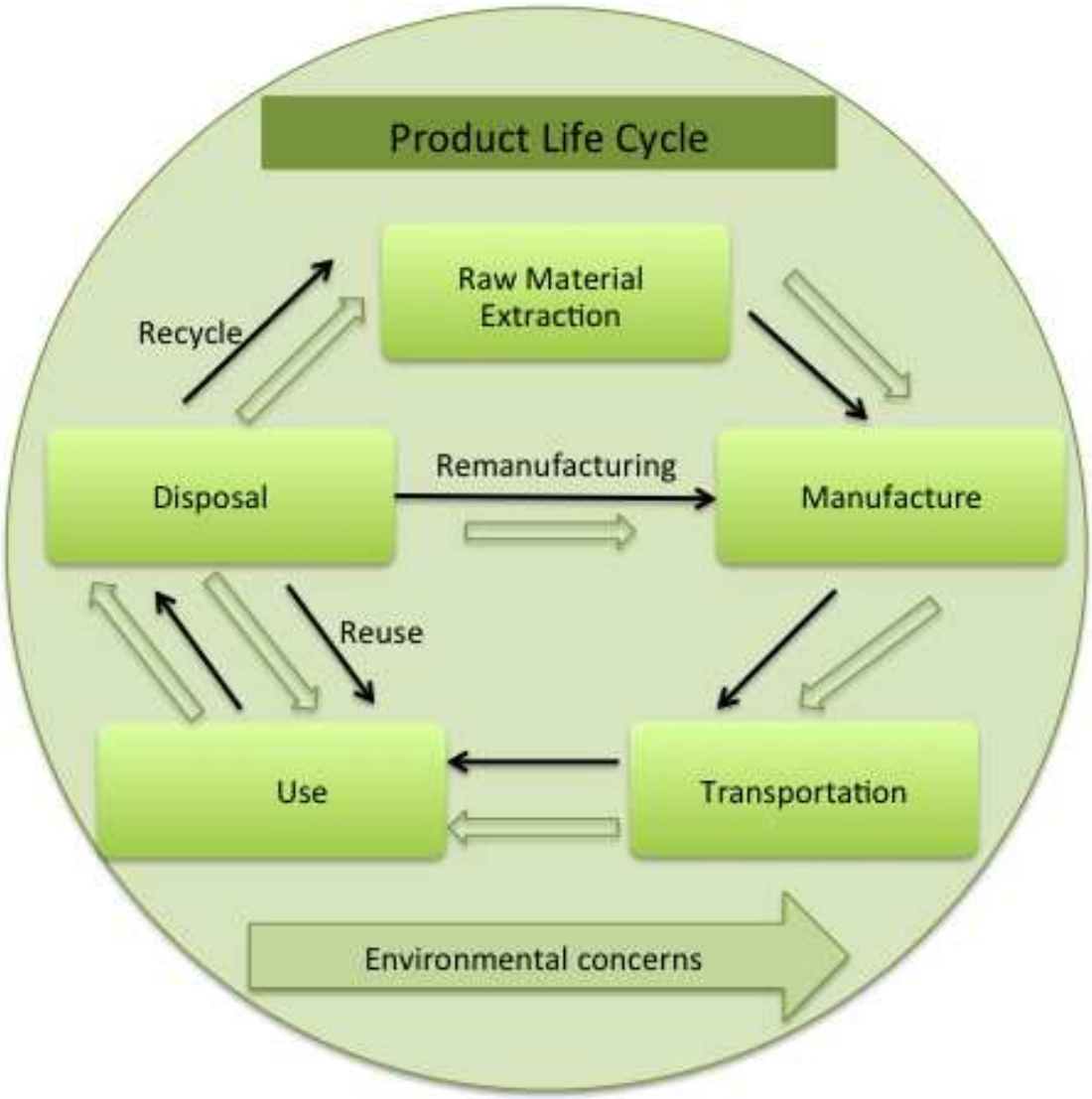
DfE is another useful tool within the IE framework for industrial designs with diminished environmental consequences. DfE evolved from the "Design for X" (DfX) approach, where X can represent manufacturability, testability, reliability, or other "downstream" design considerations (Allenby, 1991). DfX is a helpful strategy by which to emphasise important design decisions from the start of the process. A variety of DfX have been developed and discussed in the literature, such as:

- Design for Assembly (Boothroyd et al., 1994, Kmenta, 2000)
- Design for Process/Design for Producibility (Bralla, 1986)
- Design for Serviceability (Gershenson and Ishii, 1992), Design for Ownership Quality (Kmenta et al., 1999)
- Design for Environment (Graedel and Allenby, 1995), Design for Product Retirement (Ishii et al., 1994), Design for Recyclability (Ishii et al., 1994), Design for End-of-Life (Rose et al., 2000)
- Design for Product Variety (Martin and Ishii, 2002)
- Design for Supply Chain (Esterman and Ishii 2001)

As research continues to be conducted, there is no doubt that more techniques will be applied in different phases of the production, and more DfXs will be generated.

DfE uses a series of considerations in an attempt to develop and then integrate environmental concerns into the design process based on the product life cycle framework. In the process, environmental issues should be given the same status as more traditional product values such as profit and overall quality. Both Fiksel (1996) and van Hemel (1998) assume that DfE considers the environmental aspects in each stage of the product development process, striving to achieve products with the lowest possible environmental consequences throughout the entire life cycle of the products (Figure 2.24).

Figure 2.24 Primary conceptual framework of DfE



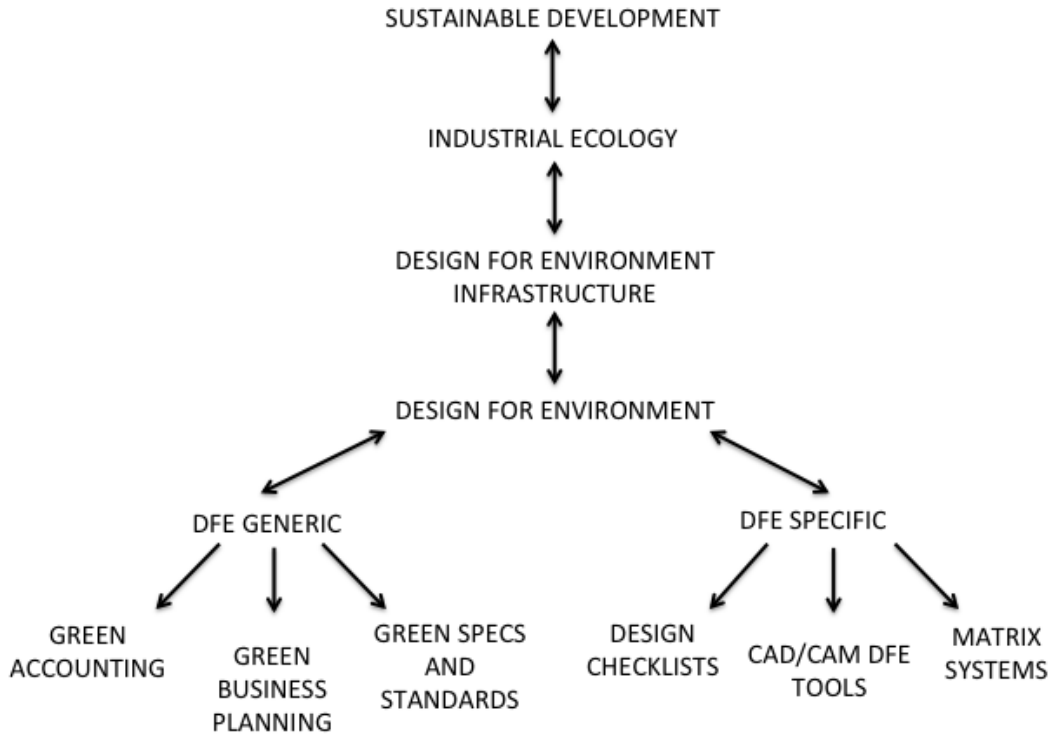
Based on: Fiksel (1996)

DfE is believed to have resulted from the many pressures on enterprises, which include customer awareness, eco-labelling programmes, product differentiation, profitability improvement, regulatory pressures, international standards and employee satisfaction (Fiksel, 1996). This argument happened to coincide with discussions regarding pressures for GSCM, as summarised in the previous section of this thesis. Furthermore, Fiksel (1996) stated that DfE is associated with benefits to enterprises in four ways, some of which are also the focus of this study in terms of GSCM performances within enterprises, which will be discussed later. Firstly, DfE can reduce costs by diminishing the cost for pollution treatment and increasing reuse

and recycling of materials and by-products in the production process. Secondly, DfE is helpful for enterprises to improve their environmental performance required by the market demand. Thirdly, DfE plays a proactive role when enterprises yield to regulatory pressures, instead of struggling with new laws. Fourthly, through the improved environmental performance, DfE is effective and efficient for enterprises to gain social benefits like improved image and enhanced reputation among customers.

Fiksel (1993) described the relationship between sustainability and DfE, pointing out that DfE is a useful approach by which to improve sustainability by reducing both resource use and waste generation today, and eliminating potential product impacts from use and disposal in the future. Michael and Ehrenfeld (1995), meanwhile, assumed that those environmental practices including pollution prevention, energy conservation, recycling, remanufacturing, reuse and so on which are systematically associated with DfE can all be regarded as tools for IE. Based on the wide discussions on the environmental frameworks into which DfE is placed, Dambach and Allenby (1995) attempted to establish a structure which analyses the relations among sustainable development/sustainability, IE and DfE, as shown in Figure 2.25.

Figure 2.25 Relations among sustainable development, IE and DfE

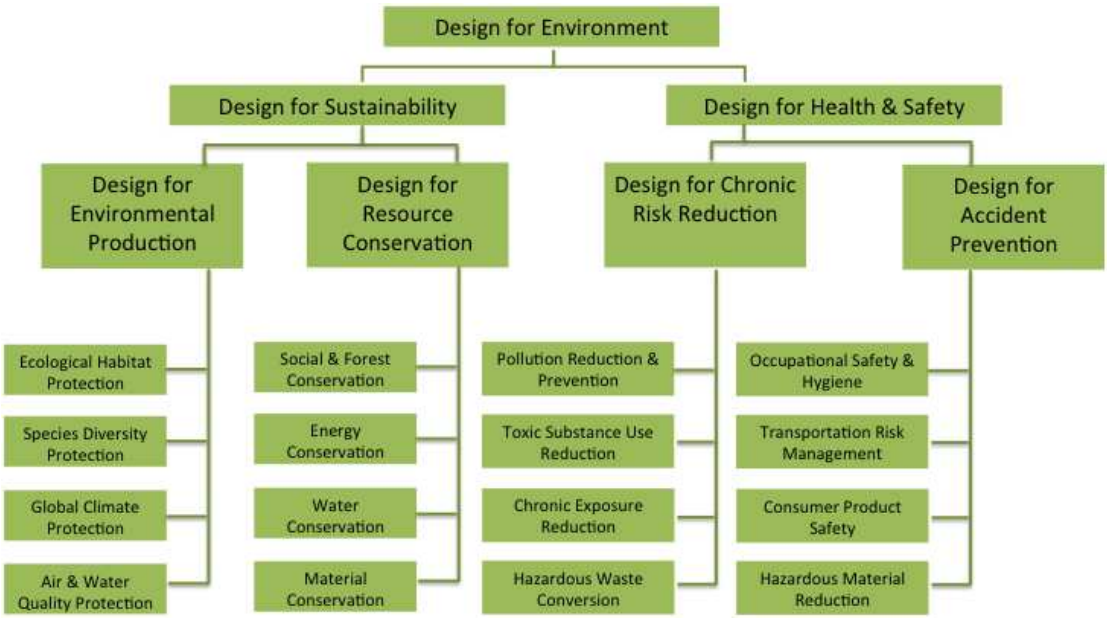


Based on: Dambach and Allenby (1995)

Dambach and Allenby (1995) believe that IE can form an objective basis for more environmentally economic activities to gain sustainability, and DfE provides practical methods for IE that can be employed in the real world; by combining both ideas, a widely intellectual framework which addresses environmental issues has been built up.

In addition to Dambach and Allenby's (1995) identification of generic and specific DfE, Fiksel (1996) classified DfE practices into Design for Sustainability and Design for Health and Safety (Figure 2.26).

Figure 2.26 DfE practice areas



Based on: Fiksel (1996)

Moreover, Crow (2002) categorised DfE into three groups with more detailed considerations shown in Table 2.5.

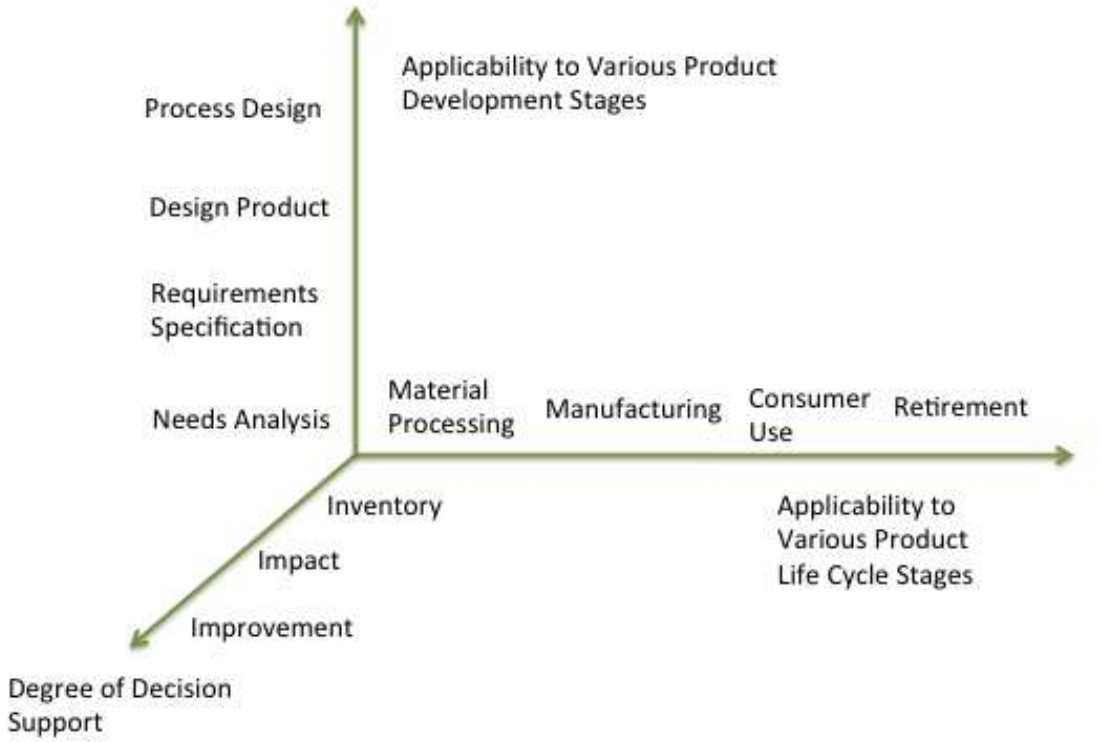
Table 2.5 DfE with more detailed considerations

DfE	Considerations
Design for environmental manufacturing	• Non-toxic processes and production materials
	• Minimum energy utilisation
	• Minimisation of emissions
	• Minimisation of waste, scrap and by-products
Design for environmental packaging	• Minimisation of packaging materials
	• Reusable pallets, totes and packaging
	• Recyclable packaging materials
	• Biodegradable packaging materials
Design for disposal and recyclability	• Re-use/refurbishment of components and assemblies
	• Material selection to enable re-use and minimise toxicity
	• Avoidance of filler material, such as fiberglass and graphite, in plastics
	• Minimisation of materials/colours used, to facilitate separating materials and re-use
	• Material identification to facilitate re-use
	• Design to enable materials to be easily separated
	• Design for disassembly
	• Avoidance of use of adhesives
	• Limiting contaminants – additives, coatings, metal plating of plastics, etc.
	• Maximising use of recycled or ground material with virgin material
	• Design for serviceability to minimise disposal of non-working products

Based on: Crow (2002)

Besides the research on DfE frameworks as a whole conception, several tools or methods have been suggested that are less technical but more practical, which enable enterprises to incorporate environmental concerns into their products, production and activities. For example, Michael and Ehrenfeld (1995) proposed a three-dimensional tools structure, as depicted in Figure 2.27.

Figure 2.27 A classification of DfE tools



Based on: Michael and Ehrenfeld (1995)

However, this classification fails to provide a functional description of the feasibility of DfE tools. Mizuki et al. (1996) tried to fill the literature gap by proposing five tools, including life cycle analysis, process flow analysis, disassembly/recyclability process analysis, manufacturability analysis and other performance optimisation measures.

In addition to the DfE practices discussed above, organisational issues also play important roles for IE and sustainable development. Fiksel (1993) was probably the first to highlight the importance of organisational issues in the successful implementation of environmental practices within an enterprise. He put forward a two-level organisational commitment model to overcome the difficulties in adopting environmental practices. Firstly, organisational norms and cultures carrying on the environmental concerns should be established. Thus, training programmes and communication from top management to middle managers to employee individuals is necessary, for instance. Secondly, all business processes should be integrated with

environmental issues. According to Fiksel (1993), design metrics, design guidelines, design verification methods and design decision frameworks should all be worked out in the product development process.

Therefore, in summary, DfE takes environmental concerns into account during the design of products and processes, as well as with respect to managerial and socio-political systems for sustainable benefits.

Based on the discussion about the theory of IE above, it is shown that to achieve the goal of sustainability set by this theory, an enterprise should hold a systemic and integrated view on their products, from the input of green activities to the output of the GSCM performances, throughout the life cycle. Moreover, the complex material flows, capital flows, energy flows and information flows should all be taken into account to establish an industrial ecosystem wherein production and technological dynamics, monetary issues and environmental improvement can be examined and evaluated. Thus, IE theory has framed a guideline for GSCM, in terms of implementing GSCM practices and examining GSCM performances; this will be discussed in the following sections.

2.7 GSCM practices

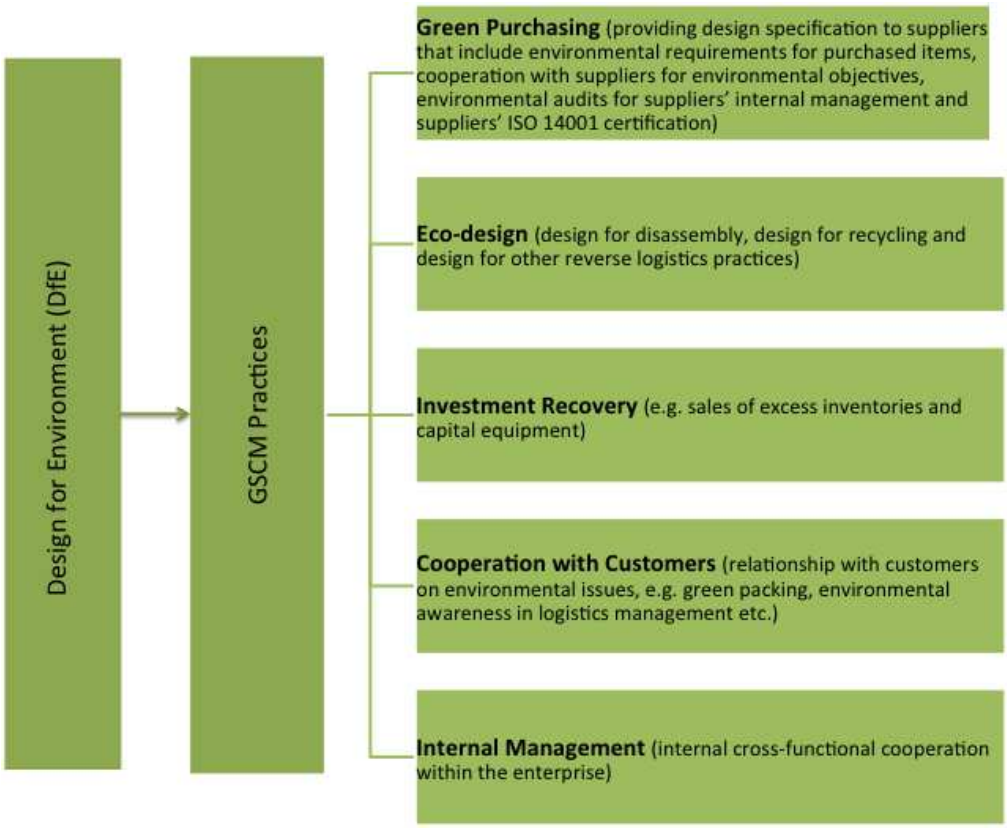
2.7.1 DfE, and GSCM practices

Materials and information can be integrated systematically into a supply chain and scientifically associated with environmental concerns for an enterprise to gain sustainability. In practice, there are several tactics that can be adopted to green the supply chain and further help to achieve the goal of sustainable development; these will be introduced the following section, with a focus on SMEs.

Based on the discussion in section 2.6.6, DfE can be seen as an important strategy to develop GSCM practices. It concerns types of product-oriented relationships that

occur in the chain and addresses product functionality by minimising life cycle environmental impacts. The success of DfE requires internal cross-functional cooperation within the enterprise and external cooperation with other partners throughout the supply chain (Lai and Cheng, 2009). The GSCM practices which will be considered under DfE in this study are shown in Figure 2.28, and will be discussed in this section.

Figure 2.28 GSCM practices investigated in this study based on the theory of DfE



Based on: Lai and Cheng (2009)

2.7.2 Development of GSCM practices

GSCM practices have received much attention in the past few years, and some researchers have attempted to summarise these practices. For example, Testa and Iraldo (2010) classified GSCM practices into three widely used strategies: "reputation-led", "efficiency-led" and "innovation-led". Reputation-led GSCM practices can help enterprises to gain positive corporate image, which include green

logistics tactics with their suppliers, customers and consumers. On the other hand, efficiency-led GSCM practices are cost saving activities such as the reduction of packaging thickness. Lastly, enterprises adopt innovation-led GSCM practices to become leaders in their industry and compete with their rivals through the development of product and process innovations. More recently, Azevedo et al. (2011) used case studies of five Portuguese automotive companies to test the relationships between green supply chain practices and supply chain performances. From the study, the authors identified four categories of GSCM practices. The first is practices that green an organisation's supply process, for example, the consideration of environmental concerns when selecting suppliers. The second is advanced green practices, which include cooperation approaches with suppliers and customers. The third is product-based green practices, including activities which attempt to integrate environmental preoccupations into production. The last classification is green activities in the product delivery phase to customers and consumers.

In China, Zhu and Sarkis (2004) also studied the relationships between GSCM practices and performance among early adopters within Chinese enterprises. They compared the automobile, power plants and electronic industries in the Chinese context and found that the three industries differ in terms of their GSCM practice adoption. They identified four kinds of GSCM practices, including internal environmental management, external environmental management, investment recovery and eco-design. Zhu et al. (2008) conducted a study to investigate the implementation of GSCM in the Chinese context, with a focus on the four industries – automobile, chemical/petroleum, power supply chain and electronic/electrical – but covered enterprises from a range of diverse sizes. Furthermore, over 80% of the respondent enterprises were large enterprises and only a few SMEs were involved in the study. Zhu et al. (2008) used ANOVA (Analysis of Variance) to identify the differences in terms of different GSCM practices, including green purchasing (GP), cooperation with customers including environmental requirements (CC), investment recovery (IR), eco-design (ECO) and internal environmental management (IEM),

among the four industries. For example, they indicated that the automobile industry lagged behind the other three industries in adopting GSCM practices, and suggested that this may be due to the high level of complexity in the adoption of GSCM practices, on the basis of contingency resource based theory, and a larger number of stakeholders, based on stakeholder theory.

According to Zhu et al. (2005), an increasing number of Chinese enterprises are putting more attention on their customers' needs, and thus cooperation with customers in terms of environmental requirements is taken as a GSCM practice in this research. It is also argued that investment recovery is key for GSCM within American and European enterprises (Zsidisin and Hendrick, 1998). Zhu and Sarkis (2006) further emphasised that eco-design is an efficient approach to improve environmental performance, while balancing product efficiency and environmental influence.

One year later, Zhu and Sarkis updated their classifications of GSCM practices into five categories – GP, CC, IR, ECO and IEM (Zhu and Sarkis, 2006). For example, eco-design is critical for manufacturers to reduce consumption of material and energy, and reduce pollution to the environment. Thus, SMEs from the wood processing and furniture sectors may be more aware of eco-design than those from the food and drink sector. Chinese SMEs from different industrial sectors vary in their GSCM practices, which may be related to the different pressures they are subject to (Zhu and Sarkis, 2006). In addition, SMEs have different considerations when adopting GSCM practices, which may be caused by their differing GSCM drivers (Testa and Iraldo, 2010). Internal environment management is believed to be an important element to improve an enterprise's performance (Carter et al., 1998). In addition, Carter et al. (1998) established a measurement model for environmental purchasing, and six key factors with respect to green purchasing.

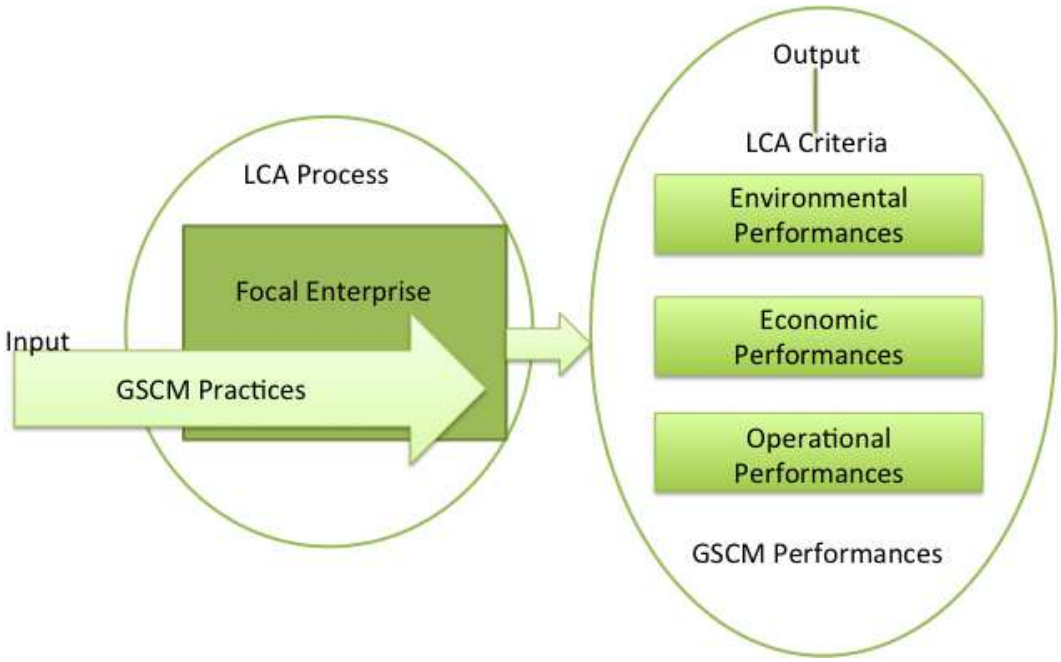
2.8 GSCM performance

2.8.1 LCA and performance of GSCM

In addition to the contributions of environmental practices to both environmental and economic performances within enterprises, van der Grijp and den Hond (1999), Fiksel (2000), and Sidiropoulos et al. (2004) all emphasised the effects of environmental practices under the IE framework to improve the performances of enterprises environmentally and economically. Within the framework of a supply chain, GSCM performances can be assessed by using an LCA approach, as discussed in section 2.6.6.

LCA addresses the assessment of the results of environmental endeavours throughout the “life cycle”. The assessment lies not only in evaluating the reduction of environment pollution, but also in examining the investment return and assessing the production effectiveness in the whole process. Thus, all the environmental, economic and operational performances are expected to be taken into account for assessments across the entire life of a product. Figure 2.29 shows how the GSCM performances will be investigated in this study based on the LCA framework.

Figure 2.29 GSCM performances investigated in this study based on LCA framework



2.8.2 Development of GSCM performance

With increasing attention from researchers, enterprises and the public on environmental concerns and GSCM, a growing number of studies have attempted to explore GSCM performance. Walley and Whitehead (1994) argued that many enterprises consider environmental management to be compliance with regulations, and have an inclination to evaluate the tradeoffs between environmental and economic performance.

Rao and Holt (2005) identified that GSCM performances rely on the overall competitiveness of an enterprise, and its economic performance. Based on Deming's 14 points and Juran's trilogy, Gevirtz (1994) built a framework of the competitive advantages for an enterprise, including the faces of customer satisfaction, employee empowerment, quality cost systems, lean manufacturing, continuous improvement and productivity enhancement. Combined with their research availabilities, Rao and Holt (2005) examined competitiveness by looking at improved efficiency, quality, and improvement, and cost saving within enterprises.

According to Azevedo et al. (2011), there are more kinds of performances should be investigated which can be influenced by green practices across supply chain. GSCM performances include operational quality, customer satisfaction, economic cost, environmental cost, environmental revenues, efficiency, environmental emissions, business waste and green image.

When investigating the relationships between GSCM practices and performances within the Chinese automobile industry, Zhu et al. (2007) looked at three categories of performance, including environmental performance, economic performance and operational performance. Lin et al. (2011) agreed with this triad and further categorised economic performance into positive and negative. The detailed performances identified as the selection criteria for evaluating how GSCM works under each of the categories are summarised in Table 2.6.

Table 2.6 GSCM Performances

Categories	Performances
Environmental performance	Pollution control initiatives
	Use of environment friendly technology
	Partnership with green organisations and suppliers
	Environmental certification
Positive economic performance	Decrease of cost of material purchasing
	Decrease of cost for energy consumption
	Decrease of fee for waste treatment
	Decrease of fee for waste discharge
Negative economic performance	Increase of investment
	Increase of operational cost
	Increase of cost for purchasing environmentally friendly materials
Operational performance	Scrap/waste reduction
	Quality improvement
	Delivery improvement
	Capacity utilisation improvement

Based on: Lin et al. (2011)

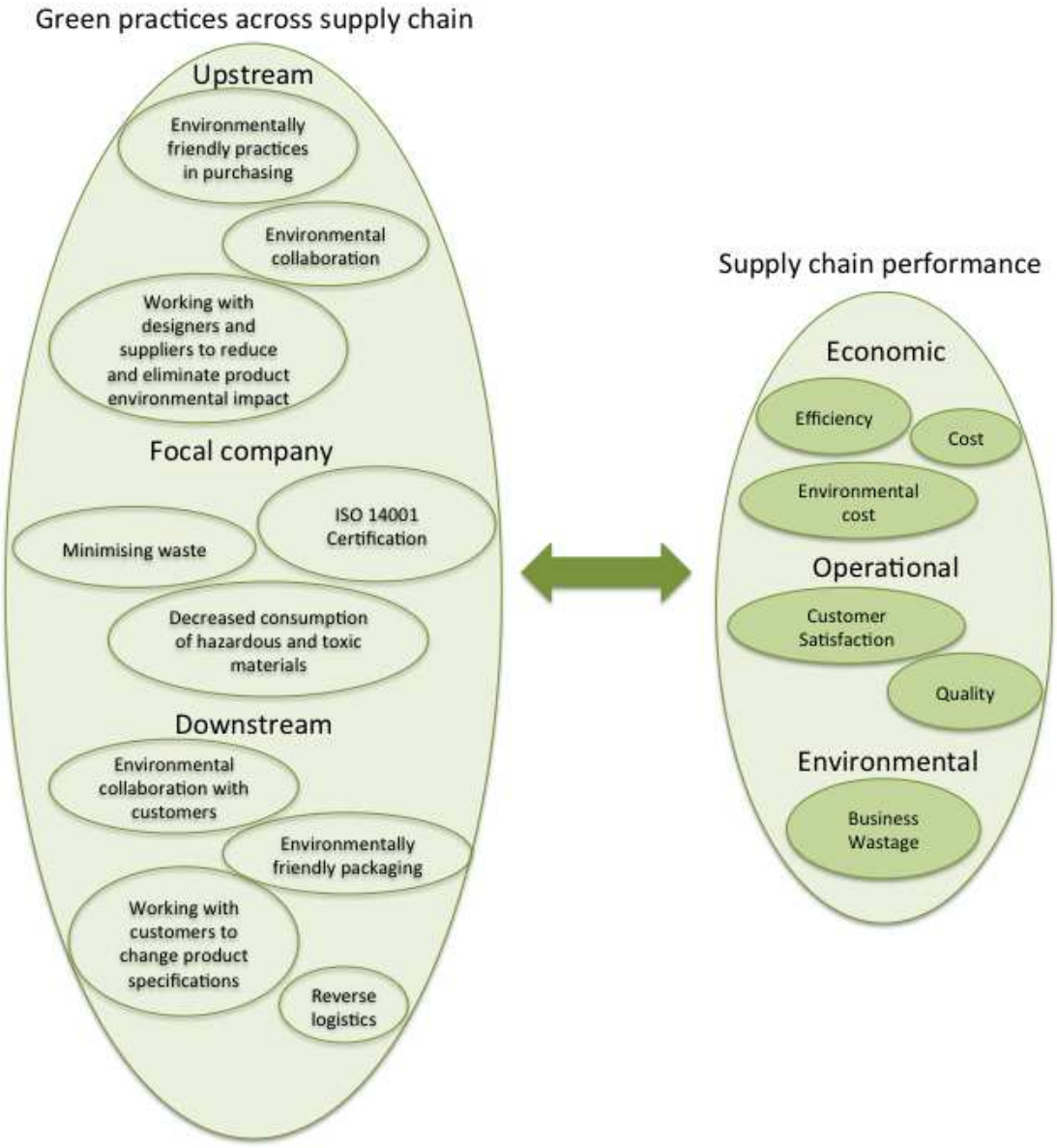
2.9 GSCM practices towards GSCM performance: a positive effect?

Many efforts have been put into studying GSCM initiatives, particularly in terms of exploring the relationships between GSCM practices and performance. It is highly possible that enterprises, especially SMEs, would be encouraged to implement GSCM if there was a clear, significant and observable correlation between these efforts and environmental, economic and operational performance. This is also the primary inspiration for this study.

In fact, there has been widespread debate among academics and practitioners regarding whether and how enterprises' adoption of GSCM enhances their overall performance; though the literature on this field to date is still rather mixed and far from adequate (Menguc and Ozanne, 2005).

Azevedo et al. (2011) considered the effect of individual GSCM practices on GSCM performance. Based on the model shown in Figure 2.28, and the methodology of case studies, a variety of GSCM practices have been examined, including environmental friendly purchasing, environmental collaboration with suppliers, working with designers and suppliers to reduce and eliminate product environmental impact, minimising waste, ISO 14001 certification, decreased consumption of hazardous and toxic materials, environmental collaboration with customers, environmentally friendly packaging, working with customers to change product specifications and reverse logistics, improving enterprises' economic, operational, and environmental performance in terms of cost reduction, business waste reduction, production efficiency increase, product quality development, and customer satisfaction improvement.

Figure 2.30 Research framework for investigating the relationship between GSCM practices and corresponding performance

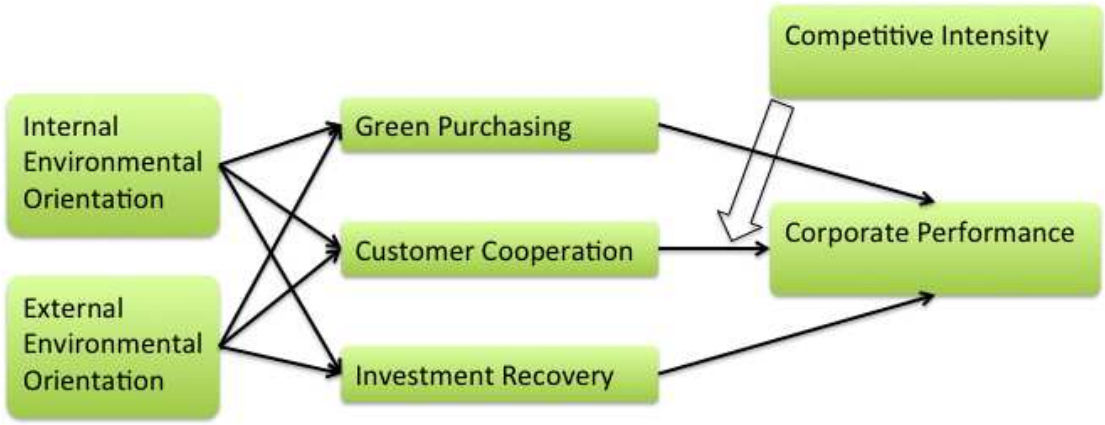


Based on: Azevedo et al. (2011)

By investigating 194 foreign investment enterprises (FIEs), Chan et al. (2012) contributed to the debate on performance resulting from environmental orientation. The study makes at least two contributions to the literature. Firstly, it demonstrates that both internal and external environmental orientations have a significantly positive influence on corporate performance, both socially and economically. Secondly, and more importantly, it describes how GSCM practices like green

purchasing, customer cooperation and investment recovery mediate these influences. Chan et al.'s (2012) framework can be seen in Figure 2.31.

Figure 2.31 Research framework for investigating the relationship between GSCM practices and corporate performance



Based on: Chan et al. (2012)

Green et al. (2012) conducted a survey of a 159 respondents in the US manufacturing industry to examine how GSCM practices, including internal environmental management, green information systems, cooperation with customers, eco-design and investment recovery, exert impacts on enterprises' performance from environmental, economic, operational and organisational perspectives. With more subdivided variables, the study has some interesting findings. For example, green purchasing is not significantly linked to environmental performance, but is positively linked to economic performance, and cooperation with customers is positively associated with both environmental and economic performance. In addition, eco-design is positively linked to environmental performance, but negatively associated with economic performance. However, GSCM practices are positively linked with either environmental or economic performance in a general sense. Moreover, this study assumes that these environmental and economic performances can leverage improved operational performance and further lead to improved organisational performance for enterprises. However, the study does not provide any

comparison of GSCM practices or performance among different sectors, though the industry category is summarised.

A survey by Lau (2011) carried out in both Chinese and Japanese manufactures compared the green logistic practices between enterprises of different sizes. This provided some interesting findings. For example, LEs from both countries perform better than SMEs, as SMEs are more cost-conscious, and thus some practices that incur high cost are not affordable to them. Moreover, the study demonstrates that China still lags behind Japan in the implementation of green logistic practices, especially in upstream supply chain facets like purchasing. In addition, regulatory pressures are still identified as the main force by which to implement green logistic practices in China, while Japanese manufacturers show a stronger awareness and willingness to adopt green logistics practices to improve their capability for long-term competition.

Differences may also exist in different regions in GSCM. Rao and Holt (2005) showed that organisations adopting GSCM in the South East Asian region ultimately enhanced both competitiveness and economic performance, while Zhu et al. (2008) indicated that enterprises implementing GSCM in China have only slightly improved environmental and operational performance, and GSCM practices do not result in a significant economic performance improvement. The reasons why the results of these studies differ from each other may relate to the heterogeneity of environmental management practices adopted by organisations and industries (Elsayed and Paton, 2005).

With respect to studies considering the sectoral/industrial perspective, it is notable that some sectors have attracted more attention – such as the automobile manufacturing sector, for instance. Environmental concerns have been well accepted in the automobile manufacturing industry in developed countries. The evidence shows that in EU countries, the European Union ELVs Directive (2000/53/EC) requires

manufacturers in the industry to conduct plans for reducing toxic material consumption; designing and producing vehicles that can be dismantled; the reuse, remanufacture, recovery and recycling of end-of-life vehicles; increasing material recycling; and ensuring components do not contain mercury, hexavalent chromium, cadmium, or lead. But directive guidelines such as these are not in place in developing countries. In Malaysia, for instance, the Malaysian National Automotive Policy has not managed to overcome the environmental impacts, although it has made Malaysia's automobile manufacturing industry a success and become the largest producer in South East Asia (Gerrard and Kandlikar, 2007; Amelia et al., 2009). In China, automobile manufacturers are sick of complying with environmental regulations and are only forced to improve environmental performance when exporting and selling to foreign customers (Christmann and Taylor, 2001; Zhu and Sarkis, 2006).

The previous research discussed above has considered that GSCM can be achieved through different types of green practices, and has used a number of variables to evaluate the connection between green practices and performance within enterprises. However, little attention has been paid to SMEs (Greenan et al., 1997; Rao, 2007; Wooi and Zailani, 2010) and the comparison among different sectors (Zhu et al., 2007; Zhu et al., 2008) with consideration of all the GSCM pressures, practices and performances (Zhu et al., 2010). Therefore, this study will fill the gap by investigating Chinese SMEs to identify their GSCM pressures, practices and performances, and how these differ across sectors.

2.10 Conceptual framework of this study

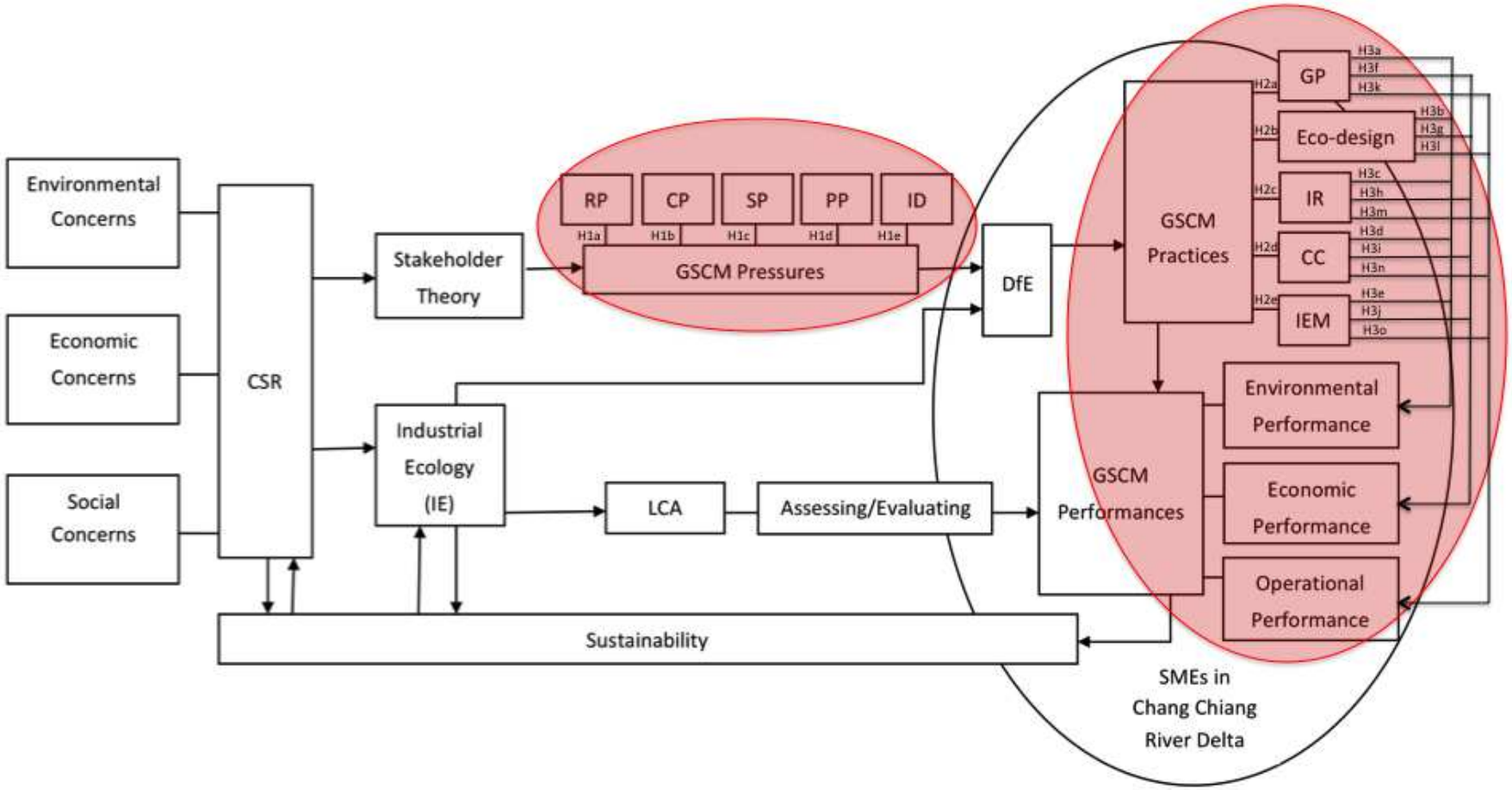
A conceptual framework will be developed in this section based on the concepts discussed above, including SCM, sustainability, GSCM, CSR, stakeholder theory, and IE with DfE and LCA (see Figure 2.32). By drawing these concepts together, the study explains that CSR should be integrated into SCM activities if enterprises hold a vision

for sustainability, wherein GSCM is expected to be implemented by those enterprises; moreover, if stakeholder theory and IE theory are considered with respect to GSCM, it is necessary to examine the GSCM pressures, practices and performances of enterprises which are the research focuses of this study emphasised with red circles in Figure 2.32.

The theories discussed in this research as well as GSCM pressures, practices and performances which were the footholds of the research could be linked through the conception of sustainability. Sustainability is both the aim and the outcome in this way, which means that we start with sustainability and ends at sustainability as well. To achieve sustainability means that the resources should be appropriately used in a long run; thus, as one of the resource consumer, if an enterprise or SME integrates social and environmental concerns in using resources for its business and in interaction with its stakeholders, it is taking its corporate social responsibility (CSR). To produce by using materials and energy (resources) with more efficiency and least damage possible on environment for an enterprise is called industrial ecology (IE) and the stakeholder theory is crucial for the enterprise to identify any individual or group inside and outside for further interaction. By considering the environmental aspects with traditional values of profit and quality in each stage of the product development process, striving to achieve products with the lowest possible environmental consequences throughout the entire life cycle of the products, an enterprise is designing for environment (DfE) which is one of IE tools to reduce both resource use and waste today and to eliminate potential product impacts from use and disposal in the future. Whether the DfE strategy is effective can be examined with another IE tool of life cycle assessment (LCA) which is helpful to evaluate the environmental burdens of a product or process “from cradle to grave”. By taking the environmental concerns into an enterprise’s supply chain management practices, an enterprise forms its GSCM strategy which can be seen as a part of its CSR program for sustainability. Why the enterprise would like to consider GSCM, what are the pressures it faces can be analysed with the stakeholder theory and the detailed

GSCM practices can be “designed” with DfE while LCA can be used to evaluate GSCM performances. If the GSCM practices successfully help the enterprise to improve its performances like waste reduction, energy saving, by-product usage and so on, it is achieving sustainability.

Figure 2.32 Conceptual framework of this study



2.11 Hypotheses formation

2.11.1 GSCM pressures

Regulatory pressures

Klassen (1993) claimed that environmental management was first taken into account in the business and management field as early as the 1990s, even with reference to SMEs (Hutchison and Chaston, 1994). Businesses with high pollution potentials face the most legal and public pressures in Europe, and these pressures on production are gradually increasing. Konar and Cohen (1997) pointed out that the penalties or fines for non-compliance with environmental rules and regulations are viewed as regulatory pressures on industrial organisations. Zhu and Sarkis (2006) also maintained that the Kyoto Protocol requirements are causing more and more enterprises worldwide to reduce greenhouse gas emissions.

By investigating 314 manufacturing enterprises, Zhu et al. (2005) found that Chinese manufacturers have been under clear pressures from a variety of sources, including supply chain pressure, cost-related pressure, marketing pressure, and regulations. The research undertaken here does not provide the same results, which may be due to the size of the enterprises considered. Medium-sized and large enterprises make up 78.4% of Zhu et al.'s (2005) respondents, while the focus of this project is on SMEs, who pay less attention to environmental regulations due to limitations with respect to their professional staff and knowledge to meet the requirements. Moreover, as SMEs always benefit from certain preferential policies from governments with respect to development, the legal restraints on SMEs in terms of environmental issues might be overlooked by both lawmakers and legal receptors.

According to Zhu et al. (2010), the Japanese government promulgates some of the most rigid laws with regards to environmental issues around the world. Besides the general regulations provided by the Fundamental Law for Establishing a Sound

Material-Cycle Society, another two Japanese Laws were enacted in 2000 to cover specific “links” in the supply chain. The Law for Promotion of Effective Utilization of Resources regulates the collection and recycling process for specific products and goods, and the Law on Promoting Green Purchasing covers the environmentally friendly procurement. In addition to the cases above, Green et al. (1996), Walton et al. (1998), Beamon (1999), Hall (2001), Min and Galle (2001), Walker et al. (2008) and Diabat and Govindan (2011) all consider government regulations and legislations as regulatory pressures of GSCM on enterprises. Furthermore, these external forces from regulations relating to environmental issues are exerting mounting impacts on SMEs. For instance, European regulations have strict requirements on the use and recovery of particular poisonous substances, which lead enterprises, including SMEs, to consider environmental management (Lee, 2008). Therefore, the following hypothesis is suggested:

H1a: Chinese manufacturing SMEs have been under the regulatory pressures from the government in terms of GSCM.

Customer pressures

In 2001, Sony suffered a great loss related to parts replacement, storage and repackaging of its famous PlayStation with a large number of 1.3 million when the consoles were banned at the Dutch border due to alarming levels of cadmium detected in the cables of the consoles, which were produced by Sony's SME suppliers (*Business Week,* 2005). As a result, Sony undoubtedly exerted pressures on its suppliers as one link throughout the supply chain. As Rao (2007) stated, businesses in Southeast Asia whose customers are usually from Europe and the US have to put extra efforts into environmental management within the overall supply chain when exporting or marketing to their global customers, in order to meet the environmental standards set by their importer countries or regions. In fact, their global customers often prefer international accreditation or licence, such as ISO 14001, when selecting

their suppliers so as to guarantee appropriate environmental production.

Zhu and Geng (2001) also recognised the same requirements for Chinese manufacturers, pointing out that an increasing number of Chinese enterprises have to acquire ISO 14001 certification to meet the environmental requirements of their foreign customers. According to Zhu et al. (2005), Chinese enterprises have been under such pressures from their overseas customers or trading partners since early 2000s, when a number of countries including Japan, the US, the Netherlands, Norway, France and Sweden introduced various environmental requirements for the importation of fabrics and clothes dyes from China. Some business giants have even put environmental requirements on second-tier suppliers, as well as their direct suppliers. For example, among the top-ten supplier evaluation criteria identified by Walton et al. (1998), environmentally friendly practice evaluation of second-tier suppliers was listed as the second most important criterion.

With regard to SMEs, Lee (2008a) assumed that although previous studies have focused on identifying the contributing factors to GSCM among SMEs, such as regulations, support or pressures from external stakeholders, and organisations' internal capabilities, little has confirmed regarding the pressures from customers, who represent the buying power in response to the SME suppliers' green initiatives. However, Walker et al. (2008) argued that small companies are under significant pressures from their customers. After considering seven cases, the researchers pointed that SMEs are more likely to be urged by their customers, usually LEs, to employ GSCM practices, especially in the industrial sectors like food, furniture, automobiles, and electronic devices. They also verify that end-consumers are a strong power in forcing enterprises to improve their environmental performance. Thus, a second hypothesis is proposed based on the above arguments:

H1b: Chinese manufacturing SMEs have been under customer pressures from purchasers at home and abroad, as well as end users, in terms of GSCM.

Public pressures

Some may claim that customers/consumers, especially for those end users could be viewed as a significantly important part for the public; thus, to differentiate between customer pressures and public pressures, the latter in this research refer to (1) consumers' influence on the legislative process and their buying patterns; (2) other social parties like NGOs and citizen communities; (3) the media.

According to Min and Galle (1997), the past few decades have seen a significant increase in consumer environmental consciousness due to rapid environmental degradation. Consumers' awareness of environmental protection and energy saving can therefore further improve the entire social perception of green issues, and this has become one of the most influential pressures for businesses to initiate GSCM. In response to this demand, enterprises should provide more environmentally friendly products to those consumers who are more green-conscious. For example, Chan and Lau (2001) compared the green purchasing behaviours of American and Chinese consumers, and found differences in the translation of green purchasing intention to related behaviour, with American consumers being more effective in terms of green purchasing. However, Skrentny (1993) pointed out that purchasing behaviours are changing with the penetration of environmental perceptions to wider society. As a result, more Chinese consumers, particular younger generations, are becoming environmentally conscious and starting to favour greener products, with less packaging, less pollution and less energy consumption (Greenan et al., 1997; Lo and Leung, 2000). Actually, the increasing environmental awareness can be regarded as an opportunity for enterprises to win new consumers, the "greens", by offering them more environmentally friendly products or services (Walker et al., 2008).

Moreover, according to González-Benito and González-Benito (2006) agreed with Clarkson (1995) that NGOs and the media could be recognized as the "secondary

stakeholders" for enterprises, which can influence and be influenced by the enterprise but would not be engaged in transactions with it. While Walker and Jones (2012) insisted that the media could even bring negative impacts on an enterprise's sustainable development on its supply chain management, such as "greenwash". Therefore, the study aimed to identify whether public pressures have a bearing on GSCM among Chinese manufacturing SMEs. It is thus proposed that:

H1c: Chinese manufacturing SMEs have been under public pressures from consumers and society in terms of GSCM.

Supplier pressures

As pointed out by Carter and Dresner (2001), suppliers are not a direct external force with respect to greening the supply chain, although they do play an influential role in injecting their ideas and resources into environmental management development. Similarly, according to Walker et al. (2008), suppliers cannot really be viewed or defined as a pressure source, and they are more like the collaboration or the integration with the upper-stream suppliers such as the product designers and raw material suppliers, to achieve more effective environmental management. Moreover, many (Theyel, 2001; Klassen and Vachon, 2003; Vachon and Klassen, 2006) have come to the conclusion that appropriate cooperation with suppliers can help to enable positive environmental improvement. These collaborative activities include joint planning work with regards to environment protection, knowledge sharing collaborations concerning greener product design or process modification, and energy conservation or waste reduction in the logistics process.

However, Vachon and Klassen (2006) and Walker et al. (2008) recognised that this paradigm has not drawn much attention as an empirical research topic. Two possible reasons are proposed for this lack of literature. One is that the supplier aspect has not been studied as a discrete topic; the other is that suppliers have not had an

impact on enterprises' environmental performance. Walker et al. (2008) investigated suppliers as a force in the implementation of GSCM, but none of the participants identified supplier as an external pressure, and the researchers define it as poor supplier commitment. Nevertheless, suppliers are still defined as a pressure in this study as they have external power in terms of pushing GSCM progress. Thus, the fourth hypotheses is as follows:

H1d: Chinese manufacturing SMEs have been under supplier pressures from upper-stream partners in terms of GSCM.

Internal drivers

There are several internal drivers in terms of GSCM development for enterprises. Walker et al. (2008) emphasised the importance of personal commitment of individuals as a useful impetus to GSCM. Furthermore, personal commitment can be top-down – from senior management to middle management and then to employees. For example, New et al. (2000) pointed out that commitment from top management, such as the founder and owner, is positively related to GSCM for an enterprise. In addition, support from middle management contributes to the green purchasing strategies of a business (Carter et al., 1998). Furthermore, employee involvement in terms of GSCM within an enterprise can lead to operational and environmental improvements (Hanna et al., 2000). Drumwright (1994) used the example of proficient policy entrepreneurs, who have an intrinsic impetus to make their businesses environmentally friendly and often apply motivation tools, such as rewards and promotions, to promote green activities to employees throughout the enterprise.

Secondly, the aspiration to build an environmentally friendly image is also an internal impetus for enterprises to consider GSCM. Taking Japanese enterprises as an example, CSR and environmentally friendly image are viewed as two important

stimuli for enterprises, especially LEs, to implement GSCM (Zhu et al., 2010). High social reputations resulting from a positive environmental image could help enterprises to gain strong market competitiveness, even in the global market.

Thirdly, the desire to reduce cost and save energy within an enterprise is also a popular driver for environmental management throughout a supply chain. As discussed by Porter and Van de Linde (1995), based on the lifecycle model of a product, the so-called hidden costs lie in pollution in the form of wasted resources, energy and labour. Therefore, pollution prevention is a useful strategy to prevent pollution and cost during the production process. Moreover, the positive outcomes from such pollution prevention efforts can help to improve the quality of the product (Pil and Rothenberg, 2003). Handfield et al. (1997) agreed in this respect, finding that the aspiration to reduce cost, eliminate waste and improve quality are the main impetus for an enterprise's GSCM initiatives, rather than customer pressures or enterprise compliance. However, none of the research discussed above clearly identifies whether the enterprise scale make sense to the promotion of these internal drivers, which provides another research avenue for this study. It is thus proposed that:

H1e: Chinese manufacturing SMEs have been encouraged by internal drivers with respect to GSCM.

2.11.2 GSCM practices

Green purchasing

Green purchasing, also called green procurement, was defined by Leire (2006) as a part of product that is taking on the CSR of an enterprise. He also argued that the environmental requirements of suppliers could help an enterprise to improve the environmental performance of its products. Therefore, green purchasing has drawn significant attention, especially in developed nations and regions. Taking the

requirements of ISO 14001 certifications for suppliers as an example, Chen (2005) pointed out that by the end of 2001 the ten leading nations and regions with ISO 14001 certified firms were all in the developed world, totalling 16,108 and the number has been continuously increasing.

However, as purchasing and supply chain managers have to take environmental concerns into consideration in addition to the traditional purchasing criteria of cost, quality and delivery in their green purchasing, it requires more effort and resources from SMEs for SMEs and SMEs may be constrained with their lack of resource to initiate green purchasing strategy. For example, Sabari et al. (2012) found that Indian SMEs did not have much awareness of green procurement such as online purchasing. While by doing a case study with a Taiwan textile SME, Lai et al. (2012) claimed that a modified ICT model helped to shorten its supplier's response time and increases information transparency and visibility and thus leaded a win-win relationship between this SME and its suppliers with lower costs. Moreover, with the help of Industrial Waste Exchange Program in Philippine, a match has been established between Peter Paul Philippines Corporation and Chia Meei-a generator of raw coconut water as its waste and a buyer of coconut water to produce coconut drinks to effectively benefit the waste generator, the waster buyer and the environment (Rao, 2007). Thus, it is proposed that:

H2a: Chinese manufacturing SMEs employ green purchasing practices.

Eco-design

According to Gottberg et al. (2006), eco-design was conceptualised following a series of innovations conducted by manufacturers for cleaner and greener products, including considerations regarding improved durability and energy efficiency, poisonous materials disuse and simple disassembling for recycling. Taha et al. (2010) also argued that eco-design practices are a kind of proactive strategic method to

reduce environmental damage. Additionally, they introduced a four-level model of eco-design implementation; the four levels are no eco-design, basic eco-design, cradle-to-grave and cradle-to-cradle.

Eco-design for SMEs have engaged attentions from many researchers. For example, with an investigation into SMEs manufacturing automotive products in the Midlands of the UK, Veshagh and Li (2006) found that design for material usage and design for durability were the most commonly used eco design strategies adopted by SMEs and the majority of investigated SMEs regarded lack of financial incentives and no justification for investment as the main barriers to their implementation of eco design. Moreover, Núñez et al. (2006) claimed that eco-design in the daily activities of the SMEs in Spain could generate advantages for them, such as continuous environmental improvement of the product system, opening of new markets, reduction of costs and so on. With regard to the developing countries, Lind (2007) conducted case studies in three Indian SMEs in the electronics industry and found that the three SMEs have initiated very limited eco-design practices and top management had a large influence on whether environmental aspects are considered or not in product designing. In order to find out what is happening amongst Chinese SMEs, an additional hypothesis is as follows:

H2b: Chinese manufacturing SMEs employ eco-design practices.

Investment recovery

Investment recovery can be regarded as a closed loop of reuse and recycling of by-products, waste water, waste emissions, waste rejectamenta and equipment adjustment in the production process. Hammond and Beullens (2006) emphasised that using returned items for remanufacturing is more economical than using virgin materials for enterprises.

For example, Parsons and Kriwoken (2009) reported that 83% of waste oil and 66.2% of waste cardboard was recycled amongst Hobart SMEs in Australia. Furthermore, Hoof and Lyon (2013) claimed that evidence from 972 Mexican SMEs indicated that waste recycling and waste prevention projects yielded high economic and environmental value. In Turkey, SMEs were also believed to initiate some investment recovery practices like adoption of water filtering system, use of air filters, buying and using recycled materials and so on (Agan et al., 2013). Thus, it is proposed that:

H2c: Chinese manufacturing SMEs employ investment recovery practices.

Cooperation with customers

Besides green purchasing from suppliers, enterprises also need to cooperate with their customers – i.e. downstream buyers or end users – to improve their environmental performance and simultaneously seek economic profits. According to Theyel (2006), collaboration with customers is similar to collaboration with suppliers, and enterprises can enjoy benefits such as waste reduction, while meeting their customers' needs as well as proposing requirements to their suppliers in terms of environmental criteria. For example, in order to ensure compliance with the requirements of their customers, companies like Herman Miller, Sony Ericsson and IKEA have to transfer these requirements to all partners throughout the supply chain.

It is believed that the impetus for SME suppliers to improve their GSCM is the requirement from "a large customer" (Hoskin, 2011). For example, The Warehouse, New Zealand's supermarket giant, has announced an intention to stop purchasing from suppliers that fail to meet its environmental standards; therefore, SME suppliers in New Zealand tried to perform well environmentally to cooperate with it, gaining competitive advantage over those that do not. Halliday (2012) also insisted that customers preferred to select green logistics SME suppliers to reduce carbon dioxide emission and SMEs who applied IT logistics solutions like Transport Management

Systems had better economic benefits through cost saving and further led to a win-win relationship with their customers. Therefore:

H2d: Chinese manufacturing SMEs employ GSCM practices in cooperation with customers.

Internal environmental management

Hamel and Prahalad (1989) argued that support from top management within an enterprise is usually a useful and stimulating power for implementation most innovations, technologies, programmes and activities. As such, GSCM practices need encouragement from senior managers. Both Zsidisin and Siferd (2001) and Rice (2003) emphasised the importance of commitments from top management in the implementation and success of the environmental achievements of an enterprise. In addition, Carter et al. (1998) and Bowen et al. (2001) stressed the importance of support and devotion from middle management with respect to success and excellence with respect to an enterprise's environmental performance.

By investigating into 46 Portuguese SMEs, Santos et al. (2011) believed that SMEs in Portugal have achieved some level of internal environmental management in terms of GSCM, such as internal audits, control documents, corrective and preventive actions, management responsibilities, employee training and so on. Raar (2011) also insisted that the internal information system of SMEs helped their waste minimisation practices with increased efficiency and effectiveness. With regard to Asian area, Lee and Klassen (2008) emphasised on the significance of top management towards the environmental management for Korean SMEs. The senior managers played a role both in identifying environmental issues and in selling environmental improvement plans inside the organization. This leads to an additional hypothesis towards Chinese SMEs:

H2e: Chinese manufacturing SMEs employ GSCM practices in their internal environmental management.

2.11.3 GSCM performance

Environmental performance

Corbett and Pan (2002) found that environmental performance involves evaluating profits from enterprises, as well as environmental impacts. Greening the supply chain by using environmentally friendly raw materials, greening production to make it cleaner, and preventing pollution and minimising waste at the source can lead to environmentally friendly waste disposal and mitigation of the effects of pollution through waste water treatment and the abatement of emissions (Rao, 2003); which can be regarded as improvements in environmental performance. Moreover, the risk of non-compliance, penalties and closure can also be reduced.

Economic performance

Economic performance is the first priority for enterprises when implementing GSCM. It is generally agreed that economic performance represents the economic yield within the profit of an enterprise, and profit increases can result from the enterprise's environmental actions (Zhu and Sarkis, 2004; Zhu et al., 2008; Claver et al., 2007). Economic performance involves the effective use of various inputs within production. It can be divided into two categories, as mentioned above: (1) positive and (2) negative economic performance. For example, the economic performances that are evaluated in the automobile industry include positive ones in the form of decreased costs with respect to energy consumption, material purchasing, waste treatment, and waste disposal. In contrast, increased investment and operational cost and the costs of purchasing environmentally friendly materials can be viewed as negative economic performances (Zhu and Sarkis, 2004; Kumar and Subrahmanya, 2010).

Operational performance

Operations are the foundation of efficient distribution and manufacturing, which then leads to financial returns (Naylors, 2002). Measuring operational performance is necessary when dealing with customer satisfaction, internal processes and activities (Moriones and Merino, 2002; Rao and Holt, 2005; Azevedo et al., 2011). In this study, the categories selected for evaluating operational performance are: (1) scrap/waste reduction, (2) inventory reduction, (3) increase in timely delivery of products, (4) quality improvement, and (5) productivity improvement.

2.11.4 GSCM practices and performance

Many researchers have proven the positive contribution made by GSCM practices towards an enterprise's environmental performance. For example, Zhu and Sarkis (2004) investigated the relationship between internal environmental management, external GSCM, investment recovery, and eco-design, and the impact of these on environmental and economic performance. The findings and results of this study show a positive relationship between GSCM and environmental performance, but no significant relationship with economic outcomes. This study tries to identify the correlations between each individual GSCM practice and corresponding performance, and the following hypotheses are thereby suggested:

H3a: The practice of green purchasing is positively related to environmental GSCM performance for SMEs in Chang Chiang River Delta of China.

H3b: The practice of eco-design is positively related to environmental GSCM performance for SMEs in Chang Chiang River Delta of China.

H3c: The practice of investment recovery is positively related to environmental GSCM performance for SMEs in Chang Chiang River Delta of China.

H3d: The practice of collaboration with customers is positively related to environmental GSCM performance for SMEs in Chang Chiang River Delta of China.

H3e: The practice of internal environmental management is positively related to environmental GSCM performance for SMEs in Chang Chiang River Delta of China.

GSCM practices and economic performance

Excluding Zhu and Sarkis's (2004) study, many maintain that GSCM practices can improve the economic performance of enterprises (Azevedo et al., 2011). Bhateja et al. (2011) introduced a case analysis of a large multinational enterprise seeking opportunities to green its supply chain by directly assigning additional tasks on GSCM to its senior executives over and above their regular jobs but without any funding. The findings of the case indicate that these GSCM adoptions led to a 5-20% cost reduction to the enterprise, without any new technology being applied. Thus, the following hypotheses are proposed:

H3f: The practice of green purchasing is positively related to economic GSCM performance for SMEs in Chang Chiang River Delta of China.

H3g: The practice of eco-design is positively related to economic GSCM performance for SMEs in Chang Chiang River Delta of China.

H3h: The practice of investment recovery is positively related to economic GSCM performance for SMEs in Chang Chiang River Delta of China.

H3i: The practice of collaboration with customers is positively related to economic GSCM performance for SMEs in Chang Chiang River Delta of China.

H3j: The practice of internal environmental management is positively related to economic GSCM performance for SMEs in Chang Chiang River Delta of China.

GSCM Practices and Operational Performance

In addition to environmental and economic performance, which have been more widely investigated and discussed in association with GSCM practices in previous studies, the evaluation of operational performance resulting from green implementations in supply chains has attracted increasing attention among researchers. For example, Azevedo et al. (2011) find that improvements in both product quality and production efficiency have the most significant relationship with

GSCM practice implementations, in addition to the performance of environmental cost reduction. Moreover, by investigating automobile industry manufacturers, Lin et al. (2011) argue that product quality can be improved with the utilisation of environmentally friendly materials, collaboration with green suppliers and stringent regulations to meet environmental requirements, which are also significantly helpful in improving their corporate image and market positions. Therefore:

H3k: The practice of green purchasing is positively related to operational GSCM performance for SMEs in Chang Chiang River Delta of China.

H3l: The practice of eco-design is positively related to operational GSCM performance for SMEs in Chang Chiang River Delta of China.

H3m: The practice of investment recovery is positively related to operational GSCM performance for SMEs in Chang Chiang River Delta of China.

H3n: The practice of collaboration with customers is positively related to operational GSCM performance for SMEs in Chang Chiang River Delta of China.

H3o: The practice of internal environmental management is positively related to operational GSCM performance for SMEs in Chang Chiang River Delta of China.

2.12 Chapter summary

This chapter began by reviewing the development of GSCM. It then discussed the theories that will be employed in this research, including CSR, stakeholder theory, IE, DfE and LCA. It explained how these theories link to GSCM, and discussed GSCM pressures, practices and performances, which are the main factors examined in this research. The theoretical framework of this research was thus established as a new perspective to review GSCM development among Chinese SME manufacturers in the Chang Chiang River Delta. Finally, the hypotheses regarding GSCM pressures and drivers, and whether they vary across different sectors, GSCM practices, GSCM performances and relationships between GSCM practices and corresponding performances were proposed.

In the next chapter, the research methodology used in this project will be discussed. The chapter will include a section on the underlying philosophy of the research, and focus on discussions about how actual data were collected, along with reflections arising on the methodology during the data collection phase.

3. Methodology

3.1 Introduction

The chapter aims to explain why certain data was collected, what data was collected, where it was collected from, when and how it was collected, and how it will be analysed. In order to test the hypotheses put forward in Section 2.11, the research methodology will be discussed. The first section, which discusses the research philosophy of this project, will help to shape the research methods discussed in section 3.3, where both the advantages and limitations of the survey questionnaire and case study methods will be considered in order to explain the final research methods chosen for this research project.

In the following sections, the procedures used for the questionnaire preparation, data gathering and data processing will be explained. The chapter will then come to the ethical concerns that arose during the research, including triangulation, reliability, validity, representativeness, and research ethics. A discussion will then be conducted on the proposed timing of this research project, and a summary will conclude the chapter.

3.2 Research philosophy

“Research philosophy” can be defined as an overarching term that relates to the development of knowledge and the nature of that knowledge with regards to particular research (Saunders et. al., 2009). The adoption of a research philosophy includes critical assumptions about the how the researcher views the world, and those assumptions will determine the choices of research strategies and methods. Although it is an abstract term, “research philosophy” is of great importance to the research strategy design because it will have a significant impact on the way the research is conducted, and the understanding of the research findings. Therefore, different philosophies adopted in research processes will obviously lead to different

findings and views on the same issue. Furthermore, according to Saunders et al. (2009), no one philosophy is better than another. The “best” way to carry out research only depends on the research reality – that is, obtaining answers to the research questions. Saunders et al. (2009) also pointed out that ontology and epistemology are two major ways to think about research philosophy, and these are often used in the social science context.

“Paradigm” is another term frequently used in the social sciences to understand research philosophy. According to Collis and Hussey (2003), the term “paradigm” refers to the progress of scientific practice on the basis of people’s philosophies and assumptions about the world and nature. In the context of “research paradigm”, it refers to how research should be conducted.

With regards to this particular research, the epistemological research philosophy will be considered. Epistemology is the study of knowledge which tries to answer “what” questions. According to Bryman and Bell (2007), epistemology is about issues having to do with the creation of knowledge for particular social concerns. This research focuses on the GSCM development of SMEs within a particular territorial area in China, and thus epistemological considerations are helpful in research design and the process of carrying out the research. According to Gephart (2004), based on the underlying research epistemology there are three categories of research paradigms or philosophical research perspective: positivist and post-positivist, interpretive, and critical postmodernism. In the present research, positivist and post-positivist, as well as interpretive, methodologies will be used in this research.

Positivist and post-positivist methodology focuses on realism, which refers to the objective realities that can be understood with reference to science (Lincoln and Guba, 2000). This methodology seeks to uncover the truth. Moreover, by using this methodology, the factual depictions of the world can be collected and analysed to reveal the definitive or probabilistic truths or realities, and to evaluate, verify or

falsify hypotheses (Gephart, 2004). In addition, it usually uses precise, objective measures and is associated with quantitative data.

Interpretive methodology focuses on relativism, which refers to the inter-subjective realities composed of both subjective and objective meanings (Gubrium and Holstein, 2000). The goal of this methodology is to uncover, describe, and theoretically interpret actual meanings that people use in real settings. Furthermore, it is usually associated with qualitative methods, such as case studies, interviews, observational methods, grounded theory and textual analysis (Gephart, 2004).

Positivism has long been believed to be the best method for social science research, which focuses on studying humans and their societies (Easterby-Smith, et al., 2002). The first person to state the importance of maintaining objectivity within social research was the famous French philosopher, Auguste Comte. In his book, *The Philosophie Positive of Auguste Comte*, published in 1853, Comte said: "All good intellects have repeated, since Bacon's time, that there can be no real knowledge but that which is based on observed facts" (pp.27).

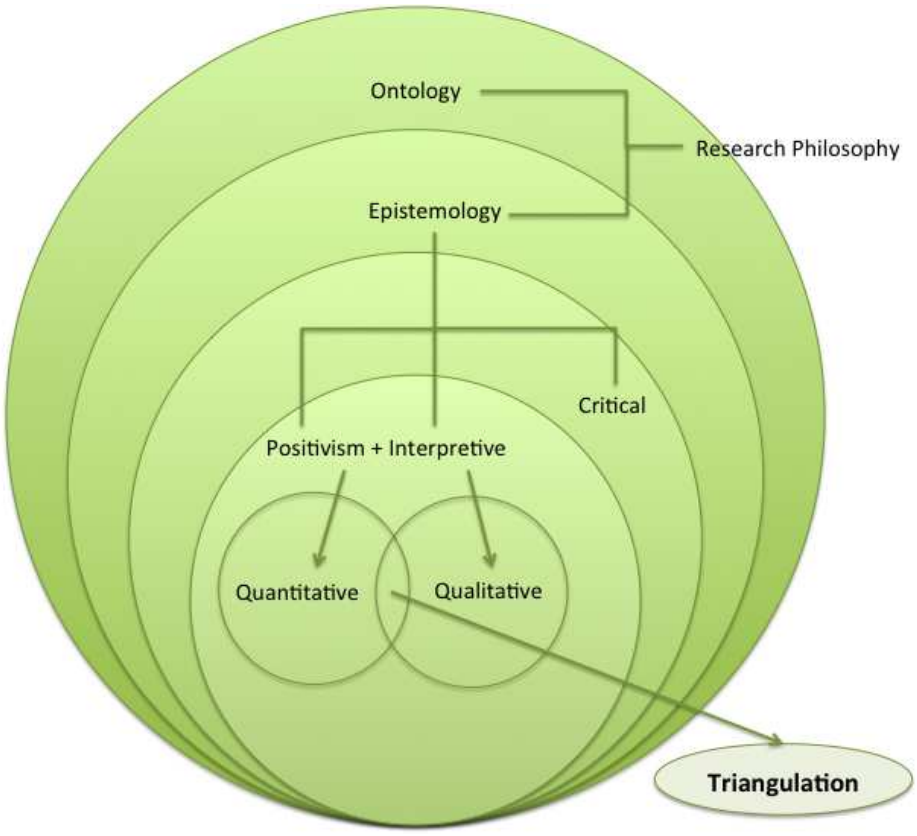
Therefore, as an outcome originating from the positivist paradigm, quantitative methods are believed to be objective and "real" because they emphasise the hard facts of society, rather than "subjectivity" – i.e. people's opinions or attitudes (Easterby-Smith et al., 2002). Although quantitative methods are efficient, objective, fast and can provide a large range of data; they are simultaneously inflexible and artificial. For example, they can test theories, but cannot generate them. Furthermore, they may miss some contextual details, for example, in-depth explanations might be missed.

In addition, although it is believed that qualitative methodologies, such as ethnography, case study, discourse analysis and grounded theory, are more flexible and able to provide more detailed information (Goulding, 2002), there are still some

criticisms towards qualitative methodologies applied in management research from the positivist tradition, which has dominated social science research, in terms of its weak purposiveness.

Thus, considering the limitations of both quantitative and qualitative research methods, a multi-method strategy is chosen here to reject the narrow analytical paradigms in favour of breadth of information, which can be provided by using more than one method. Quantitative research allows the collection of a large amount of data from a sizable population in a highly economical way, while qualitative research provides detailed information to explain social phenomena in depth; therefore, the combination of these two approaches is a popular strategy at present, especially in business and management research, and is called "triangulation". This will be further discussed in Section 3.8. Based on the discussion above, the research methodology can be summarised as shown in Figure 3.1.

Figure 3.1 The research methodology used in this study



3.3 Research methods

According to Yin (2003), different research methods help to answer different forms of research questions. Table 3.1 shows a summary of the various types of questions that can be answered with different research methods.

Table 3.1 Questions answered with different research methods

Strategy	Form of research questions	Requires control over behavioural events?	Focuses on contemporary events?
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival Analysis	Who, what, where, how many, how much	No	Yes
History	How, why	No	No
Case Study	How, why	No	Yes

Based on: Yin (2003)

Given the research questions listed in section 1.2, this study aims to answer "what" and "how" questions. "What" questions are exploratory in nature and "how" questions are explanatory in nature; both are concerned with identifying and understanding the functioning of a process or processes within a phenomenon. Therefore, "what" and "how" questions can also be deployed in descriptive and exploratory studies, as is the case of this research, with the purpose of developing the selection framework. A questionnaire survey can thus be employed to identify and describe the variability, and examine and explain relationships between the variables (Saunders et al., 2009); case study can be used to accomplish various aims, including providing description, and testing or generating theory, either explanatory or exploratory (Eisenhardt, 1989; Yin, 2003).

This research is anticipated to form part of a larger area of study, and is descriptive and exploratory in nature, with the bulk of questions within the questionnaire aiming

to identify the variables within the phenomenon at hand, and the relationship between them, while the case study is intended to describe and explain the phenomenon in detail. The use of the questionnaire survey and case study can be further justified from the analysis in Table 3.1, which shows that a study with “what” and “how” questions will be more suited to survey and case study research methodology.

Furthermore, Mintzberg (1979) described the use of both types of data as synergistic, with quantitative data used to establish relationships, and qualitative data uncovering relationships achieved from quantitative data. Therefore, the mixture of both qualitative and quantitative data within this research is ultimately supported by the fundamentals of the survey and case study methodology. The technique of triangulation is thus used in this study, and further discussion of the data collection can be seen below in section 3.6.

3.3.1 Questionnaire survey

The quantitative questionnaire survey method is used in this study. Surveys are a fairly popular research strategy within business and management research (Saunders et al., 2009), and there are several possible reasons for this. Firstly, surveys are quite helpful to obtain straightforward information from respondents (McIntyre, 2005). They enable respondents to directly clarify their answers to the researchers. Secondly, this method provides a cost-effective way for the researchers to obtain data from a large number of samples (Easterby-Smith et al. 2002). In addition, it is highly economical to sample rather than to target the whole population, as the findings from a survey sample can represent the whole population (Saunders et al., 2009). Another interesting point, according to Saunders et al. (2009), is that surveys are always regarded as authoritative, as they are relatively easy to explain and to understand in comparison to other data collection techniques. For this study, a questionnaire with 100 questions is used for the survey, and the measurements and

data collection process will be introduced in the following sections.

The questionnaire survey method does also have limitations which need to be addressed. Firstly, closed-ended questions are incapable of identifying any points that participants have misinterpreted as a result of inappropriate wording and placement of questions, or misunderstanding, which will probably lead to biased results (Choi and Pak, 2005). Secondly, poor internal validity can arise because standardised questions cannot reveal detailed information such as why something happens (Mitchell and Jolley, 2010). In light of these limitations, and to obtain more detailed information within the investigated phenomenon, the case study method can be used to overcome the possible disadvantages generated by single-method strategy.

3.3.2 Case study

Case study enables a researcher to closely examine the data within a specific context (Saunders et al., 2009). The method that has been applied extensively by researchers in many fields, including education (Gulsecen and Kubat, 2006), sociology (Grassel and Schirmer, 2006), community-based problems (Johnson, 2006), Law (Lovell, 2006), Medicine (Taylor and Berridge, 2006) and management (Saunders et al., 2009). There are several reasons for its popularity. For example, the data collected from a case study can be examined and analysed in context (Yin, 2008). In other words, the data does not need to be analysed by other tools or in other ways. Moreover, the detailed information from a case study can help not only to understand what is happening in real life at that moment, but to explain the complexities of contemporary real life environment, which may not be possible using experimental or survey research (Zaidah, 2003).

However, there are several disadvantages of the case study method. The first relates to its generalisability (Yin, 2003; Tellis, 1997; Silverman, 2009), which is limited by its

dependency on a single case or a few cases. In addition, researchers can have biased views, which can affect the findings and conclusions (Yin, 2003).

3.3.3 Research methods for this study

Given the limitations of both methods, as discussed above, this study will combine the findings from a case study with quantitative survey data in order to provide a more detailed explanation of GSCM pressures, practices and performances among SMEs with the avoidance of generalisability. The questionnaire survey will be used to test the hypotheses by collecting a relatively wide range of data, while the case study represents the intersection of theory by attempting to fit theoretical methodology with reality. This study's contribution to knowledge lies in its employment of proven techniques in new environments, as well as contributing to industry by deploying the new framework in the real world amidst the dynamism of reality.

3.4 Guidelines on data collection

3.4.1 Questionnaire development

The primary data used in this study comes from questionnaire responses from managers in SMEs that have a profound impact on the environment, and are located within Chang Chiang River Delta in China. The questionnaire contains four sections consisting of 100 questions. The first section is composed of six questions which aim to obtain basic information of the enterprises, including "how old" the enterprises are, which sectors they operate in, and their location. It will also ask for information on the number of employees, the total assets and the annual turnover so as to ensure that the respondents belong within the scope of SMEs. The remaining three sections are made up of items affecting implementation; namely, the pressures, current practices and corresponding performance.

Section two contains 29 items on pressures. These are based on a number of sources

form the literature, including Min and Galle (1997), Carter and Carter (1998), Christmann and Taylor (2001), Chan and Lau (2001), Zhu et al. (2005), and González-Benito and González-Benito (2006). The section contains 45 questions regarding practice; these items were generated based on previous research initiatives (Zsidisin and Hendrick, 1998; Walton et al., 1998; Carter et al., 2000; Zhu and Sarkis, 2004; Zhu et al., 2008; Azevedo et al., 2011). The last section of 20 questions concerns environmental, economic and operational performance, and has also been developed from the literature (van der Grijp and den Hond, 1999; Zhu et al. 2005; Azevedo et al., 2011; Lin et al., 2011). Table 3.2, 3.3 and 3.4 show the question items used in this study, being developed from previous research in terms of GSCM pressures, practices and performances respectively.

Table 3.2 Items of GSCM Pressures

Variables (GSCM Pressures)	Items	Previous Research	Original items
Regulatory Pressures	State environmental laws; National laws on resource conservation; Local environmental laws; Local laws on resource conservation; Environmental regulations from import countries	Min and Galle (1997)	"state environmental regulation", "federal environmental regulation"
		Carter and Carter (1998)	"current government legislation", "the threat of future legislation"
		Christmann and Taylor (2001)	"domestic environmental regulations", "exports to developed countries"
		Zhu et al. (2005)	"central governmental environmental regulations", "regional environmental regulations"
Customer Pressures	Joint venture buyers; Domestic customers; End-users	Min and Galle (1997)	"buyer awareness"
		Carter and Carter (1998)	"requests by retailers or distributors to reduce primary packaging", "consumer pressures", "demands by customers to take back packaging waste"
		Zhu et al. (2005)	"export", "sales to foreign customers in China"
Public Pressures	Building green brand for customers; Establishing green corporate image in Media; Society boosts like NGOs	Chan and Lau (2001)	"behavior intention" for green products of "personal use"
		González-Benito and González-Benito (2006)	"NGOs and the media as the secondary stakeholder"
Supplier Pressures	Environmental collaboration; Improvements in developing green product; Green packaging; Homogeneous producers; Substitute producers; Industry association requirements	Min and Galle (1997)	"supplier awareness"
		Carter and Carter (1998)	"actions by suppliers", "new product offerings by suppliers"
		Zhu et al. (2005)	"environmental partnership with suppliers", "competitors' green strategies", "industrial professional group activities"
Internal Drivers	Corporate environmental vision; Top management; Middle management; Employees; Human resource; Special budget for green products development; Special budget for environmental management; Pollution preventive budget; Pollution disposal budget; By-products disposal budget; Healthy corporate image; Green trademarks	Min and Galle (1997)	"management commitment", "cost of environmental programmes"
		Zhu et al. (2005)	"enterprise's environmental mission", "cost for disposal of hazardous materials", "cost of environmentally friendly goods", "cost of environmentally friendly packaging"

Table 3.3 Items of GSCM Practices

Variables (GSCM Practices)	Items	Previous Research	Original items
Green Purchasing	Requirements of environmental protection to suppliers; Collaborations with suppliers for environmental protection; Regular environmental audit to suppliers; Assessment to environmentally friendly practices to secondary suppliers; JIT logistics with suppliers; Demands on suppliers for green packaging materials; Collaboration with suppliers for less packaging materials	Zsidisin and Hendrick (1998)	"purchase of hazardous materials/chemicals/equipment", "provide design specifications to suppliers that include environmental requirements for purchased items", "ISO14000 environmental certification", "collaboration with suppliers to provide materials, equipment, parts, services that support environmental goals", "environmental audits of suppliers"
		Walton et al. (1998)	"environmental criteria used to evaluate potential suppliers", "suppliers actively participated in environmental efforts", "supplier qualification"
		Carter et al. (2000)	"purchases recycled packaging", "purchases packaging that is of lighter weight", "asks suppliers to commit to waste reduction goals"
		Zhu and Sarkis (2004)	"providing design specification to suppliers that include environmental requirements for purchased items", "cooperation with suppliers for environmental objectives", "environmental audit for suppliers' internal management", "suppliers' ISO14000 certification", "second-tier supplier environmentally friendly practice evaluation"
		Azevedo et al. (2011)	"environmental collaboration with suppliers", "environmentally friendly purchasing practices"
Eco-design	Consideration on conservation of energy and resource in design; Consideration on recycling in design; Consideration on using less hazardous raw materials in design; Consideration on reducing negative production in design; Consideration on using less hazardous packaging materials in design	Zsidisin and Hendrick (1998)	"design of products for reduced consumption of material/ energy", "design of products for reuse, recycle, recovery of material, component parts", "design of products to avoid or reduce use of hazardous material in products and/or their manufacturing processes"
		Walton et al. (1998)	"processes redesigned to reduce waste", "life cycle of product considered" in "product design"
		Carter et al. (2000)	"uses a life-cycle analysis to evaluate the environmental friendliness of products and packaging", "participates in the design of products for disassembly", "participates in the design of products for recycling or reuse"
		Azevedo et al. (2011)	"working with designers and suppliers to reduce and eliminate product environmental impact"
Investment Recovery	Minimum waste production; Recycling and selling by-products; Using disposal systems of waste water; Using disposal systems of waste emission; Using disposal systems of waste rejetamenta; Quick to adjust the equipment amount	Zsidisin and Hendrick (1998)	"investment recovery (sale) of excess inventories/materials", "sale of scrap and used materials", "sale of excess capital equipment"
		Walton et al. (1998)	"solid waste handled", "disposition of scrap and waste"
		Azevedo et al. (2011)	"minimizing waste", "decreasing the consumption of hazardous and toxic materials"
Cooperation with Customers	Collaboration with customers in eco-design; Collaboration with customers in clean production; Collaboration with customers in green packaging; Collaboration with customers in green logistics; Collaboration with customers in reclaiming seconds and used products; Collaboration with customers in reclaiming stocks	Walton et al. (1998)	"customer request environmentally-responsible products", "reverse logistics flows", "environmental issues impact transportation selection and/or distribution methods"
		Zhu and Sarkis (2004)	"cooperation with customer for eco-design", "cooperation with customer for cleaner production", "cooperation with customer for green packaging"
		Azevedo et al. (2011)	"reverse logistics", "environmental collaboration with customers", "environmentally friendly packaging", "working with customers to change product specification"
Internal Environmental Management	Active environmental management from top management; Environmental considerations from top management for big decisions; Support from middle managers; Staff training programme of environmental management; Departments collaborations; Complying with environmental regulations and requirements; Updated environmental policies; ISO14001 certification; Monitoring system of TQEM; Prompt reaction to environmental problems; ISO9000 certification; Pollution prevention scheme; Eco trademarks; Internal performance evaluation including environmental performances; Internal assessment including environmental report; Rewards and punishment systems to environmental performances for top managers/ middle managers/employees; Consideration on social responsibility cost	Zhu and Sarkis (2004)	"commitment of GSCM from senior managers", "support for GSCM from mid-level managers", "cross-functional cooperation for environmental improvements", "total quality environmental management", "environmental compliance and auditing programmes", "ISO14001 certification", "environmental management system exist"
		Azevedo et al. (2011)	"ISO14001 certification"

Table 3.4 Items of GSCM Performances

Variables (GSCM Performances)	Items	Previous Research	Original items
Environmental Performances	Emission reduction; Waste-water reduction; Solid waste reduction; Reduction of hazardous material used; Lower incidence of environmental accidents; Environmental improvement	Zhu et al. (2005)	"reduction of air emission", "reduction of waste water", "reduction of solid waste", "decrease of consumption for hazardous/harmful/toxic materials", "decrease of frequency for environmental accidents", "improve an enterprise's environmental situation"
		Azevedo et al. (2011)	"business waste"
		Lin et al. (2011)	"pollution control initiatives", "use of environment friendly technology", "partnership with green organizations and suppliers", "environmental certification"
Economic Performances	Increased environmental investment; Increased operation cost; Increased training cost; Increased cost to purchase environmentally friendly materials; Cost reduction by using recycled materials; Cost reduction of energy consumption; Cost reduction of waste disposal; Cost reduction of waste discharge; decreased fines for environmental incidents	Zhu et al. (2005)	"increase of investment", "increase of operational cost", "increase of training cost", "increase of cost for purchasing environmentally friendly materials", "decrease of cost for materials purchasing", "decrease of cost for energy consumption", "decrease of fee for waste treatment", "decrease of fee for waste discharge"
		Azevedo et al. (2011)	"environmental cost"
		Lin et al. (2011)	"decrease of cost for materials purchasing", "decrease of cost for energy consumption", "decrease of fee for waste treatment", "decrease of fee for waste discharge", "increase of investment", "increase of operational cost", "increase of cost for purchasing environmentally friendly materials"
Operational Performances	Increased number of products timely delivered; Reduction in inventory; Reduction in scrap; Improved product quality; Improved production efficiency	Zhu et al. (2005)	"increase amount of goods delivered on time", "decrease inventory levels", "decrease scrap rate", "promote products' quality", "increased product line", "improved capacity utilization"
		Azevedo et al. (2011)	"quality", "customer satisfaction", "efficiency"
		Lin et al. (2011)	"scrap/waste reduction", "quality improvement", "delivery improvement", "capacity utilization improvement"

All 94 questions from the latter three sections are measured on a five-point Likert-type scale, as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

3.4.2 Sample selection

Survey sample

The data used in the research were obtained from questionnaire responses from manufacturing SMEs in the Chang Chiang Delta region of China. The data collection was implemented through two steps: a pilot test was carried out to test and refine the questionnaire, followed by a survey in the target research area. The survey was completed through postal mail, telephone calls and convenience distribution through personal networks. The case was then selected out of the questionnaire respondent firms and the case study carried out to obtain more and deeper information.

Sampling technique

A convenient sampling, which is one method of non-probability sampling techniques, was done for this research and it was because of the limitations of availability of the statistical number of SMEs neither in the research area of Chang Chiang Delta nor in national wide. A possible reason for the lacuna of such data is that Chang Chiang River Delta is not an official administrative region, and thus no organisation is responsible for the statistical data collection. In addition, given the instability of development respect to SMEs, identifying the number of SMEs seems to be an unviable task, especially when taking into account those that are not registered. As an initial plan, a total of 1,000 SMEs would be approached through emails or posts attached with the questionnaires, with the expectation of a response rate as high as possible.

Sampling frame

The sampling frame of this study comprised Chinese SMEs randomly selected from the e-marketplace who are in the manufacturing industry, which included food and beverage, clothing, textile and tannery, wood processing and furniture, paper making and printing, pharmaceutical and biological products, chemistry and chemical, plastic and rubber, metal, instrumentation, vehicles, machine and machinery, and electronic telecommunications facilities. The sectoral categories were listed as options for the questionnaire respondents to choose from so as to indicate their industry, and was designed based on the classifications of industries and sectors from both the Shanghai Stock Exchange and the New York Stock Exchange. Table 3.2 shows the distribution of the respondent SMEs in terms of industrial sectors.

Table 3.5 Distribution of respondent SMEs in terms of industry for this study

Sector	Total	Percentage(%)
Food and Beverage	7	3.5
Clothing, Textile and Tannery	44	21.8
Wood Processing and Furniture	8	4.0
Paper Making and Printing	8	4.0
Pharmaceutical and Biological Products	11	5.4
Chemistry and Chemical	13	6.4
Plastic and Rubber	15	7.4
Metal	17	8.4
Instrumentation	11	5.4
Vehicles	10	5.0
Machine and Machinery	25	12.4
Electronic Telecommunications Facilities	33	16.3
TOTAL	202	100

Selecting a case

Reasons for selection

Qualitative research, like case study, can provide more detailed information to contribute to the discussions and conclusions within a study. Therefore, one SME from the questionnaire respondents was selected as a case study in order to more deeply explore GSCM among SMEs in the specific region of Chang Chiang River Delta in China.

Moreover, together with the findings of the investigation into the specific enterprise, a GSCM model was built up based on the results of the quantitative survey; this model would not only be helpful for the specific enterprise investigated with respect to improving its GSCM strategy and sustainable development in the long run, but would also have significance for SMEs in the same industrial sector and in the region of Chang Chiang River Delta, and may even serve as a useful as a example for SMEs across industries nationally and internationally.

Criteria for selection

As mentioned above, the enterprise for the case study was selected from the research respondents to ensure generalisability when combining the results with the findings of the questionnaire survey. The chosen firm, should also have business relations with foreign enterprises, in order to provide convincing information when taking foreign regulatory and customer pressures into consideration.

Convenience with respect to selection

The first thought regarding selection was that the potential SME should be from the pharmaceutical industrial sector, because the researcher graduated from China Pharmaceutical University and may have a better understanding of this industry over others in terms of regulatory issues, production, operation, marketing and other aspects. The second idea for selecting a pharmaceutical SME manufacturer was that

chemical and medicine/pharmaceutical industries are environmentally sensitive, with increasing attentions to their GSCM strategies as this industry has a closer relationship with the natural environment (Management Centre Europe, 2012). Moreover, the researcher has a good relationship with several pharmaceutical enterprises, and direct access to “insiders” within these enterprises.

Based on above discussion, the SME chosen as the subject for the case study was in Ningbo and the case study enterprise should be by anonymous so that more freedom would be provided to describe the interview structure, the interviewees, and the interview process in more detail as well as being more critical of their processes in the discussion.. More information on this SME will be provided in Section 4.4.

3.5 Preparation for data collection

3.5.1 Pilot test

As part of the exploratory stage of the research, a pilot test was carried out in order to test the validity and practicality of the questionnaire. The pilot test was targeted at SMEs who attended the 2010 China Suzhou International SME Fair. The sample population for the study included 100 SMEs, and these were contacted by email, together with a covering letter, with the allotted time for returning the questionnaire set at four months. A total of 33 questionnaires were returned by the deadline, which provides a response rate of 33% for the exploratory survey.

3.5.2 Preparation for main study

In the following few months, some preparation was required prior to conducting the main study in the proposed time; the specific timings will be discussed in section 3.9. Firstly, based on the feedback and comments from the respondents of the questionnaires, no further modifications were made to the questionnaire as the

majority of the respondents believed that the questions asked accurately reflected the problems and actualities that they were currently experiencing. Secondly, a pre-notification strategy was used with the purpose of increasing the response rate; this will be discussed in Section 3.8.4. Considering the time limitations of the research project, only SMEs falling within the researcher's network were contacted. These were sent an advance email informing them that they had been selected for an upcoming study, and letting them know when they could expect to receive the actual survey invitation, as well as asking them to reply with acceptance or refusal when convenient. The typography and printing of the questionnaires also took some time before the actual survey was conducted.

3.6 Data collection

3.6.1 Survey - Main study

An questionnaire survey was conducted as the main study, starting in January 2011. This was targeted at proprietors, general managers, supply chain managers or production managers in selected SMEs participating in the Chinese e-marketplace (e.g. Alibaba.com), where the contact information for these SMEs was easily found. The rationale for choosing online marketplaces like Alibaba.com for this study was based on the large and transparent Chinese SME databases. In addition, the researcher's personal network and connections with SMEs were used to facilitate data collection. A total of 1,000 questionnaires, along with a covering letter, were sent to the target sample from January 2011, via email or post. Follow-up techniques were also employed to maximise the response rate: another email encouraging a response was sent to the respondents if they failed to return the completed questionnaire within two months. The collection period ended in February 2012; at this point, 229 responses were returned, of which 169 were valid, with all the questions answered, while the remainder were invalid due to being incomplete.

3.6.2 Case study

General Plan

The case study enterprise was originally a private enterprise and now it has been restructured as a joint stock corporation. But with the help of the insiders, the research still had some convenience in accessing to the enterprise.

The first two days was used for the research to settle in, including the tour around the enterprise and introduction to some senior managers from other department. For the rest three days of the first week, information of the enterprise were gathered through documentation and records as the analyses of documents and records could help to examine the validity of information obtained by other methods and could also provide further information on issues that the researcher was interested in gathering. It has a small kind of reception room where they display their patent copies, prizes and other reputations to its guest and all the documentation including journals papers, reports, memoranda, statements, news, letters, policy documents and guidelines of the enterprise could be obtained in this room.

The next five days was first scheduled for interviews and another five days for observation; but an immediate business trip for the manager from the operation department confounded this plan and then the researcher decided to make an open schedule for the following ten working days with interviews and observations. The researcher went to the offices, plants and warehouse for observation and interviewed people. But the axenic workshops were not approached, as there were many complex rules and procedures to enter into those workshops. The interviews were semi-structured; the researcher had a list of themes and questions to be covered but these would vary from interview to interview as it is assumed that employees from different department and plants might concern differently in terms of green issues, resources use or environmental protection.

The last five days were used for doing the summary from the observations and interviews; and the information gathered from the case study enterprise were checked by the insiders before the researcher left for research ethical concerns.

Data collection

From the general plan for case study, there were two main methods to gather data in the enterprise– observations and interviews.

Observation

Observation is a method to watch what people do, listen to what they say and sometimes ask them to clarify certain issues. The benefits of engaging in observation include looking at what people actually do, instead of what they said they are doing or what and how they should be doing it (Gillham, 2000). Through observations, the researcher was able to investigate the GSCM development in the case study companies. Observations for this research project also enabled the researcher to identify possible questions asked during interviews.

However, there are also limitations to case study method including the possibilities of hidden processes behind the execution and that participants might be play-acting and going through the motions that they thought the researcher wanted to see, and not exactly what they would have been doing when not being observed. The disadvantage of observations was limited in this study, as the majority from the case study enterprise did not know that they were observed and behaved as usual.

In the case of this research project, the researcher was allowed to go all areas of the enterprise to observe what people doing and saying related to its GSCM and note down for analysis with the findings from the interviews.

Semi-structured interviews

Semi-structured interviews are interviews designed with a number of sufficiently open-ended questions in advance, while subsequent follow-up questions are not supposed to be planned but improvised impromptu (Wengraf, 2001). Gillham (2000:65) also believed that semi-structured interviews are highly flexible and regarded as "the most important form of interviewing in case study research". A semi-structured interview method aims to gradually reconstruct the interviewee's subjective views and also as a method to seek validation of previous interviews, as well as critical re-examination of competing alternatives. Thus, the researcher could summarise and reconstruct the views of the interviewees on their understandings of GSCM, their evaluations on GSCM development within enterprise/department and so on.

According to Saunders et al. (2009), semi-structured interview strategy provides the interviewers freedom to add or omit some questions in particular interview given specific interview contexts. The order of questions or themes raised in interviews can also be varied depending on the flow of the conversations. But it has to be assured that all the questions asked were within the framework of the questionnaire and related to the aspects mentioned and more findings from interviews and observations will be discussed in Section 4.4.3.

In the case of this study, eight candidates were chosen to be interviewed, including personnel from top management, middle management and employees from the five different departments, including sales department, production department, finance department, quality department and engineering department. One of the candidates from senior management was the general manager, while two middle management candidates included the sales manager and production manager. The other employees each represented a function of the enterprise. To avoid biased information as far as possible, it was assured that all the interviewees except the

general manager were not told with the aim of this study until they had been chosen and started their interviews.

The interviewees were labeled as Interviewee A, B, C, D, E, F, G and H in the following discussions for research ethics considerations. The alphabetical order was corresponding to the sequence of the interviewees participating to the case study and who were these interviewees in terms of their positions and departments are labeled in Table 3.6. During the interviews, only note taking was used to record the information/data from the interviewees as negotiated with the case study enterprise. Thus, the narrative data were collected.

Table 3.6 Interviewee labelling

Interviewee	Position	Department
A	Middle manager	Production Depart.
B	Employee	Quality Depart.
C	Employee	Production Depart.
D	Employee	Sales Depart.
E	Middle manager	Sales Depart.
F	Employee	Finance Depart.
G	Employee	Engineering Depart.
H	Top manager	General Manager (in charge of sales business)

The structure for each of the interviews for this project was as follows: firstly, the introduction of the interviewer and the purpose of the interview and the study; secondly, brief outline of the possible areas to be discussed; thirdly, asking questions and recorded information from interviewees by note-taking; finally, seeking feedback from interviewees on the interview itself and also confirmation of data collected. Each interview lasted around 30 minutes in order not to disturb the regular order of production and operation for the case study enterprise..

Significant as Stake (1995) claimed that the interviewer should have a strong advance plan in order to push the data gathering process and it was therefore also important to ask the right questions. The interview themes were derived from the literature and the questionnaire and the list of main questions that was used in providing a guide to the semi-structured interview process can be found in Table 3.7.

Table 3.7 List of main questions for the semi-structured interview

Questions
How do you understand GSCM?
How do you think the GSCM development in your enterprise/department?
How do you evaluate the GSCM policy of your enterprise if there is any?
Any other comments on GSCM with regard to your job?

Data analysis

Narrative analysis method was used to analyse the data collected from the case study; it is a form of qualitative data analysis in which the analyst focuses on how respondents impose order on the flow of experience in their lives and thus make sense of events and actions in which they have participated (Saunders et al., 2009). Narrative analysis has been widely used for management research in recent years as it is significantly helpful in providing the way to understand "organizational sense-making" (Bryman and Bell, 2007:542). According to Taylor-Powell and Renner (2003), the form of notes, summary, word-for-word transcripts from the interviews and descriptive accounts as a result of watching and listening from the observations, as well as any published written material like documents, reports, articles can be regarded as the narrative data. Thus the qualitative data analysis of narrative analysis was selected to describe and interpret the GSCM development of the case study

enterprise.

3.7 Analysis of the quantitative data

3.7.1 Assessment of data from the pilot test and main study

A total of 202 responses (33 from the pilot survey and 169 from the main survey) were used for the study. In order to assess the reliability and validity of all the data from both the pilot test and the main study so as to eliminate bias, a series of t-tests were used to compare the differences between the two groups of data, namely, data from the early pilot test (n=33, 16.3%) and data from the main study (n=169, 83.7%). The test results indicated that no statistical differences existed between the means of the data from the early and late respondents for all 94 items on GSCM pressures, practices and performances (TURE at 5% or higher level of significance). Therefore, the full dataset of 202 responses was suitable for use in examining the research hypotheses.

3.7.2 Analysis plan

To test the hypotheses of this research, the statistical software SPSS (Statistical Product and Service Solutions) was used to calculate and analyse the quantitative data. A number of methods were used for analysis, including descriptives, factor analysis, correlations and regression. Descriptive statistics can help to easily summarise the samples and measures, while the means reveal the significance of the pressures, practices and performances within the enterprises (Swift and Piff, 2010). Moreover, factor analysis can be conducted to further confirm grouping of GSCM practice and GSCM performance from the survey data. Factors were extracted using the maximum likelihood method, followed by varimax rotation. The relationship between GSCM practices and performances was examined using bivariate correlation, and regression analysis was employed to test and confirm the correlations between these practices and performances. Foremost, however, before analysing the data

collected, the statistical parameter Cronbach's alpha will be introduced and discussed to explain its importance in verifying the reliability of the questions employed in this study.

Cronbach's alpha – to ensure the reliability of the questions and items

The alpha (α) measure was developed and named by Lee Cronbach in 1951 with the aim of developing further coefficients. In statistics, Cronbach's alpha is a coefficient of internal consistency which can help to describe the extent to which all the items in a test measure the same concept or construct, and to demonstrate the interrelatedness of items within the test. Thus, it is commonly used as an estimate of reliability within a psychometric test for a sample of examinees. However, it is now also widely used in the social sciences, business, nursing, and other disciplines (Pastore and Lombardi, 2011). Therefore, the term "item" could have more meanings, such as questions, raters or indicators, of which one might ask to what extent they measure the same thing. In this research project, "items" are manipulated as questions in the framework of different GSCM items and factors.

Theoretically, Cronbach's alpha ranges in value from 0 to 1 as it is used to describe the reliability of factors extracted from dichotomous questions (i.e. those with two possible answers) and multi-point formatted questionnaires or scales (i.e. rating scale: 1 = poor, 5 = excellent) (Streiner and Norman, 1989). A five-point Likert-type scale was used when designing the questions; thus, Cronbach's alpha can be taken into account to examine the internal consistency within each group of questions for this research project. Empirically, however, Cronbach's alpha can take on any value less than or equal to 1, including negative values, although only positive values make sense. A commonly accepted rule of thumb for using Cronbach's alpha is as follows:

Table 3.8 Rule of thumb for using Cronbach's alpha

Cronbach's alpha	Internal consistency
$\alpha \geqslant 0.9$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Based on: Cortina (1993)

Descriptive statistics

Descriptive statistics quantitatively describe the main features of a dataset, and include measures of central tendency, such as mean, median and mode, and measures of variability or dispersion like standard deviation, variance, minimum and maximum variables, kurtosis and skewness (Mann, 1995). The means can help show the tendency of the GSCM pressures undertaken by SME manufacturers, and the standard deviations indicate how much difference between those pressures exist among SMEs from the same industrial sector. A low standard deviation suggests more similar experiences among SMEs within the same industrial sector, while a high one indicates that SMEs from the same industrial sector feel different levels of GSCM pressures. The five GSCM pressures for SME manufacturers in the area of Chang Chiang Delta will be discussed in the following section.

Factor analysis

1) Factor analysis helped to verify the groupings of GSCM pressures and practices used in this research, both of which contain 29 and 45 items respectively.

2) Before regressing the relationships between the GSCM practices and performances, another two steps had to be taken to ensure reliable results. Firstly, in

the questionnaire, 20 items asked about GSCM performances; however, 20 items is too many for building up a picture of the relations between each of the five practice factors, and some of the items may be homogeneous in nature with different focuses. Thus, factor analysis helped to group the 20 items into fewer GSCM performance factors, which could be used to further examine the relationships between each of the GSCM practices and the grouped performance factors.

Pearson's correlation coefficient

Next, a preliminary examination on the relationships between the GSCM practices and the grouped GSCM performance factors was carried out. Thus, Pearson's correlation coefficient was calculated to measure the extent to which the variables are related. The results of Pearson's correlation coefficient range between -1 and 1. A result of -1 means that there is a perfect negative correlation between the two variables, while a result of 1 means that there is a perfect positive correlation between the two variables. Therefore, the high correlations lie on the value intervals between 0.5 and 1, as well as between -1 and -0.5.

Regression

Finally, regression analysis was used to identify the linear relationships between independent variables (GSCM practices, including green purchasing, eco-design, investment recovery, cooperation with customers, and internal environmental management) with dependent variables (each of three GSCM performances including environmental performance, economic performance, and operational performance), as hypothesised from H3a to H3o.

3.8 Reflection on research methodology

At this point, it is necessary to reflect on the research methodology with respect to ensuring maximum reliability and validity of the research, since it is exploratory in nature.

3.8.1 Triangulation

Triangulation is borrowed from the navigation and military sphere, wherein it relates to precisely locating an object's position by using three reference points (Easterby-Smith et al., 2002). The most famous definition of triangulation employed in social science research was given by Denzin in *The Research Act (2nd Edition)* in 1978; here, Denzin says that triangulation is "the combination of methodologies in the study of the same phenomenon" (pp.291). In addition, according to Easterby-Smith et al. (2002), there are four different types of triangulation in management research, including theoretical triangulation, data triangulation, investigator triangulation, and methodological triangulation. Among these four types, methodological triangulation seems to be more popular and important within management research, wherein it refers to combining quantitative and qualitative methods to collect data. Moreover, Jick (1979) emphasised that triangulation should be regarded as an inspired way to maximise data collection for research, rather than a constrained term by definition.

Triangulation of qualitative and quantitative methodology has gained increasing importance in the past few years for social science researchers. According to Fry et al. (1981), the flourishing development of the integration of the two methods comes from the obvious merits of the combination. Firstly, conceptualisation becomes more elegant and practical; secondly, there tends to be a better understanding of unexplained variances; thirdly, more useful indicators are generated from the methodological integration; fourthly, the quantitative data can be interpreted and analysed more clearly; finally and most importantly, many new perspectives can be produced during the process of triangulation. In addition, Jick (1979) agreed that triangulation has many strengths. The first is that research tends to be more powerful because of the combination of multiple methods. It is also useful for creating new perspectives or greater understanding of a research problem; which

supports the view of Fry et al. (1981). Moreover, it is stressed that the use of multiple methods can result in theoretical triangulation.

However, triangulation is not a perfect solution in every case, since it does have some drawbacks (Jick, 1979). Firstly, it is quite difficult to replicate the integration of several methods. Secondly, where several methods are used in triangulation, the research probably has an ambiguous aim. Finally, either the quantitative or the qualitative method is likely to be more heavily addressed, and the other subverted; consequently, the outcome may suffer from bias. Therefore, the most important rule for practising effective triangulation is to ensure that the weaknesses of one methodology can be compensated by the strengths of the other.

In fact, Jick (1979) also stated that the advantages of triangulation result from the active participation of qualitative methods. In addition, Cahill (1996) laid emphasis on the necessity to integrate qualitative methods into quantitative ones. Furthermore, specifically for the logistics research field, to which this research belongs, Näslund (2002) pointed out that quantitative research has dominated the field for a long period of time because logistics is often viewed from a positivist angle. However, logistics calls for qualitative research methods as the application of these methods can generate deeper and more practical support for the phenomena. In addition, Mangan et al. (2004) stressed the benefits of the triangulation of both quantitative and qualitative research methods for logistics. They stated that the involvement of qualitative methods does not mean that quantitative ones can be replaced; the combination of both methodologies is of great help to obtain a better understanding of logistics.

Therefore, this research does employ the triangulation strategy, and both questionnaire and case study methods are used. Questionnaires can provide basic information on the current situation using a relatively large population; simultaneously, a case study can provide more detailed information, and here the

case will be selected from the questionnaire respondents.

3.8.2 Reliability of research

Reliability within a research framework refers to the extent to which data collection or data analysis procedures will generate consistent findings. Three questions should always be asked to indicate the reliability of research: (1) “Will the measures yield the same results on other occasions?”, (2) “Will similar observations be reached by other observers?”, and (3) “Is there transparency in how sense was made from the raw data?” (Saunders et al., 2009, pp.157). For example, if examining whether a piece of software managing the product flow is easily operated or not, the operators of the logistics department who handle with this software daily cannot be the only participants involved; other personnel who are in touch with the software, such as salesmen, should also be considered. This is because the operators are likely to indicate that the software is “easy” as they use it every day, so the research will lose reliability if these are the only respondents included.

3.8.3 Validity of research

Research validity refers to whether the findings are really about what they seem to be about. The key point for validity is to make sure that the relationship between the two variables is a causal one. There are many threats to validity, including factors of history, testing, instrumentation, mortality, maturation and ambiguity about casual direction (Saunders et al., 2009). To illustrate maturation, for example, when investigating the management styles of logistics managers in a company while other major events are happening, it is possible that those events may affect the management styles in question. Explicitly, if an SME experiences a merger with another corporation and becomes a large enterprise, the logistics managers of the previous SME may change their management styles to some extent, due to the merger.

3.8.4 Representativeness of data collected

Questionnaire survey

Representativeness refers to the degree to which data accurately and precisely represents a characteristic of a population (Riley et al., 2000); in other words, it may help readers to evaluate the study findings with assurance that the sample of respondents reflects elements of the population with breadth and depth.

Brick and Kalton (1996) suggest that one way of dealing with a lack of representativeness is to weight the study sample segments to reflect the attributes of the greater population. However, there is no statistic in literature on a total number of SMEs in the focal area of this research, or the segments of those SMEs as discussed previously in the sampling technique section.

Though representativeness is difficult to measure, Cook et al. (2000) pointed out that response rate is important as it has a bearing on representativeness in Internet-based survey research, though this form of research has suffered from a significantly decreasing response rate since 1986 (Sheehan, 2001). We obtained an 18.36% response rate for this study, which is not low given the difficulties in conducting studies in the Chinese context (Orr and Menzies, n.d.). However, the response rate might have been increased if fewer questions were asked. In addition, the research did use some methods to maximise the response rate, such as the pre-notification and follow-up contact strategies encouraged by Sheehan (2001) and Nulty (2008).

Case study

Gillham (2000) declared that it is always difficult to ensure that data collected in a case is representative of the whole. Even when the researcher actively communicates with the subjects, there is still the problem of whether the researcher is speaking to the right personnel and whether these people talk about what they think the

researcher expects to hear. Furthermore, the researcher has to evaluate whether he is being shown the documentation that the organisation wants him to see, rather than what is most pertinent to the study.

However, the problem of representativeness was limited in this case study as a result of the high level of access granted by the enterprise. The researcher was allowed to talk to any personnel within the business. Additionally, observations were carried out in all areas of the enterprise, and information was gathered from its archival and communications data, which helped to ensure a high level of representativeness.

3.8.5 Research ethics

Research ethics is of particular importance for qualitative research. It pertains to the fact that the researcher must formulate and clarify the research topic; design the research and gain access; collect, process, store, and analyse the data; and write up research findings in a moral and responsible way (Saunders, et.al, 2009). There are several general ethics issues that should be always paid attention by researchers. For example, researchers should guarantee the privacy of participants, as well as the voluntary nature of participation and the right to withdraw partially or completely from the process at any time. In addition, the consent and possible deception of participants should be accepted during the process. More importantly, the researchers must keep the data provided by individuals or identifiable participants confidential. Furthermore, the researchers should be actively aware of the reaction of and effect on participants in order to avoid embarrassment, stress, discomfort, pain and harm when collecting, analysing or reporting data. In the present research, it was necessary to ensure that all the participants knew that the research would have no impact on their businesses. Furthermore, the data obtained included business details and information, so it was important for the researcher to should show respect to the respondents and be aware of protecting their interests, and minimising potential adverse effects on them.

3.9 Timing

This research project started in March of 2009, to be completed within a four-year period. The main activities can be seen in Table 3.4. Before carrying out the main study, a pilot test was conducted in May of 2010 when the 2010 China Suzhou International SME Fair was held. As discussed in Section 3.6, the main study, which consisted of a questionnaire survey sent via email, took place over a 14-month period. The case study took 20 working days during May of 2011 for observations and interviews. This was negotiated and agreed with the enterprise, and was enough for the researcher to gain information without interrupting the firm's normal daily operations and processes. It was expected that the data analysis would be finished within a two-month period, with another month reserved for contingency planning if any problems arose. The rest of the time would be spent writing up the thesis. Literature reviews were carried out throughout the whole process of the research project.

Table 3.9 Main activities of this research

Time Period / Activities	03.2009-12.2009	01.2010-04.2010	05.2010	06.2010-12.2010	01.2011-02.2012	03.2012-04.2012	05.2012	06.2012-02.2013
Literature review								
Questionnaire design								
Pilot test								
Preparation for main study								
Main study								
Data presentation and analysis								
Case study								
Thesis writing								

3.10 Chapter summary

In this chapter, the underlying research philosophy of epistemology, as well as paradigms of positivism and interpretivism, were explained in order to provide context for the research methods, which were both quantitative and qualitative, for the actual data collection. In addition to concerns about triangulation in order to select an appropriate research methodology, other factors including the development of the questions for the questionnaire survey, the selection of the survey sample and the case study firm, and the analysis plan for the data gathered for the research project were discussed.

The chapter also explained that after taking into account both the advantages and limitations of the potential research methodology for answering the research questions of this project, the questionnaire survey and case study methods were selected. The chapter then conducted discussions on questionnaire design, sample selection, how actual data collection was carried out, and how the data will be analysed. In the final sections of the chapter, reliability and validity issues were discussed with respect to the data gathered, as well as concerns regarding ethical issues, and how the researcher dealt with these during the project. The proposed timings of main activities for this research project were also reviewed in this chapter.

4. Results and Findings

4.1 Chapter introduction

This chapter provides the results of both the questionnaire survey and the case study, in order to answer the main research problems: What are the current pressures of GSCM on SMEs in Chang Chiang Delta? What are their GSCM initiatives? And how are the GSCM initiatives related to their GSCM performances? The data collected from the survey is used to test the hypotheses, and the findings from the case study will help to provide more in-depth information on GSCM pressures, practices and performances.

The results of the data analyses from SPSS are presented with reference to GSCM pressures, practices and performances. In Section 4.3, the Cronbach's alpha values of the three factors are calculated to ensure the validity and relevance of the research variables within the questions. The means and standard deviations from the descriptive statistics are provided help to determine the GSCM pressures and drivers undertaken by Chinese SME manufacturers. Besides, factor analysis is used to verify the groupings of GSCM pressures and practices from the items used in the questionnaire. Next, the factor analysis is conducted to help identify GSCM performance groupings, which will be further used in the following sections to test the relationships between GSCM practices, and then within the correlations and regressions. The results of the hypotheses tests are summarised and presented as a table.

The remainder of this chapter will outline the findings from the case study, which will provide detailed information to combine with the data collected from the survey. The chapter concludes with a summary section.

4.2 Coding for hypothesis testing

When using SPSS to analyse data, all the variables should be coded. Therefore, the 12 sectors were labelled 1 to 12 (Table 4.1). In addition, the kinds of pressures, practices and performances were also given abbreviations like CP, GP, and IEM (see section 2.7.2) as codes for other analyses.

Table 4.1 Coding for sectors

Code	Sectors	Code	Sectors
1	Food and Beverage	7	Plastic and Rubber
2	Clothing, Textile and Tannery	8	Metal
3	Wood Processing and Furniture	9	Instrumentation
4	Paper Making and Printing	10	Vehicles
5	Pharmaceutical and Biological Products	11	Machine and Machinery
6	Chemistry and Chemical	12	Electronic Telecommunications Facilities

4.3 Hypotheses testing and findings from the survey

As planned, descriptives, ANOVA, factor analysis, correlations and regression analysis were used by employing SPSS to test the data.

4.3.1 Descriptive statistics and GSCM pressures

Cronbach's alpha for validity and reliability

The reliability analysis confirms the reliability of RP, CP, SP, PP and ID, with Cronbach's alpha values equal to 0.88, 0.73, 0.88, 0.88 and 0.94, respectively. These are all well above 0.70, which ensures the constructs' internal consistency and validity (Nunnally, 1978). Therefore, it can be concluded that the items listed in the questionnaires contribute to the validity and relevance of the questions within the questionnaire and the study. Further discussion will be provided in Section 5.2.

Descriptive statistics

A summary of the results is shown in Table 4.2. The summative presentation of the means and standard deviations provides a general comparison of the pressures and drivers that SMEs face in relation to GSCM and the standard deviations helps to show the significance of the differences among the SMEs within the same sector for each of the items.

Taking regulatory pressures, for example, the data shows that the mean 3.34, which is between the range off 3 to 4 (in the five-point scale of this research, 3 = Neither agree nor disagree and 4 = Agree). Only two means from sectors 4 and 5 are close to 3 (2.68 and 2.84 respectively), and the means from the other ten sectors are all above 3, among which four are deflecting to 4. Thus, H1a is somewhat supported with respect to regulatory pressures from the binding laws and regulations on the environment at home and abroad.

Similarly, and generally, the means for customer pressures, public pressures, supplier pressures and internal drivers are all over 3, at 3.49, 3.55, 3.39 and 3.53, respectively; thus, H1b, H1c, H1d and H1e can also be partly supported. Explicitly, Chinese manufacturing SMEs are under customer pressures, public pressures and supplier pressures, and have also been encouraged by internal drivers in terms of GSCM.

Table 4.2 Descriptive statistics for GSCM pressures/drivers

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Regulatory Pressures (α=0.88)	3.34.	3.77	0.973	3.23	1.117	3.7	1.067	2.68	1.207	2.84	1.050	3.51	1.017	3.69	1.039	3.25	1.045	3.47	0.858	3.26	0.944	3.38	1.046	3.28	0.949
National laws and regulations on environmental protection	RP1	4	1	3.2	1.091	4.13	0.641	2.63	1.408	2.73	1.104	3.92	0.954	3.67	1.047	3.24	1.033	3.64	0.809	3.3	0.949	3.32	1.108	3.33	0.957
National laws and regulations on resource conservation	RP2	3.29	0.951	3.25	1.164	4.13	0.991	2.38	0.916	2.82	0.982	3.38	0.768	3.6	0.986	3.41	1.064	3.73	0.905	2.9	1.101	3.32	1.03	3.21	0.857
Local laws and regulations on environmental protection	RP3	3.71	1.113	3.14	1.173	3.38	0.744	2.5	0.926	2.82	0.874	3.38	1.044	3.8	1.014	3.06	1.144	3.45	1.128	3.2	0.919	3.4	1	3.06	1.059
Local laws and regulations on resource conservation	RP4	3.57	0.976	3.23	1.159	3.38	1.188	2.88	1.126	2.64	1.286	3.23	1.092	3.73	0.961	3.24	1.033	3.18	0.603	3.3	0.949	3.32	0.988	3.3	0.847
Environmental regulations from the import countries	RP5	4.29	0.756	3.34	1.033	3.5	1.512	3	1.69	3.18	1.079	3.62	1.193	3.67	1.291	3.29	1.047	3.36	0.809	3.6	0.843	3.56	1.158	3.52	1.004
Customer Pressures (α=0.73)	3.49	3.81	0.981	3.57	0.934	3.92	1.018	2.71	1.160	3.18	1.130	3.41	0.818	3.82	1.093	3.49	1.027	3.39	0.933	3.67	0.802	3.59	1.054	3.27	0.977
Overseas enterprises located in China and joint venture purchasers	CP1	3.57	1.272	3.7	0.93	3.75	1.035	2.63	1.408	3.09	1.136	3.54	0.66	3.6	1.121	3.53	0.943	3.55	0.82	3.5	0.707	3.8	1.041	3.52	1.004
Environmental protection demands from domestic customers	CP2	4	0.816	3.57	0.873	3.75	1.282	2.75	1.035	3.09	1.044	3.46	0.776	3.8	1.082	3.41	1.121	3.36	0.924	3.9	0.876	3.44	1.003	3.09	0.947
Increasing environmental awareness of the end consumers	CP3	3.86	0.9	3.43	0.998	4.25	0.707	2.75	1.165	3.36	1.286	3.23	1.013	4.07	1.1	3.53	1.068	3.27	1.104	3.6	0.843	3.52	1.122	3.21	0.96

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Pubic Pressures (α=0.88)	3.55	4.29	0.561	3.47	1.059	4.08	0.830	3.04	1.232	3.15	1.149	3.62	0.990	3.96	0.928	3.16	1.084	3.24	1.119	3.67	0.959	3.68	0.903	3.29	0.918
Pressures of building green brand	PP1	4.14	0.69	3.52	1.067	4.13	0.991	2.88	1.126	3.18	1.328	3.38	0.961	3.93	1.033	3.12	1.219	3.18	1.079	3.7	1.16	3.56	0.961	3.45	0.905
Pressures of establishing green corporate image	PP2	4.29	0.488	3.48	1.089	4.13	0.835	3.13	1.356	3	1.095	3.54	1.198	3.8	0.941	3.06	0.966	3.36	1.206	3.7	0.949	3.68	0.852	3.15	0.906
Increase of environmental awareness from the society	PP3	4.43	0.535	3.41	1.041	4	0.756	3.13	1.356	3.27	1.104	3.92	0.76	4.13	0.834	3.29	1.105	3.18	1.168	3.6	0.843	3.8	0.913	3.27	0.944
Supplier Pressures (α=0.88)	3.39	3.62	0.987	3.38	0.967	3.33	0.930	2.83	1.173	3.27	0.921	3.44	0.877	3.79	0.906	3.25	1.057	3.35	0.936	3.58	0.869	3.54	0.931	3.27	0.898
Collaboration in environment protection with our suppliers	SP1	3.57	0.976	3.41	0.897	3.25	0.886	2.88	1.356	3.18	1.079	3.62	0.768	3.93	0.704	3.18	1.131	3.36	1.027	3.5	0.707	3.4	0.957	3.36	0.859
Improvements in designing green products with our suppliers	SP2	3.86	0.69	3.34	0.987	3.63	0.744	2.88	1.246	3.73	0.786	3.46	0.776	3.6	0.986	3.53	1.007	3.27	1.191	3.3	0.823	3.6	0.866	3.24	0.792
Improvements in products green packaging with our suppliers	SP3	4.14	0.378	3.39	1.017	3.38	0.916	2.5	1.195	3.27	0.786	3.08	0.862	3.53	1.187	3.06	0.966	3.36	0.674	3.6	0.843	3.48	1.005	3.21	0.96
Pressures from green strategy of identical goods manufacturers	SP4	3.71	1.254	3.41	0.972	3.25	0.886	2.63	0.916	3	1	3.38	1.121	3.87	0.64	3.29	1.105	3.18	0.874	3.8	1.229	3.64	0.952	3.33	1.021
Pressures from green strategy of substitute products manufacturers	SP5	3.29	1.254	3.39	0.945	3.25	1.165	3.25	1.389	3.27	1.009	3.54	1.05	3.93	0.884	3.06	1.144	3.64	0.924	3.8	0.789	3.6	0.957	3.33	0.89
Requirements of green development from the industry association	SP6	3.14	1.069	3.34	1.033	3.25	1.165	2.88	1.126	3.18	0.874	3.54	0.66	3.87	0.99	3.35	1.057	3.27	1.009	3.5	0.85	3.52	0.918	3.12	0.893

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Internal Drivers (α=0.94)	3.53	3.83	0.942	3.80	0.835	3.54	1.025	2.63	1.267	3.21	0.981	3.56	0.992	3.76	0.893	3.48	0.959	3.73	0.763	3.68	0.676	3.74	0.933	3.35	1.001
Drivers from enterprise's environmental vision	ID1	4.29	0.488	4	0.807	3.63	1.061	2.5	1.195	3.45	1.368	3.69	1.032	4	1	3.59	1.278	3.73	0.647	3.6	0.699	3.64	1.075	3.39	0.998
Support of the green strategy from the top management	ID2	4.14	0.9	4.07	0.759	3.75	1.282	2.63	1.302	3.36	0.924	3.77	1.092	4.07	0.704	3.35	0.996	3.55	0.82	3.7	0.675	3.6	1	3.39	1.088
Support of the green strategy from the middle management	ID3	3.57	1.272	3.75	0.781	3.75	1.282	2.25	0.886	3.36	0.924	3.38	1.121	3.73	0.961	3.29	1.105	3.64	0.924	3.6	0.843	3.72	0.98	3.52	1.064
Implementation of green strategy from employees	ID4	3.43	1.397	3.8	0.795	3.5	1.195	2.5	1.195	2.73	0.905	3.62	0.87	3.67	1.113	3.59	1.004	3.73	0.905	3.4	0.843	3.64	0.907	3.48	1.004
Drivers from specialized human resource for GSCM	ID5	3.86	0.69	3.82	0.815	3.63	1.188	2.5	1.195	3.27	1.272	3.38	0.87	3.67	1.047	3.35	0.862	4	0.632	3.7	0.675	3.76	0.926	3.33	0.957
Drivers from specialized budget for green products development	ID6	3.71	0.756	3.66	0.963	3.38	0.916	3	1.512	3.18	0.751	3.23	0.927	3.67	0.976	3.47	1.007	3.82	0.603	3.8	0.632	3.8	0.866	3.24	1.062
Drivers from specialized budget for environmental improvement	ID7	3.57	0.976	3.75	0.839	3.25	1.035	2.63	1.408	3.36	1.12	3.54	0.967	3.67	0.976	3.53	0.943	3.82	0.874	3.7	0.675	3.84	0.85	3.27	0.944
Drivers from specialized budget for pollution preventive budget	ID8	3.86	0.9	3.7	0.878	3.63	0.744	2.88	1.356	3.27	0.905	3.69	1.251	3.73	0.884	3.71	0.849	3.55	0.82	3.7	0.675	3.76	0.879	3.3	1.075
Drivers from specialized budget for pollution disposal budget	ID9	4	1	3.61	0.813	3.25	0.886	2.38	1.302	3.27	0.905	3.85	0.899	3.53	0.743	3.41	1.064	3.45	0.82	3.7	0.675	3.76	1.012	3.15	0.972
Drivers from specialized budget for by-products disposal budget	ID10	3.57	1.134	3.75	0.781	3.38	0.744	2.75	1.488	3.09	0.831	3.46	0.967	3.6	0.91	3.35	0.862	3.82	0.751	3.8	0.632	3.68	0.9	3.15	1.093
Drivers from healthy corporate image	ID11	3.71	1.113	3.89	0.895	3.63	1.188	2.63	1.408	2.91	0.944	3.54	1.05	3.73	0.799	3.47	0.874	3.73	0.786	3.7	0.675	3.88	0.927	3.48	0.906
Drivers from corporate green marks	ID12	4.29	0.488	3.84	0.861	3.75	1.165	2.88	1.553	3.27	1.009	3.54	1.05	4.07	0.594	3.59	0.795	3.91	0.701	3.7	0.675	3.76	1.012	3.45	0.905

ANOVA

ANOVA is a general technique that can be used to test the hypothesis that the means among two or more groups are equal, under the assumption that the sampled populations are normally distributed (Swift and Piff, 2010). It was not introduced in the analysis plan section as it was only employed to test whether Chinese manufacturing SMEs from different industrial sectors in the focal area have experienced different GSCM pressures in terms of the five factors.

With regard to different items of GSCM pressures, differences exist among the SMEs from the 12 sectors. Taking regulatory pressures for example, the mean for pressures arising from importers' environmental regulations is 4.29 for the SMEs from sector 1, while the mean for sector 4 is only 3. The corresponding SD values are 0.756 for sector 1 and 1.69 for sector 4, which suggests that SMEs from sector 1 feel a similar intensity with respect to regulatory pressures, while the intensity of pressures felt among SMEs from sector 4 varies. A similar situation occurs between sector 1 and 4 in terms of pressures from national laws and regulations on environmental protection, with the means of 4 and 2.63, respectively; this indicates that Chinese SMEs from sector 1 are under clear regulatory pressures regarding employing GSCM strategy, but this kind of pressure for SMEs from sector 4 is not supported, as the mean is below 3. Though differences exist as shown by the different means, ANOVA can help to test whether the differences are significant or not among these different industrial sectors. Table 4.3 to 4.7 show the ANOVA results of the five pressure factors respectively, indicating varied significance of different pressures among the sample sectors. For example, ANOVA results in Table 4.5 show that the public pressures for applying GSCM have significant differences among Chinese manufacturing SMEs from different industrial sectors with the p-value (Sig.) of 0.022 which is less than 0.05; while the p-value of 0.14 from Table 4.3 indicates that there is no significant difference among SMEs from different industrial sectors in terms of feeling regulatory pressures to adopt GSCM.

Table 4.3 ANOVA results for regulatory pressures differences in different sectors

ANOVA							
RP							
			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		11.900	11	1.082	1.486	0.140
	Linear Term	Unweighted	0.062	1	0.062	0.086	0.770
		Weighted	0.056	1	0.056	0.077	0.782
		Deviation	11.844	10	1.184	1.627	0.102
Within Groups			138.353	190	0.728		
Total			150.253	201			

Table 4.4 ANOVA results for customer pressures differences in different sectors

ANOVA							
CP							
			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		12.342	11	1.122	1.767	0.062
	Linear Term	Unweighted	0.166	1	0.166	0.262	0.610
		Weighted	0.550	1	0.550	0.866	0.353
		Deviation	11.792	10	1.179	1.857	0.053
Within Groups			120.633	190	0.635		
Total			132.975	201			

Table 4.5 ANOVA results for public pressures differences in different sectors

ANOVA							
PP							
			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		18.626	11	1.693	2.107	0.022
	Linear Term	Unweighted	2.551	1	2.551	3.175	0.076
		Weighted	0.854	1	0.854	1.063	0.304
		Deviation	17.772	10	1.777	2.212	0.019
Within Groups			152.679	190	0.804		
Total			171.305	201			

Table 4.6 ANOVA results for supplier pressures differences in different sectors

ANOVA							
SP							
			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		7.262	11	0.660	1.158	0.319
	Linear Term	Unweighted	0.109	1	0.109	0.191	0.662
		Weighted	0.017	1	0.017	0.031	0.861
		Deviation	7.245	10	0.724	1.271	0.250
Within Groups			108.328	190	0.570		
Total			115.591	201			

Table 4.7 ANOVA results for internal drivers differences in different sectors

ANOVA							
ID							
			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		14.826	11	1.348	2.627	0.004
	Linear Term	Unweighted	0.051	1	0.051	0.099	0.753
		Weighted	0.700	1	0.700	1.363	0.244
		Deviation	14.127	10	1.413	2.753	0.003
Within Groups			97.483	190	0.513		
Total			112.310	201			

4.3.2 Descriptive statistics and GSCM practices

Cronbach's alpha for validity and reliability

The reliability analysis confirms the reliability of GP, ECO, IR, CC and IEM, with Cronbach's alpha levels equal to 0.90, 0.90, 0.90, 0.92 and 0.97, respectively. All five values are well above 0.70, which, according to Nunnally (1978) demonstrates the constructs' internal consistency and validity. Therefore, it can be concluded that the items listed in the questionnaires are valid and relevant in terms of both the questions themselves and the study as a whole. This is further addressed in Section 5. 2.

Descriptive statistics

The summative presentation of the means and standard deviations, which are shown in Table 4.8, provides a general comparison of the practices that manufacturing SMEs may undergo with respect to GSCM. The standard deviations also help to show the significance of the differences among the SMEs within the same sector in terms of each of the items. This is similar to the GSCM pressures discussed in Section 4.3.1. Further explanations on the meanings of the means and standard deviations will be provided in Section 5.5.

Table 4.8 Descriptive statistics for GSCM practices

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Green Purchasing (α=0.904)	3.78	3.98	0.82	3.75	0.94	3.84	0.67	3.31	1.30	3.24	1.02	3.78	0.98	4.20	0.72	3.78	0.76	3.70	0.75	3.83	0.63	3.94	0.86	3.65	0.94
Clear requirements of environmental protection in the products design book to suppliers	GP1	4.14	0.90	3.65	1.05	4.13	0.64	3.00	1.51	3.45	1.13	4.08	0.86	4.47	0.64	4.00	0.79	3.82	0.98	3.80	0.63	3.88	0.93	3.64	0.93
Actively collaborates with suppliers for environmental protection goals	GP2	4.14	0.69	3.96	0.96	3.88	0.35	3.13	1.46	3.45	0.82	3.92	0.95	4.40	0.74	3.71	0.59	3.73	0.65	3.90	0.57	3.80	0.91	3.73	0.88
Regular environmental audit to suppliers	GP3	3.43	1.13	3.74	0.94	3.75	0.71	3.38	1.30	3.45	0.82	3.85	0.90	4.33	0.82	3.71	0.85	4.00	0.77	3.60	0.70	3.80	0.76	3.70	0.88
Selects suppliers with ISO14001 certificate	GP4	4.00	1.00	3.78	1.03	3.63	0.74	3.63	1.41	3.36	0.92	3.69	0.95	4.27	0.70	3.94	0.75	3.64	0.81	3.80	0.63	4.20	0.91	3.61	1.14
Assessment to the environment-friendly practices to secondary suppliers (suppliers' suppliers)	GP5	3.86	0.90	3.57	0.87	4.00	0.53	3.38	1.30	3.18	1.08	3.46	0.97	4.20	0.68	3.53	0.72	3.36	0.67	3.90	0.57	3.92	0.86	3.52	0.94
Just-in-time logistics system	GP6	3.71	0.76	3.80	0.81	3.63	0.52	3.25	1.28	3.00	0.89	3.92	0.95	4.00	0.85	3.88	0.70	3.64	0.67	3.90	0.74	3.96	0.84	3.73	0.91
Makes demands on suppliers to use green packaging	GP7	4.29	0.49	3.83	0.94	3.63	1.06	3.13	1.25	3.00	1.10	3.69	1.25	4.00	0.65	3.76	0.83	3.73	0.79	3.90	0.57	4.12	0.73	3.61	0.97
Actively collaborates with suppliers to use less packaging materials	GP8	4.29	0.49	3.65	0.87	4.13	0.64	3.63	1.30	3.00	1.41	3.62	1.12	3.93	0.59	3.71	0.85	3.73	0.65	3.80	0.79	3.80	0.91	3.70	0.98

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Eco-design (α=0.905)	3.95	4.29	0.67	3.97	0.81	4.10	0.78	3.53	1.20	3.33	1.02	3.91	1.00	4.19	0.77	4.07	0.88	3.71	0.71	3.94	0.77	4.23	0.79	3.71	1.00
Considers conservation of energy and resource in products design	ECO1	4.14	0.90	4.00	0.80	4.50	0.53	3.63	1.19	3.27	1.01	3.77	1.01	4.33	0.72	4.06	1.09	3.91	0.70	4.10	0.88	4.36	0.86	3.79	0.93
Considers the recycling in products design	ECO2	4.29	0.49	3.93	0.82	4.00	1.07	3.25	1.16	3.27	1.01	3.46	1.33	4.20	0.77	3.88	0.78	3.82	0.75	3.90	0.88	4.32	0.80	3.55	1.15
Considers avoiding using or using fewer raw materials which will put negative impact on environment in products design	ECO3	4.43	0.53	4.04	0.83	4.00	0.76	3.50	1.41	3.45	0.82	4.15	0.80	4.00	0.93	4.12	0.93	3.55	0.69	3.90	0.74	4.24	0.78	3.79	1.02
Considers avoiding putting or reducing the negative influence on environment caused by the production process in design	ECO4	4.43	0.53	3.98	0.76	4.00	0.53	3.50	1.41	3.36	1.12	4.08	0.86	4.07	0.80	4.12	0.78	3.64	0.81	4.00	0.67	4.20	0.82	3.79	0.96
Considers avoiding using or using less packaging which will put negative impact on environment in products design	ECO5	4.14	0.90	3.89	0.85	4.00	0.93	3.75	1.04	3.27	1.27	4.08	0.86	4.33	0.62	4.18	0.88	3.64	0.67	3.80	0.79	4.04	0.73	3.64	0.99

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Investment Recovery (α=0.896)	3.79	4.17	0.54	3.69	0.89	3.94	0.78	3.56	1.07	3.14	1.04	3.85	1.07	4.20	0.84	3.91	0.78	3.79	1.02	3.68	0.75	3.89	0.97	3.68	0.97
Considers the minimum waste production in the technological process of production	IR1	3.86	0.69	3.93	0.79	3.88	1.13	3.75	1.04	3.36	1.12	4.08	1.12	4.27	0.70	3.94	0.75	3.73	0.47	3.90	0.74	4.24	0.88	3.76	0.97
Recycles or sells by-products in the production process	IR2	4.29	0.49	3.63	0.94	3.88	0.35	3.38	1.06	3.27	0.90	3.69	1.25	4.13	0.83	3.65	0.70	3.82	0.98	3.60	0.70	3.72	0.89	3.55	1.03
Uses disposal systems of waste water in the production process	IR3	4.29	0.49	3.63	0.93	3.75	0.89	3.75	1.28	3.18	1.08	4.00	1.08	4.20	0.86	3.82	0.81	3.73	1.19	3.60	0.84	3.72	1.02	3.73	1.15
Uses disposal systems of waste emission in the production process	IR4	4.00	0.58	3.57	0.97	4.13	0.64	3.38	1.30	3.09	1.30	3.85	1.07	4.13	0.92	4.06	0.90	3.91	1.14	3.60	0.84	3.80	1.08	3.61	0.83
Uses disposal systems of waste rejectamenta in the production process	IR5	4.29	0.49	3.74	0.86	4.00	0.93	3.63	0.92	2.91	0.94	3.77	1.09	4.27	0.88	4.06	0.83	3.91	1.14	3.60	0.84	4.04	0.89	3.64	0.90
Quick to adjust the equipment amount in the production process	IR6	4.29	0.49	3.65	0.82	4.00	0.76	3.50	1.07	3.00	1.00	3.69	0.95	4.20	0.94	3.94	0.75	3.64	1.21	3.80	0.63	3.80	1.00	3.79	0.96

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Cooperation with Customers (α=0.916)	3.74	4.10	0.48	3.72	0.91	3.94	0.70	3.35	1.16	3.15	0.98	3.62	1.08	3.93	0.72	3.75	0.72	3.61	0.76	3.87	0.62	3.93	0.84	3.62	0.93
Actively collaborates with our customers on Eco design.	CC1	3.86	0.69	3.70	0.96	4.00	0.93	3.38	1.30	3.09	1.04	3.46	1.13	4.20	0.56	3.71	0.77	3.55	0.69	4.00	0.67	3.88	0.73	3.58	0.94
Actively collaborates with our customers on clean production	CC2	4.00	0.58	3.61	0.93	3.88	0.64	3.25	1.16	3.09	0.54	3.69	0.95	4.13	0.64	3.82	0.64	3.45	0.82	3.80	0.79	3.96	0.84	3.61	0.97
Actively collaborates with our customers on green packaging	CC3	4.14	0.38	3.72	0.89	4.00	0.53	3.75	0.89	3.27	1.01	3.69	1.11	4.07	0.46	3.88	0.70	3.64	0.92	3.90	0.57	3.84	0.85	3.70	0.95
Actively collaborates with our customers on green logistics	CC4	4.29	0.49	3.63	0.99	3.88	0.83	3.38	0.74	3.09	1.38	3.38	0.96	3.73	0.70	3.59	0.94	3.64	0.81	3.90	0.57	3.88	0.78	3.48	1.00
Actively collaborates with our customers on reclaiming seconds and used products	CC5	4.14	0.38	3.83	0.86	4.13	0.64	3.25	1.58	3.09	1.04	4.00	1.00	3.67	0.90	3.71	0.69	3.82	0.75	3.90	0.57	3.88	1.05	3.64	0.82
Actively collaborates with our customers on reclaiming stocks	CC6	4.14	0.38	3.85	0.82	3.75	0.71	3.13	1.36	3.27	0.90	3.46	1.39	3.80	0.86	3.82	0.64	3.55	0.69	3.70	0.67	4.12	0.78	3.70	0.92

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Internal Environmental Management (α=0.970)	3.75	4.01	0.66	3.67	1.00	3.91	0.74	3.23	1.11	3.26	1.00	3.67	1.02	4.00	0.84	3.89	0.89	3.91	0.83	3.77	0.66	3.90	0.89	3.65	0.98
Top managers make active commitment to environmental management	IEM1	3.86	0.69	3.80	0.99	4.38	0.52	3.13	1.13	3.09	0.70	3.92	0.95	3.93	0.80	3.71	1.05	3.91	0.83	3.70	0.67	3.76	1.01	3.73	0.84
Top managers fully take environmental issues into considerations when making big decisions for the enterprise	IEM2	4.00	0.82	3.57	1.12	4.13	0.83	3.38	0.92	3.45	0.93	3.62	0.96	3.93	0.88	4.06	0.90	3.64	0.92	3.70	0.67	3.84	0.94	3.61	0.93
Middle managers give active support to environmental management	IEM3	3.86	0.69	3.59	1.01	4.00	0.76	3.13	1.25	3.36	0.92	3.54	0.88	3.93	0.80	3.65	1.06	3.82	0.75	4.00	0.67	3.92	0.86	3.52	0.97
Has staff training program of environmental management.	IEM4	4.00	0.58	3.70	1.03	3.88	0.35	3.38	1.19	3.18	1.08	3.62	0.96	3.87	0.83	3.76	1.20	4.00	0.89	3.90	0.57	3.80	0.91	3.76	0.94
Different departments actively cooperate with each other on environmental management	IEM5	4.14	0.38	3.74	1.03	3.75	0.89	3.38	1.19	3.27	1.10	3.77	1.17	4.00	0.76	3.88	0.86	3.91	0.83	3.80	0.63	3.92	0.91	3.61	1.03
strictly complies and implements with related environmental regulations and requirements	IEM6	4.14	0.38	3.87	0.83	3.63	0.52	3.38	1.19	3.55	1.04	4.15	0.90	4.07	0.80	3.82	0.81	3.91	0.70	3.80	0.63	4.08	0.86	3.52	1.03
Updates and learns latest environmental protection policies	IEM7	4.29	0.49	3.61	0.91	3.75	0.89	2.88	1.25	3.27	0.79	3.85	1.07	4.20	0.86	4.12	0.78	3.91	0.70	3.70	0.67	4.04	0.84	3.76	1.00
Has got ISO14001 certification	IEM8	4.00	0.82	3.85	1.04	3.88	0.64	3.50	1.07	3.45	0.82	3.54	1.05	4.33	0.82	4.06	1.09	4.00	1.00	3.70	0.82	4.08	0.81	4.03	0.98
Has Total Quality Environmental Management system	IEM9	3.86	0.69	3.63	1.10	4.00	0.76	3.38	1.30	3.64	0.92	3.54	1.05	4.20	0.94	3.88	0.93	3.82	0.75	3.80	0.63	4.28	0.79	3.67	1.05
Has the monitoring system of Total Quality Environmental Management	IEM10	3.86	0.69	3.70	1.08	4.25	0.46	3.38	1.41	3.18	0.87	3.54	1.13	4.00	1.00	3.88	1.05	3.82	0.98	4.00	0.67	3.96	0.79	3.52	1.00

Sector		1		2		3		4		5		6		7		8		9		10		11		12	
N		N=7		N=44		N=8		N=8		N=11		N=13		N=15		N=17		N=11		N=10		N=25		N=33	
Items	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Internal Environmental Management contiuned																									
Related departments of the enterprise solve problems and make improvements in time when problems found	IEM11	3.71	0.76	3.74	0.80	4.25	0.71	3.63	1.30	3.00	1.10	3.77	0.93	4.27	0.70	3.94	1.03	3.73	0.79	3.90	0.57	4.16	0.80	3.76	0.97
Has got ISO9000 certification	IEM12	4.29	0.49	3.87	0.91	3.75	0.46	3.50	1.31	3.55	0.93	4.00	0.82	4.47	0.74	4.24	0.90	4.00	0.89	3.60	0.84	4.08	0.86	3.97	1.05
Has pollution prevention scheme	IEM13	4.14	0.38	3.67	0.94	3.88	0.64	3.25	1.16	3.64	1.29	3.92	1.04	3.93	0.88	3.71	0.85	4.09	0.83	3.80	0.63	3.76	0.83	3.76	0.94
Products have Eco trademarks	IEM14	4.00	0.82	3.50	1.04	4.00	0.76	3.50	1.31	3.18	0.98	3.54	1.05	3.80	1.15	3.71	0.69	3.91	0.94	3.80	0.63	3.96	0.98	3.45	0.94
Environmental performance is taken into consideration to the internal performance evaluation	IEM15	3.86	0.69	3.46	0.97	3.75	0.89	3.13	0.64	3.09	0.54	3.23	1.17	3.87	0.83	3.88	0.78	3.82	0.87	3.60	0.70	4.00	0.76	3.58	0.94
Environment report as a part of internal assessment	IEM16	3.86	0.69	3.50	1.00	3.38	0.92	3.38	1.19	3.09	1.04	3.92	1.04	3.80	0.68	4.00	0.71	4.00	0.77	3.80	0.63	3.68	0.80	3.55	1.06
Has rewards and punishment systems to the environmental performance of top managers.	IEM17	3.86	0.90	3.72	1.14	3.88	0.99	2.88	1.13	3.00	1.26	3.62	1.04	3.80	0.94	3.94	0.75	4.09	0.83	3.70	0.67	3.44	1.00	3.48	0.97
Has rewards and punishment systems to the environmental performance of middle managers	IEM18	4.00	0.82	3.65	1.03	3.88	0.64	2.63	0.92	3.09	1.45	3.46	0.97	3.73	0.80	4.00	0.79	3.91	0.94	3.70	0.67	3.60	1.08	3.61	0.97
Has rewards and punishment systems to the environmental performance of employees.	IEM19	4.14	0.90	3.57	1.10	4.00	0.76	2.50	0.76	3.00	1.18	3.38	1.12	4.00	0.76	3.82	0.81	3.82	0.75	3.60	0.84	3.88	0.97	3.64	0.90
The cost of social responsibility incorporated into accounting	IEM20	4.29	0.76	3.67	1.00	3.88	1.13	3.38	0.74	3.09	1.04	3.54	1.27	3.93	0.70	3.82	0.73	4.18	0.98	3.80	0.63	3.76	0.66	3.52	1.09

4.3.3 Factor analysis and GSCM pressures and practices

Factor analysis and GSCM pressures

Factor analysis helped to empirically group the scale items of five main GSCM pressures as predicted and employed in this study (see Table 4.9). Five GSCM pressures factors explain 67.256% of the inherent variation in their items. The five factors can be labelled as regulatory pressure, customer pressure, public pressure, supplier pressure and internal driver.

Table 4.9 Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.070	41.621	41.621	12.070	41.621	41.621	6.841	23.591	23.591
2	3.995	13.775	55.396	3.995	13.775	55.396	5.606	19.330	42.921
3	1.348	4.650	60.046	1.348	4.650	60.046	3.757	12.954	55.875
4	1.076	3.711	63.756	1.076	3.711	63.756	2.208	7.615	63.490
5	1.015	3.500	67.256	1.015	3.500	67.256	1.092	3.766	67.256
6	0.934	3.221	70.477						
7	0.810	2.792	73.269						
8	0.697	2.402	75.671						
9	0.676	2.332	78.003						
10	0.620	2.139	80.142						
11	0.575	1.981	82.123						
12	0.504	1.738	83.861						
13	0.469	1.618	85.479						
14	0.456	1.573	87.053						
15	0.430	1.482	88.534						
16	0.391	1.349	89.883						
17	0.352	1.215	91.099						
18	0.341	1.177	92.275						
19	0.311	1.072	93.348						
20	0.284	0.979	94.327						
21	0.274	0.944	95.271						
22	0.243	0.839	96.110						
23	0.237	0.816	96.926						
24	0.203	0.699	97.625						
25	0.173	0.597	98.222						
26	0.148	0.509	98.731						
27	0.142	0.488	99.219						
28	0.126	0.434	99.653						
29	0.101	0.347	100.000						

Extraction method: principal component analysis.

Factor analysis and GSCM practices

Factor analysis also assisted to empirically verify the groupings of five main GSCM practices as predicted and employed in this study (see Table 4.10). Five GSCM practices factors explain 69.101% of the inherent variation in their items. The five factors can be labelled as green purchase, eco-design, investment recovery, collaboration with customers and internal environmental management.

Table 4.10 Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	25.813	57.362	57.362	25.813	57.362	57.362	7.228	16.063	16.063
2	1.802	4.005	61.367	1.802	4.005	61.367	7.026	15.613	31.676
3	1.301	2.891	64.258	1.301	2.891	64.258	5.949	13.221	44.897
4	1.200	2.666	66.924	1.200	2.666	66.924	5.529	12.286	57.183
5	0.980	2.177	69.101	0.980	2.177	69.101	5.363	11.919	69.101
6	0.905	2.010	71.112						
7	0.829	1.843	72.955						
8	0.793	1.763	74.718						
9	0.745	1.656	76.374						
10	0.686	1.524	77.898						
11	0.658	1.463	79.361						
12	0.605	1.345	80.706						
13	0.573	1.273	81.979						
14	0.545	1.211	83.190						
15	0.509	1.131	84.321						
16	0.475	1.055	85.376						
17	0.469	1.041	86.417						
18	0.433	0.963	87.380						
19	0.402	0.894	88.274						
20	0.371	0.824	89.098						
21	0.359	0.798	89.896						
22	0.349	0.776	90.672						
23	0.349	0.775	91.447						
24	0.312	0.693	92.140						
25	0.301	0.670	92.810						
26	0.276	0.614	93.423						
27	0.259	0.576	94.000						
28	0.252	0.559	94.559						
29	0.245	0.544	95.102						
30	0.212	0.472	95.574						
31	0.204	0.454	96.028						
32	0.196	0.436	96.464						
33	0.173	0.385	96.849						
34	0.164	0.363	97.213						
35	0.158	0.350	97.563						
36	0.150	0.334	97.896						
37	0.141	0.312	98.209						
38	0.127	0.282	98.491						
39	0.115	0.255	98.746						
40	0.111	0.247	98.994						
41	0.105	0.234	99.228						
42	0.097	0.215	99.443						
43	0.094	0.209	99.653						
44	0.081	0.180	99.833						
45	0.075	0.167	100.000						

Extraction method: principal component analysis.

4.3.4 Factor analysis and GSCM performance

Cronbach's alpha for validity and reliability

The analyses confirm the reliability of the three factors environmental performance, economic performance and operational performance, with Cronbach's alpha values equal to 0.93, 0.90, and 0.88, respectively, which again are above the threshold of 0.70 and thus confirm the consistency and reliability (Nunnally, 1978). Therefore, it can be concluded that the items listed in the questionnaires are valid and relevant in terms of both the questions themselves and the study as a whole. This will be further discussed in Section 5.2.

Factor analysis

A factor analysis was conducted to further confirm the groupings of GSCM performance from the data of the survey. The factors were extracted using the maximum likelihood method, followed by varimax rotation. The Kaiser criterion (eigenvalues>1) was employed in conjunction with an evaluation of scree plots. The results suggest the presence of four factors for performance, which were retained for rotation. This factor analysis empirically grouped the scale items of GSCM performance as predicted (see Table 4.5), thereby confirming the original groupings. Four GSCM performance factors explain 72.27% of the inherent variation in their items. The four factors can be labelled environmental performance, positive economic performance, negative economic performance, and operational performance (see Table 4.6). The positive and negative economic performances were then combined to contribute to the factor of economic performance employed in this study. Further discussion can be seen in section 5.6.

Table 4.11 Kaiser-Meyer-Olkin and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.915
Bartlett's Test of Sphericity	Approx. Chi-Square	3041.296
	df	190
	Sig.	.000

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.915 (Table 4.11), demonstrating that the variables are suitable for factor analysis. In addition, the sig. is .000, which indicates that the strength of the relationship between variables is strong, and the variables are suitable for factor analysis (see Table 4.13).

Table 4.12 Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.076	50.380	50.380	10.076	50.380	50.380	4.465	22.323	22.323
2	1.726	8.630	59.010	1.726	8.630	59.010	3.423	17.115	39.438
3	1.491	7.454	66.464	1.491	7.454	66.464	3.353	16.765	56.203
4	1.161	5.806	72.270	1.161	5.806	72.270	3.213	16.067	72.270
5	.735	3.673	75.943						
6	.604	3.021	78.964						
7	.533	2.667	81.631						
8	.507	2.533	84.163						
9	.446	2.231	86.394						
10	.419	2.093	88.487						
11	.362	1.812	90.299						
12	.342	1.711	92.010						
13	.283	1.416	93.426						
14	.279	1.396	94.822						
15	.236	1.180	96.002						
16	.200	1.000	97.002						
17	.186	.929	97.931						
18	.155	.774	98.705						
19	.141	.704	99.410						
20	.118	.590	100.000						

Extraction method: principal component analysis.

Table 4.13 Rotated component matrix[a]

	Component			
	1	2	3	4
ENP2	.846	.180	.253	.168
ENP1	.821	.170	.169	.196
ENP4	.778	.261	.245	.184
ENP3	.764	.252	.232	.166
ENP5	.753	.184	.251	.175
ENP6	.637	.361	.188	.288
OP3	.201	.789	.189	.143
OP5	.215	.776	.212	.210
OP4	.278	.763	.165	.273
OP2	.226	.651	.317	.199
OP1	.303	.534	.368	.219
EP7	.198	.172	.863	.122
EP8	.264	.293	.805	.106
EP6	.230	.224	.777	.168
EP5	.374	.208	.577	.289
EP9	.356	.368	.519	.251
EP2	.200	.127	.129	.851
EP4	.185	.270	.123	.833
EP3	.173	.161	.184	.804
EP1	.271	.302	.194	.692

a Rotation converged in 6 iterations.

4.3.5 Correlation

The bivariate correlation results, using Pearson correlation coefficients, are shown in Table 4.14. The results show a significant relationship between GP, ECO, IR, CC and IEM, and each of the three supply chain performance types, including environmental performance, economic performance, and operational performance. The correlations between GSCM practices and corresponding performance types are in the expected direction.

Table 4.14 Correlation coefficients of relationships between GSCM practices and performances

	1	2	3	4	5	6	7	8
Practices								
GP	1							
ECO	0.812(**)	1						
IR	0.798(**)	0.726(**)	1					
CC	0.830(**)	0.802(**)	0.773(**)	1				
IEM	0.887(**)	0.794(**)	0.856(**)	0.817(**)	1			
Performances								
ENP	0.616(**)	0.579(**)	0.622(**)	0.579(**)	0.659(**)	1		
EP	0.727(**)	0.636(**)	0.692(**)	0.687(**)	0.793(**)	0.694(**)	1	
OP	0.653(**)	0.533(**)	0.652(**)	0.566(**)	0.686(**)	0.640(**)	0.720(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

4.3.6 Regression

Regressing environmental performance

To completely test hypotheses H3a, H3b, H3c, H3d, and H3e, the environmental performance parameter was regressed on the GSCM practice of GP, ECO, IR, CC and IEM (Table 4.15). The R-squared value is 0.453. This means that the research model explains 45.3% of the variance in environmental performance.

Table 4.15 Model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673[a]	.453	.439	.53394

a Predictors: (Constant), IEM, ECO, CC, IR, GP
b Dependent Variable: ENP

Through the ANOVA (Table 4.16), the model reaches statistical significance (sig. = .000, and p $\leqslant$.01).

Table 4.16 ANOVA Summary[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46.323	5	9.265	32.497	.000[a]
	Residual	55.878	196	.285		
	Total	102.200	201			

a. Predictors: (Constant), IEM, ECO, CC, IR, GP
b. Dependent Variable: ENP

Table 4.17 Coefficients of relationships between GSCM practices and environmental performances

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	β (Beta)		
1	(Constant)	1.471	.214		6.886	.000
	GP	.055	.131	.055	.424	.672
	ECO	.099	.094	.105	1.049	.296
	IR	.165	.094	.186	1.761	.080
	CC	.016	.103	.017	.157	.875
	IEM	.336	.132	.354	2.553	.011

The test of hypothesis H3a assessed whether green purchasing is positively related to environmental performance. The results (β = 0.55, t = 0.424, p $\geqslant$.05) failed to suggest that a higher level of green purchasing practice lead to higher environmental performance as p-value was larger than 0.05 which indicated that there was no significance between the two variables; and thus H3a is rejected. In addition, Table 4.17 shows the results of the significance test for the relationship between eco-design practices and environmental performance. As the relationship is insignificant (β = 0.099, t = 1.049, p $\geqslant$.05), H3b is rejected. The two items of investment recovery and environmental performance are insignificantly related with the test results of β = 0.165, t = 1.761, p ≥.05, so H3c is rejected. In addition, H3d is rejected by the GSCM practice of cooperation with customers (β = 0.016, t = 0.157, p ≥.05). H3e proposed that internal environmental practices are positively associated with environmental performance. The results show that the relationship between IEM and environmental performance is significant (β = 0.336, t = 2.553, p $\leqslant$.05). Thus, H3e is supported.

Table 4.15 provides the correlation coefficient values. The R-squared value shows the amount of variance in the dependent variable, which can be explained by the independent variable. In this case, the independent variable of GSCM practice accounts for 45.3% of the variance in environmental performance. The ANOVA helped to test the significance of the regression model. From Table 4.16, it can be seen that the sig. (*p* value) = 0.000. As $p < 0.05$, the predictors are significantly better than expected. The regression line predicted by the independent variables explains a significant amount of the variance in the dependent variable. Next, Table 4.17 shows how the independent variables are related to the dependent variable, as well as which variables are individually significant, independent of the dependent variable. From the unstandardised coefficients B column, the regression equation can be obtained as follows:

Environmental performance = 1.471 + 0.055 GP + 0.099 ECO + 0.165 IR + 0.016 CC + 0.336 IEM.

Data from the standardised beta coefficient column show the contribution that an individual variable makes to the model. A positive beta implies a positive correlation between the independent variable and the dependent variable, while a negative beta indicates a negative correlation between the two variables. In addition, the beta weight is the average amount that the dependent variable increases when the independent variable increases by one standard deviation. However, it is clear from Table 4.10 that that IEM is the only significant variable with $p = 0.011$, implying that the other four variables have no significant relationship with the development of the environmental performance..

Therefore, hypotheses from H3a to H3d can be rejected but H3e can be supported; only the GSCM practices of IEM is positively related to environmental performance for Chinese manufacturing SMEs in Chang Chiang Delta which is the most influential and significant. There are several possible reasons for this result. Firstly, GSCM is currently in a fledging period of development among SMEs in the Chinese context, and thus an SME's green strategies and activities may not be fully understood or accepted by its suppliers or customers in terms of green purchasing, eco-design and

so on. Consequently, this leads to an insignificant influence on environmental performance improvement. Secondly, comparing with any cooperative actions with the other party to implement GSCM practices, for less residuals output for instance, it is much easier to take actions within an enterprise its own rather than rely on others' efforts. In addition, strong support from the top and middle management of an enterprise is always believed to have a high impact on GSCM development, as discussed in Section 2.11.2.

Regressing economic performance

To completely test hypotheses H3f, H3g, H3h, H3i, and H3j, the economic performance parameter was regressed on the GSCM practice of GP, ECO, IR, CC and IEM (Table 4.18). The R-squared value is 0.635, which means that the research model explains 63.5% of the variance in environmental performance.

Table 4.18 Model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.797(a)	.635	.626	.40277

a Predictors: (Constant), IEM, ECO, CC, IR, GP
b Dependent Variable: EP

Through the ANOVA (Table 4.19), the model reaches statistical significance (Sig. = .000, and p $\leqslant$ .01).

Table 4.19 ANOVA summary[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	55.398	5	11.080	68.296	.000[a]
	Residual	31.797	196	.162		
	Total	81.194	201			

a. Predictors: (Constant), IEM, ECO, CC, IR, GP
b. Dependent Variable: EP

Table 4.20 Coefficients of relationships between GSCM practices and economic performances[a]

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	β (Beta)		
1	(Constant)	1.106	.161		6.864	.000
	GP	.071	.099	.076	.724	.470
	ECO	-.046	.071	-.053	-.645	.520
	IR	.012	.071	.015	.174	.862
	CC	.100	.078	.112	1.278	.203
	IEM	.581	.099	.663	5.857	.000

The test of H3f assessed whether green purchasing is positively related to economic performance. The results (β = 0.71, t = 0.424, p ⩾.05) could not suggest that a higher level of green purchasing practice lead to higher economic performance as p-value was larger than 0.05 which indicated that there was no significance between the two variables; thus H3f is rejected. Eco-design has a negative β value for economic performance (β = -0.046, t = -0.645), thus indicating that a higher level of eco-design practice leads to lower economic performance. However, the relationship is not significant at p ⩾ .05. Thus, H3g is rejected. In addition, Table 4.20 shows the results of the significance test for the relationship between investment recovery practices and economic performance. Because the relationship is insignificant (β = 0.012, t = 0.174, p ≥.05), H3h is rejected. The two items cooperation with customers and economic performance are insignificantly related, with results of β = 0.100, t = 1.278, and p ≥.05; thus H3i was also rejected. H3j proposed that internal environmental practices are positively associated with economic performance. The results show that the relationship between IEM and economic performance is significant (β = 0.581, t = 5.857, p ⩽.01). Thus, H3j is strongly supported.

Table 4.18 shows that the independent variable of GSCM practices accounts for 79.7% of the variance in economic performance. From Table 4.19, which shows the ANOVA results, it can be seen that sig. (*p* value) = 0.000, which is less than 0.05, indicating that the predictors are significantly better than expected. Table 4.20 shows that IEM is the only independent variable that is positively related to the dependent variable;

that is, economic performance. From the unstandardised coefficients B column, the regression equation can be obtained as follows:

Environmental performance = 1.106 + 0.071 GP - 0.046 ECO + 0.012 IR + 0.100 CC + 0.581 IEM.

The negative standardised beta coefficient of ECO (-0.053) theoretically indicates a negative correlation between eco-design practices and economic performance. In other words, a higher level of eco-design implementation within an SME will cause a financial decrease for the SME. However, the p-value of 0.52 suggested that the relationship between ECO and economic performance is not significant and IEM is the only significant variable with $p = 0.000$.

Therefore, H3f, H3g, H3h and H3i should be rejected and H3j can be supported, the GSCM practices of IEM is positively related to economic performance for Chinese manufacturing SMEs in Chang Chiang Delta The reasons for the results may be similar to those referred to when discussing environmental performance, but there is another notable point here. Both positive and negative economic performances have been included in the investigation; if these practices are still positively related to overall economic performance, it may be concluded that although some costs increases occur in the process of GSCM practice implementation for a SME, the earnings are still greater, leading to increased profit for the SME. This should encourage SMEs to implement GSCM. Schischke et al. (2005) stressed that the reduction of material consumption and waste in the production and manufacture of products, as well as reduced energy consumption, can directly benefit to the manufacturer, while also reducing internal risk and increasing employee motivation. More importantly, it can be expected that as acceptance and popularity of GSCM increases, the cost of eco-design practices will decline, as what might be “designed” previously would have already been reality.

Regressing operational performance

To completely test hypotheses H3k, H3l, H3m, H3n, and H3o, the operational

performance parameter was regressed on the GSCM practice of GP, ED, IR, CC, IEM. (Table 4.21). The R-squared value is 0.498, which means that the research model explains 49.8% of the variance in operational performance.

Table 4.21 Model summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.706[a]	.498	.485	.49964

a Predictors: (Constant), IEM, ECO, CC, IR, GP
b Dependent Variable: OP

Through the ANOVA table (Table 4.22), the model reaches statistical significance (Sig.=.000, and p $\leqslant$ .01).

Table 4.22 ANOVA summary[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	48.567	5	9.713	38.909	.000[a]
	Residual	48.930	196	.250		
	Total	97.497	201			

a. Predictors: (Constant), IEM, ECO, CC, IR, GP
b. Dependent Variable: OP

Table 4.23 Coefficients[a] of relationships between GSCM practices and economic performances

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	β (Beta)		
1	(Constant)	1.383	.200		6.920	.000
	GP	.251	.122	.254	2.055	.041
	ECO	-.098	.088	-.107	-1.116	.266
	IR	.209	.088	.241	2.379	.018
	CC	-.063	.097	-.067	-.648	.518
	IEM	.365	.123	.393	2.964	.003

a. Dependent Variable: OP

The test of hypothesis H3k assessed whether green purchasing is positively related to economic performance. The results suggest that a higher level of green purchasing practice leads to higher operational performance (β = 0.251, t = 2.055, p

⩽.05); thus, H3k was supported. Eco-design has a negative β for economic performance (β = -0.098, t = -1.116), indicating that the higher the level of eco-design practice, the lower the operational performance. But the relationship is not significant at p⩾.05, and thus H3l is rejected. In addition, Table 4.23 shows the results of the significance test for the relationship between investment recovery practices and operational performance, wherein the relationship is significant (β = 0.209, t = 2.379, p ⩽.05). Therefore, H3m is supported. The two items of cooperation with customers and operational performance are negatively related, with results of β = -0.063, t = -0.648, p ⩾. 05; thus H3n is not supported. H3o proposed that internal environmental practices are positively associated with operational performance. The results show that the relationship between IEM and operational performance is significant (β = 0.365, t = 2.964, p ⩽.01). Therefore, H3o is strongly supported.

The results from Table 4.21 to Table 4.23 help to explain how the five GSCM practices impact SMEs' operational performance. The R-squared value implies that the independent variable of GSCM practices accounts for 70.6% of the variance in operational performance. The sig. (*p* value) = 0.000 in Table 4.22, which is less than 0.05, indicating that the predictors are significantly better than expected. Table 4.23 shows that the independent variables of GP, IR and IEM are positively related to the dependent variable of operational performance, while ECO and CC are negatively related to operational performance. It is notable that IEM is still the most significant independent variable, followed by GP and IR. From the unstandardised coefficients B column, the regression equation can be obtained as follows:

Environmental performance = 1.383 + 0.251 GP - 0.098 ECO + 0.209 IR + 0.063 CC + 0.365 IEM.

The results shown that practices of green purchasing, investment recovery and internal environmental management, are positively related to operational performance, among which IEM (0.393) still has the largest influence. Furthermore, GP, IR and IEM are all significant, with *p* values of 0.041, 0.018 and 0.003,

respectively.

As a result, H3k, H3m and H3o can be supported, while H3l and H3n should be rejected. The GSCM practices of GP, IR and IEM are positively related to the operational performance of Chinese manufacturing SMEs in Chang Chiang Delta, among which, IEM is the most influential practice. It is noteworthy that IEM practices always contribute to improved performance for an SME, including operational performance. The most likely reason for this, as proposed above, may be that self-management is much easier and more efficient than depending on reactions from others. Shorter distance, prompter response, and better communication within an SME might lead to operational improvements. The opposite case may occur when cooperating with customers. Increased communication requirements and tolerance, and even problems with time differences, can cause decreases in operational efficiency. In addition, as discussed above, ECO is not as simple as it appears to be. For example, it might involve conducting business with both suppliers and customers simultaneously if a SME is considering an innovative product that requires new materials, and customer feedback on these new materials. This complex process would probably result in low operational efficiency for the SME.

Table 4.24 provides a summary of the results of the hypotheses tests.

Table 4.24 Summary of Hypotheses

Hypotheses	Results
H1a: Chinese manufacturing SMEs have been under the regulatory pressures from government in terms of GSCM.	Supported
H1b: Chinese manufacturing SMEs have been under the customer pressures from the purchasers at home and abroad as well as the end users in terms of GSCM.	Supported
H1c: Chinese manufacturing SMEs have been under the public pressures from the consumers and the society in terms of GSCM.	Supported
H1d: Chinese manufacturing SMEs have been under the supplier pressures from the upper stream partners in terms of GSCM.	Supported
H1e: Chinese manufacturing SMEs have been encouraged by the internal drivers in terms of GSCM.	Supported
H2: Chinese SMEs from different industrial sectors differ in terms of experiencing pressures in adoptions of GSCM.	Supported
H3: Chinese SMEs from different industrial sectors differ in adopting practices of GSCM in terms of green purchasing (GP), cooperation with customers including environmental requirements (CC), investment recovery (IR), eco-design (ECO) and internal environmental management (IEM).	Supported
H4a: The practice of green purchasing is positively related to GSCM environmental performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4b: The practice of eco-design is positively related to GSCM environmental performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4c: The practice of investment recovery is positively related to GSCM environmental performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4d: The practice of collaboration with customers is positively related to GSCM environmental performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4e: The practice of internal environmental management is positively related to GSCM environmental performance for SMEs in Chang Chiang River Delta of China.	Supported
H4f: The practice of green purchasing is positively related to GSCM economic performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4g: The practice of eco-design is positively related to GSCM economic performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4h: The practice of investment recovery is positively related to GSCM economic performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4i: The practice of collaboration with customers is positively related to GSCM economic performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4j: The practice of internal environmental management is positively related to GSCM economic performance for SMEs in Chang Chiang River Delta of China.	Supported
H4k: The practice of green purchasing is positively related to GSCM operational performance for SMEs in Chang Chiang River Delta of China.	Supported
H4l: The practice of eco-design is positively related to GSCM operational performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4m: The practice of investment recovery is positively related to GSCM operational performance for SMEs in Chang Chiang River Delta of China.	Supported
H4n: The practice of collaboration with customers is positively related to GSCM operational performance for SMEs in Chang Chiang River Delta of China.	Rejected
H4o: The practice of internal environmental management is positively related to GSCM operational performance for SMEs in Chang Chiang River Delta of China.	Supported

4.4 Case study findings

4.4.1 Background – the pharmaceutical industry in China

China is believed to have the world's fastest growing economy. For example, China is the second largest economy in terms of purchasing power parity in the world, with a GDP of US$ 8.8 trillion and a rate of 8.7% (Central Intelligence Agency, 2010). A surge has been experienced by the Chinese pharmaceutical industry over the past decade: from 2001 to 2008, the industry grew at a compounded annual growth rate (CAGR) of 20% (Li et al., 2009). Both Morgan Stanley and WiCON predicted a sales increase of 16% for the Chinese pharmaceutical industry in 2009 (Pharma China, 2009; Li et al., 2009).

The Chinese pharmaceutical industry mainly consists of seven subsectors, among which the following five are argued to be most important: APIs (Active Pharmaceutical Ingredients), PCFs (Pharmaceutical Chemical Formulations), TCMs (Traditional Chinese Medicines), biologics, and herbals. In terms of sales and output value, these sectors comprise over 90% of the entire industry (Pharma China, 2009).

In terms of sales, China's pharmaceutical industry in 2008 was estimated at US$ 102.5 billion, accounting for 48% of the overall US$ 213.8 billion healthcare market (Li et al., 2009). This is a large percentage compared to Western markets, where pharmaceuticals typically make up less than 25% of total healthcare spending (Herd et al., 2010).

According to Jiang et al. (2001), the Chinese pharmaceutical industry has two significantly unique characteristics. One is that TCM is becoming more widely accepted by consumers all over the world. TCM, which has roots in Chinese culture, occupies over 40% of the total market, while chemical and biotech products account for less than 60%. The other unique characteristic is that the pharmaceutical market in China covers a variety of areas, including medicine produced by domestic manufacturers who are often state-owned; products from Chinese and foreign joint ventures; and imported medicines which are registered through the State Drug

Administration (SDA) of China. Additionally, it is notable that imported medicines made up 40% of the Chinese pharmaceutical market over the past decade. The case study enterprise, a domestic producer, is the SME selected for the case study section of this research.

4.4.2 The case study enterprise

As a new and high-tech enterprise, the case study enterprise researches, develops, manufactures, and markets new medicines. It is located in Ningbo City, Zhejiang Province..

The case study enterprise established the Team Academy of Pharmaceutical Science as a basis of new drugs research, development and registration; this organisation has developed many new drugs to both the Chinese market, and worldwide. More than ten of its drugs have been approved as National Major New Products, are listed in the National Torch Plan which is a guidance program for developing new and high tech industries in China and approved by the State Council, and rewarded for state science and technology advancement, etc. It is a leading technology advancement enterprise in Ningbo, and one of the best economic benefit enterprises in Zhejiang Province.

The pharmaceutical SME covers 61,334m^2, of which 46,038m^2 is a built-up area. Its tablet workshops, injection workshops and raw material workshops have acquired GMP (Good Manufacturing Practices) certification from SFDA (State Food and Drug Administration). All of the company's production and analysis equipment is advanced, and the company has an extensive quality assurance system in place. Its products are also produced according to GMP standards.

It produces more than 60 products, of which the main ones include Zhudan (Ondansetron Hydrochloride), Zhuxing (Granisetron Hydrochloride), and Zhurui (Tamoxifen Citrate); it also produces drugs for cancer, hypertension, asthma and geriatric disease, as well as antilipids, antipyretics, and analgesics. The enterprise

occupies a substantial share in the Chinese market, especially in the anti-cancer field.

The sales network of the case study enterprise covers the whole of China. It has set up more than 30 branches and offices around the main cities in China, and has built close relationships with more than 1,000 hospitals and many famous experts. It has experienced rapid sales increases, especially in the anti-cancer fields.

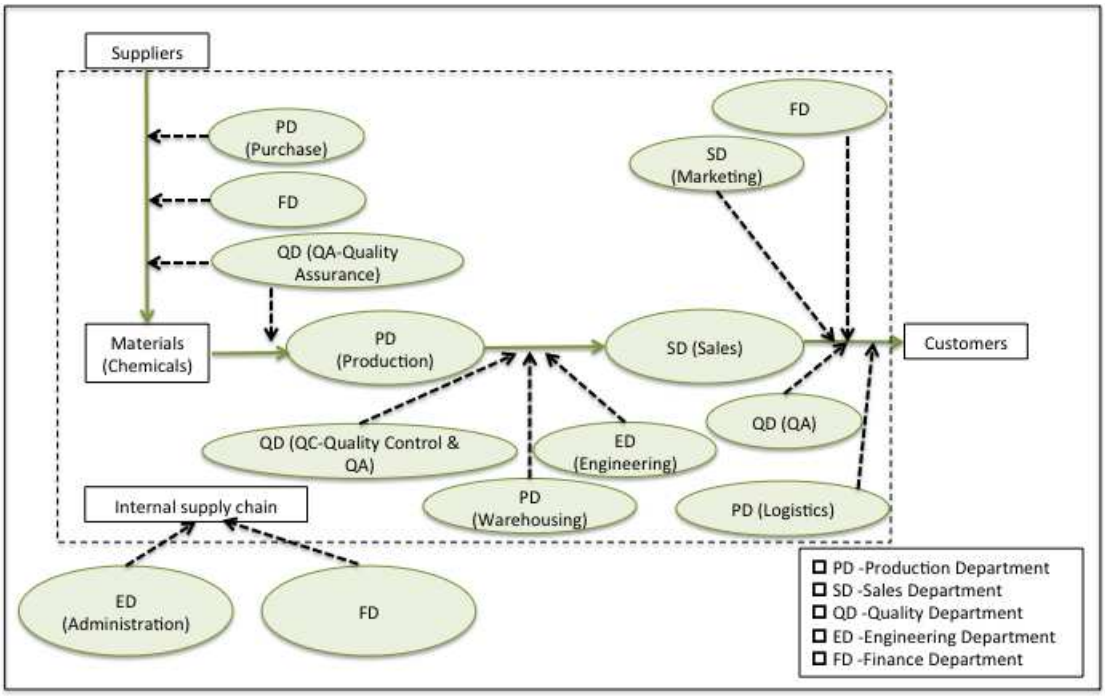
4.4.3 Observations and interviews

Observations

The observation was unstructured without any checklist and the researcher was allowed to go all area within the case study enterprise to watch what people doing and saying related to the research project.

Through documentary and observations of the case study enterprise, a brief supply chain relationship throughout the enterprise is described in Figure 4.1, including the internal supply chain within the enterprise and the joints with suppliers and customers. The production department is extremely vital in the supply chain for the case study enterprise and the quality department is always asked to play a part throughout the supply chain given that the enterprise is a pharmaceutical firm.

Figure 4.1 Supply chain of the case study enterprise



The production department has two main functions for this enterprise, including supply (purchase and warehousing) and production. There are five categories of production workshops and they are raw material workshops, injection workshops, tablet workshops, transfusion workshops and water treatment plants. Usually the suppliers are responsible for delivering the raw materials to the case study enterprise and the quality assurance office is asked to participate the receiving process with the inspection. The quality assurance office is also required to cover the examination during the shipment before the products delivering to its customers.

It was found that there was a specific storage place for each of the production workshops to store the residues which could be recycled. The inventory of the residues was clean and clear but they were handwritten records. The waste water system was updated in the year of 2011 which reached the world-class level. The input for the water treatment plants and the output (recycling materials, by-products and recycling water) were recorded with an automatic electronic message system. The case study enterprise has tried to take full use of its residues and wastewater in its production.

Besides the QC and QA offices, there is a research and development center (R&D) under the quality department of the case study enterprise. It was responsible for new drug design, in ingredient and in production. The poster attached to the wall of the R&D center clearly listed the scope of official duty, among which developing new drugs with least negative environmental impact was emphasized.

The engineering department covered two main businesses – mechanical engineering and administrative functions. The case study enterprise had a separate administration building where the non-operator employees were working. It is worthy mentioning that the notable slogans of energy conservation were put up in the building. All the administrative employees have been asked to turn their working computer off when leaving and the last one who leaves the office should be responsible for turning off all the lights and other electronic equipment like printers, scanners and so on. And such kind of "rules" were repeated and emphasized at the end of the department regular meetings.

Furthermore, based on the documentary and observation, a green supply chain model which currently is using by the case study enterprise was inducted and will be discussed in Section 4.4.4.

Interviews

It is not surprising that the majority of the interviewees were unclear about the conception of GSCM, especially for those employees. Interviewee H said that he had heard of the idea of GSCM before in a workshop session for entrepreneurs when he was in Shanghai. That was a workshop for the participated entrepreneurs to exchange their managerial experiences. An invited professor mentioned the notion of GSCM in his lecture to the entrepreneur but he did not discuss much about it and the interviewee did not think much of it. H said that he could only relate the item with the idea of environment protection but he was not able to talk much about it either. Interviewee A was outstanding among the interviewees as he seemed to know most about GSCM comparing with others. He said that GSCM could help an

enterprise to reduce waste, save energy and further for environmental protection and sustainable development.

All the interviewees denied that there was any clearly stated or written form of GSCM policies or strategies that implemented within the enterprise. Interviewee C hesitated to answer the question at first and he then asked in reply: “what does GSCM policy mean?” With the clarification by the interviewer, he still hesitated to answer. He asked whether the requirements of reduce waste in his operation handbook could be regarded as GSCM policy. The interviewee confirmed with him that the policy should be very clear and specific on green practices through the supply chain and C finally answered with a definite “No”. Both Interviewee A and H tried to explain that the enterprise had some rules for more effective use of material and energy saving and of financial punishment policies for failure in clean production for both employees and the management; but they agreed that no clear policies, strategies or principles in written form on GSCM implemented in the enterprise.

Interviewee A, E, F, G and H made emphasis on the advanced water treatment system implemented in the enterprise as one aspect of its recent GSCM development. Interviewee A strongly agreed that more frequent training on Total Quality Management to employees within his department helped to increase the awareness and efficiency of clean production and environmental protection among the staff. Interviewee H admitted that he and his management group would think about the environmental issues when they have to make decisions to start a new production project. They would evaluate the possible benefits from the new production and the cost for the treatment of waste water and residues. Furthermore, Interviewee A, C, E, G and H talked about the recycling of waste and residues in the production which was consistent with the findings from the observations and documentary of the case study enterprise.

Interviewee B, D and E stressed that among their overseas customers, only the ones from France have more and high requirements in terms of green packaging, clean production and JIT logistics to the case study enterprise; others from India and North

American countries have relatively lower standards when importing products from them. E admitted that the latter customers were more welcomed as more green practices indicated that more expenditure should be put in terms of financial and human resource cost. They also conveyed the same idea that no requirements of GSCM from the enterprise to its suppliers and only cost and quality have been taken into consideration to buy raw materials.

4.4.4 The current model of the case study enterprise

Based on the narrative data from the observations and interviews, it is believed that the case study enterprise's current model consists of three steps. Firstly, it establishes close and long-term business relationships with its main suppliers, the chemical manufacturers, in order to ensure that high quality raw materials are used. Secondly, it manufactures pharmaceuticals, APIs and finished medicine using precision production techniques to ensure high-quality pharmaceutical products. Thirdly, any residues are used as fully as possible in other production areas, and the co-products are also recycled as raw materials.

Figure 4.2 depicts a process flow of an API product from the case study enterprise (the name of the pharmaceutical product cannot be published due to the secrecy requirements of the enterprise). Along the chain, the downstream reaction/production uses wastes from the upstream reaction/production as raw materials. For example, the residues from the first reaction are combined with water, toluene and sodium chloride to produce an organic phase through the sodium hydroxide solution. The residues from chemical production are usually discharged or disposed of as wastes, but in the enterprise they are used as the fertilizer to make products. Moreover, the wastewater from production can be reused within other reactions. In the pharmaceutical SME, co-products are also taken full advantage of in the supply chain. For example, the co-products toluene and acetone from production can be recycled as raw materials. Through the use of residue products and the recycling of co-products, it not only reduces its waste, but also improves its financial performance via cost reduction.

Furthermore, the research and development (R&D) department works hard to create innovations regarding technologies in order to improve the efficiency of extraction and to reduce residues. For example, in API production, the technologies developed have helped to reduce residues by 20%, and extraction has been increased by 30%.

Figure 4.2 A green process flow of an API product

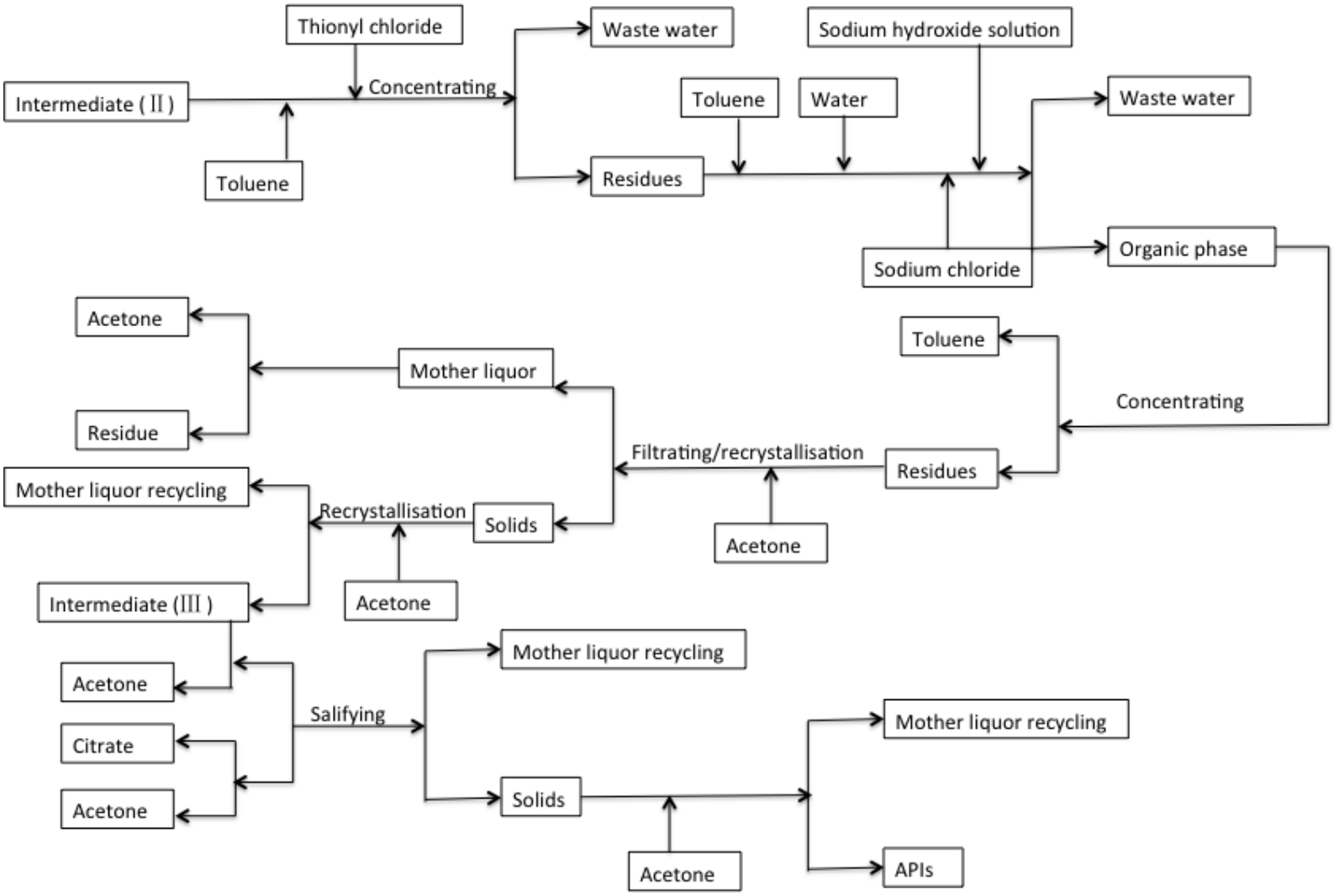
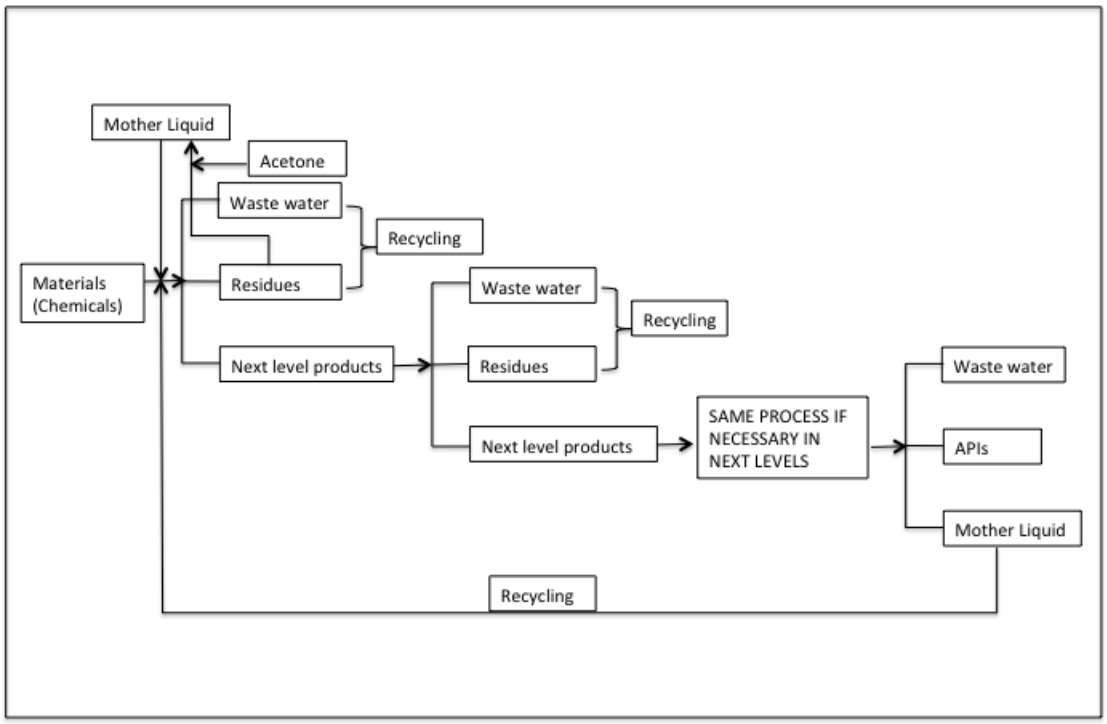


Figure 4.3 Current green supply chain model of the case study enterprise



From the investigation into the case study enterprise, the current GSCM model can be identified and summarised, as shown in Figure 4.2. Although more sophisticated techniques have been used in production, co-products and side products are now recycled during the production process in the enterprise.

4.4.5 Key findings from the case study

Although the case study enterprise has not officially declared any corporate strategy on GSCM, it has gained some experience with GSCM practice initiatives; however, it also still faces some GSCM pressures from different stakeholder sources. In addition, it has encountered difficulties in pursuing sustainable development as a result of limitations arising from its status as an SME; lack of capitals, for instance.

GSCM can ensure that the material cycles in the supply chains are managed in an environmentally, economically and socially responsible way to ensure minimum waste generation and maximum energy conservation at each stage of the life cycle of a product; thus, the materials can be reduced, reused and recycled within the supply chain. In the case study enterprise, waste or residues are treated as resources and

co-products throughout the chain. One aim of this case study is to identify ways in which to optimise the environmental, economic and operational performance of it using the suggested GSCM model.

The main problem with the GSCM policy for the case is that there is no clear and specific regulation on green issues or environmental concerns within the pharmaceutical industry. The pharmaceutical manufacturers, especially SMEs, follow rules established according to the underlying principles within the industry. They usually have to struggle with the constraints set by dominant enterprises, who are often LEs. Thus, though it manufactures under the general framework built up by the governmental parties in China, it does not experience strong pressures or enforced regulations.

Though the enterprise has business relations with enterprises from seven countries, the majority are from India and North American countries, which hold relatively lower standards and requirements for export in terms of a green supply chain. Only a few business partners are from the EU, which has more requirements regarding green purchasing, green production and green logistics, and entails more contributions in terms of financial and human resource input. Thus, the cost has to be increased. Consequently, it has a low level cooperation with customers for its cost reduction.

Little work has been done regarding green purchasing and collaboration with suppliers for the case study enterprise, as the range of options available to it are too expansive. The major consideration in the selection of suppliers is cost and quality. For suppliers in pharmaceutical industry, quality can be guaranteed according to strict GMP principles and detection by the customer enterprises. Thus, price plays an extremely important role in selecting suppliers for the enterprise, with little consideration of GSCM perspectives.

From the perspective of internal management, GSCM is still not desirable due to the absence of a clear and systematic strategy. As a consequence of the lack of policies,

regulations and laws for the pharmaceutical industry, both top and mid-level management within the case study enterprise pays insignificant attention to the improvement of GSCM. Decisions are made mainly on the basis of lowering cost, with standardised quality considerations. But the good point is that the enterprise is strictly in compliance with the existing regulations and principles from the top management to the middle managers and to the employee individuals. In addition, they do have some policies in place, off the record, regarding failures or faults with respect to clean production by implementing financial penalties for managers and employees. But this “unwritten rule” is also ambiguous, and the amount of penalty has not been fixed. As a result, it takes very little social responsibility due to a cost-reduction-led strategy.

4.5 Chapter summary

The results and key findings from both the questionnaire survey and the case study were presented in this chapter. Codes were assigned to each of the GSCM factors, and the respondents’ different sectors assigned numbers from 1-12. SPSS was used to analyse the data. The Cronbach’s alpha values for the three factors of GSCM pressures, GSCM practices and GSCM performances were all over 0.7, indicating a high degree of reliability for the questionnaire survey among the respondent sample. The means and standard deviations from the descriptive statistics provide strong evidence to verify that Chinese manufacturing SMEs face regulatory pressures, customer pressures, supplier pressures, public pressures and internal drivers from different stakeholder parties in terms of GSCM to varying degrees. In addition, the results the correlation and regression analyses show that the GSCM practices examined in this research, including green purchasing, eco-design, investment recovery, cooperation with customers and internal environmental management do contribute to improving firm performance from economic, environmental and operational perspectives.

The findings from the case study can be seen as supplementing those of the questionnaire survey. As an SME, the case study enterprise has an unclear

consciousness of GSCM, however it has already put in place some GSCM initiatives, such as recycling residues and co-products, environmentally friendly disposal of waste water, and so on, which has resulted in improvements in production efficiency and cost reduction. However, the company is still encountering some difficulties in terms of the systematic implementation of GSCM, and further developments from the perspective of sustainability, including the absence of a specific regulatory document for the whole industry to take environmental concerns into account within the supply chain; insufficient cooperation with customers and suppliers; undefined internal policies regarding environmental management within the enterprise; and financial constraints due to the enterprise's size.

The results and findings will now be discussed. Based on the findings of the case study on the pharmaceutical SME and the questionnaire survey, a developed and optimal model will be proposed for the enterprise.

5. Discussion

5.1 Introduction

Based on the quantitative survey and case study introduced in Chapter 4, the GSCM pressures, practices and performances have been explored among Chinese SMEs in the Chang Chiang River Delta, and discussed under the theoretical framework of sustainability which was introduced in Chapter 2. Further discussions on the interconnections between knowledge, implementation and relationships are provided in this chapter.

Section 5.2 will discuss the Cronbach's alpha values obtained, which will help to verify the reliability of the questions employed in this study. With a well-controlled number of items, a higher Cronbach's alpha value is more desirable. Next, the chapter will proceed to answer the four research questions individually, followed by another section to discuss the case study in detail, covering aspects of the case firm's experiences, difficulties and possible solutions with respect to GSCM. An optimised model is then proposed and presented in section 5.7. The chapter will conclude with a summary section.

5.2 Cronbach's alpha

The Cronbach's alpha values calculated in Section 4.3.1, 4.3.3 and 4.3.4 are summarised in Table 5.1.

Table 5.1 Summary of Cronbach's alpha values for GSCM factors

GSCM factors	Cronbach's alpha	Internal consistency
GSCM Pressures		
Regulatory Pressures	0.88	Good
Customer Pressures	0.73	Acceptable
Supplier Pressures	0.88	Good
Public Pressures	0.88	Good
Internal Drivers	0.94	Excellent
GSCM Practices		
Green Purchasing	0.90	Excellent
Eco-design	0.90	Excellent
Investment Recovery	0.90	Excellent
Cooperation with Customers	0.92	Excellent
Internal Environmental Management	0.97	Excellent
GSCM Performances		
Economical Performance	0.93	Excellent
Environmental Performance	0.90	Excellent
Operational Performance	0.88	Good

Based on the discussion in Section 3.7.2, it is obvious that under each different GSCM factor, all of the research questions asked are highly interrelated with the corresponding GSCM factors, which indicates a high degree of reliability for the questionnaire survey.

However, Streiner and Norman (1989) also pointed out that a high Cronbach's alpha value is not necessarily desirable. Firstly, the value is dependent not only on the magnitude of the correlations among items, but also on the number of items in the scale. A scale can be made to look more "homogenous" simply by doubling the number of items, even though the average correlation remains the same. This can lead to another problem relating to high levels of item redundancy if the Cronbach's alpha value is too high. A number of items can ask the same question, just in slightly

different ways. Two efforts were made to avoid the possible consequences of high Cronbach's alpha values. Firstly, the questions regarding GSCM pressures, practices and performances were carefully designed and worded, with consideration of a variety of sources, as discussed in section 3.4. Secondly, a pilot test was carried out before conducting the main study in order to gather feedback and comments from respondents regarding the returned questionnaires in order to conduct further modifications of the questions. However, the majority of the respondents believed that the questions accurately reflected the problems and actualities that they were currently experiencing.

Thus, a conclusion can be drawn here that the relatively high Cronbach's alpha values from the items in the GSCM factor framework could indicate that all the questions asked contributed to the high validity and relevance of the questionnaire survey, and the whole research project.

5.3 Research question 1: How does "green" relate to SCM for SMEs?

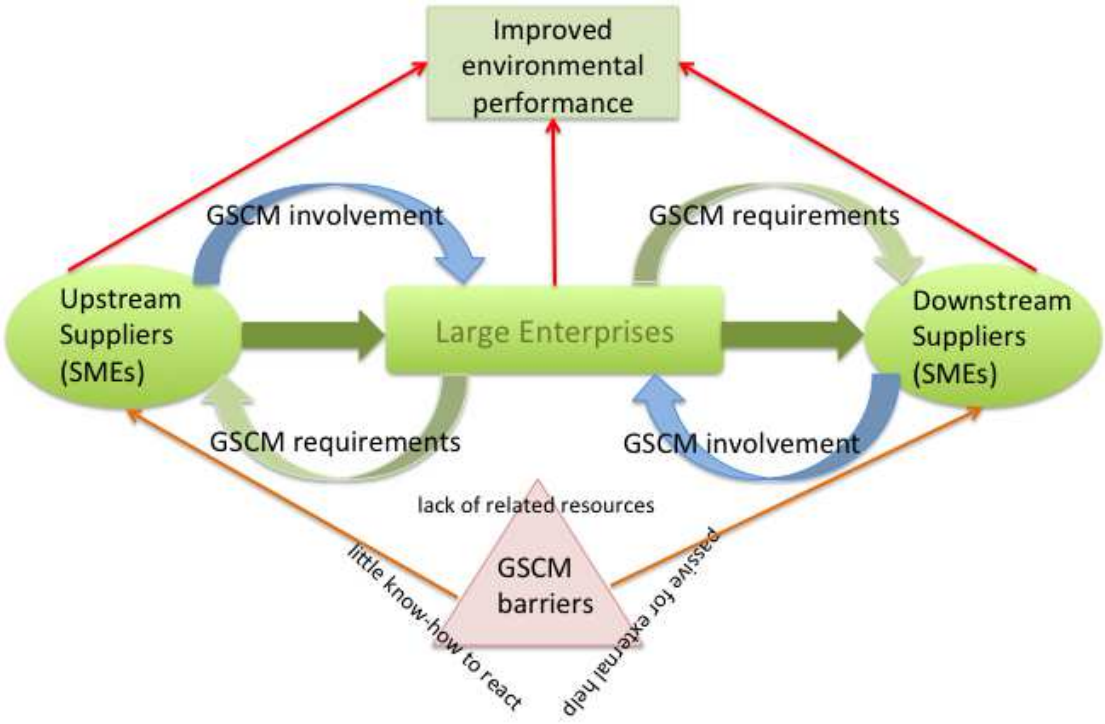
As discussed in the previous sections, the overwhelming majority of the existing literature on GSCM focused on LEs with only a few on SMEs emphasis. According to Lee (2008), green supply chain initiatives are transferring and disseminating environmental management practices into the whole supply chain by using the relationships between large-sized buying companies and their suppliers for improved environmental performance with the consideration of sustainability and corporate social responsibility. And this might can help to explain the growing body of research on GSCM in LEs covering the aspects of drivers for GSCM, GSCM implementation and the relationship between GSCM and the performances of the enterprises (Lee and Klassen, 2008).

The popular reason for the lack of literature on GSCM towards SMEs is the lack of related resources, as claimed by Hilton (2000) and Crals and Vereeck (2005). Consequently, they have little know-how to react to the technical and managerial changes to meet emerging environmental and social requirements (Luken and Stares,

2005). It is worse that those less capable SMEs were believed to be passive to reach out for help without any external stimulus. Lee (2008), however, argued that the LEs have been paying increasing attention to their SME suppliers by involving them into the supply chain loop to improve the environmental performances. In this way, the environmental risks from the SMEs have been decreased and inter-organizational mechanism has taken effect with the large-sized enterprises leading their upstream and downstream SME suppliers for a greener supply chain. Actually, SMEs have played a significantly vital role in GSCM as the environmental performance of the supply chain can only be improved through the interaction of various activities undertaken by each part across the chain.

Based on the discussion above, GSCM towards SMEs could be depicted as in Figure 5.1.

Figure 5.1 GSCM towards SMEs through LEs



Further, from the findings of this research project, LEs, could only be viewed as two sources of GSCM pressures to SMEs as suppliers or customers. Besides, regulations from the governments, pressures from the public as well as SMEs' internal drivers

can also play a role in stimulating those SMEs for GSCM development. The findings were consistent with the previous studies on LEs from Green et al. (1996), Walton et al. (1998), Beamon (1999), Hall (2001), Min and Galle (2001), Zhu et al. (2005), Walker et al. (2008) and Diabat and Govindan (2011). The consistence of findings from LEs and SMEs might be explained with the collaborative mechanism through the supply chain as discussed above. Moreover, the findings proved the results from existing literature on SMEs like Rao (2007) and Lee (2008).

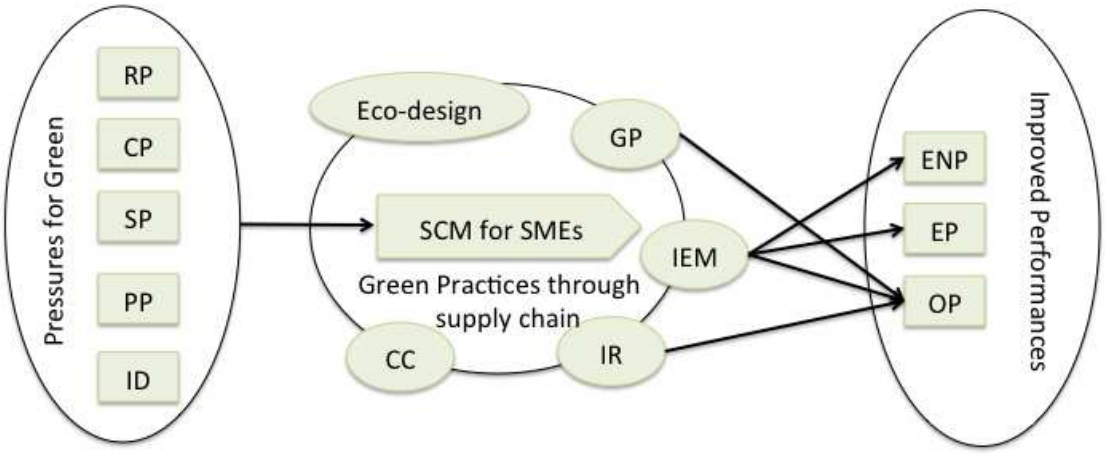
With regard to the GSCM involvement or participation of SMEs, this study identified and examined five GSCM practices and the evidence shown that Chinese manufacturing SMEs in Chang Chiang Delta have initiated GSCM practices. The findings were consistent with those from Zhu et al. (2005) and Zhu et al.(2008) which studied the GSCM initiatives among Chinese LEs. Similar results could be seen with the research carried out by Rao (2007), Studer et al. (2008), Lai et al. (2012) and so on among SMEs.

Bowen et al. (2001) insisted that GSCM practices among UK enterprises (mainly LEs) could help to achieve improved economic performances for them and the improved environmental performance would follow in a relatively long term. While Rao (2003) argued that the GSCM initiatives in South East Asia, including Philippines, Indonesia, Malaysia, Thailand and Singapore, were believed to positively related to the environmental performance. Rao and Holt (2005) further proved that GSCM practices could improve enterprises' economic performance through cost saving, increase of sales, market share and new market opportunities for greater profit margins. However, Testa and Iraldo (2010) believed that GSCM practices could contribute to improve environmental performance but with ambiguous effect on economic performance. Furthermore, Zhu and Sarkis (2004) found that there was a direct and positive relationship between GSCM practices and both environmental and economic performances among Chinese LEs. The findings from this research were consistent with these studies; explicitly, the practices of internal environmental management was the only confirmed GSCM application to improve the environmental and economic performance among Chinese manufacturing SMEs in the focal area.

Azevedo et al. (2011) claimed that GSCM practices have positive effects on enterprises' operational performances like improvement of quality, customer satisfaction and efficiency. Green et al. (2012) further verified that the adoption of GSCM practices by manufacturing enterprises generally lead to improved environmental performance and economic performance, both of which in turn would positively impact operational performances for the manufacturers. Findings from this research project identified that green purchasing, investment recovery and internal environmental management practices were positively related to the operational performance for Chinese SME manufacturers.

Therefore, with the findings of this study, GSCM towards SMEs might be illustrated with Figure 5.2.

Figure 5.2 How "green" related to SCM for SMEs based on the findings of this study



5.4 Research question 2: What are the current pressures of GSCM on SMEs in Chang Chiang Delta?

By using the data collected from the questionnaire survey to test the hypotheses, along with the descriptive statistics of means, it is clear that Chinese manufacturing SMEs are under regulatory pressures, customer pressures, public pressures and supplier pressures, and are also being encouraged by the internal driver of GSCM, as explained in section 4.3.1. There are many interesting findings from this research project, and these findings definitely complement those presented by Henriques and Sadorsky (1996), Zhu and Sarkis (2006), Rao (2007) and Lee (2008b).

5.4.1 Regulatory pressures

Since 90.1% (54 out of 60) of the mean values are higher than 3, we have verified that Chinese manufacturing SMEs are under regulatory pressures from the government in terms of GSCM to a certain degree, but that this pressure is not that strong as only 7.2% of the means are greater than 4. Compared with the means for all five regulatory pressures in terms of different sectors, it can be seen that SMEs from the food and beverage sector face the highest intensity in terms of stress from regulations or laws, while these are least felt by the paper making and printing sector, followed by the pharmaceutical and biological products sector. Possible reasons for these results may include the fact that both the paper making and printing sector and the pharmaceutical and biological products sector have traditionally been viewed as environmental villains. Although they have been restricted by environmental regulations and policies, they might have become accustomed and even numb to these regulatory restrictions, and some malicious manufacturers may find ways to circumvent them. Therefore, these SMEs could feel less pressure from regulatory powers. Moreover, supportive evidence in this study came from the case investigation for this research project. The case study enterprise has not received a great deal of regulatory pressure from the government, as it believed that no punishment will affect the enterprise's actions, even if it fails to manufacture in accordance with environmental regulations or laws. Conversely, the food and beverage sector has drawn increasing attention lately due to the escalation of food safety problems. Thus, the SMEs in this sector could face more pressures from the government to ensure cleaner production and less environmental destruction.

In addition, the significance of GSCM pressures among manufacturing SMEs from individual sectors can be identified by combining the means and the standard deviations. For instance, with a mean of 4.29 and a relatively low standard deviation of 0.756, it is shown that SMEs from the food and beverage sector have felt intense pressures from their import countries' environmental laws or regulations when considering GSCM, and there are all the respondent SMEs from the research within

this sector experience these pressures to a similar degree. This may indicate that no one SME could stay away with the strict requirements of green development from its overseas importers for reducing negative effects to environment. A further thought is that SMEs can also follow these requirements when manufacturing for the domestic market, as many environmental protection and resource conservation laws extend beyond borders.

5.4.2 Customer pressures

Customer pressures among Chinese manufacturing SMEs regarding GSCM are partly revealed by this study; that is, those SMEs from the 12 sectors in the Chinese manufacturing industry have been under pressures from their purchasers at home and abroad, as well as end-users in terms of GSCM. These pressures are, however, not as significant as they were for the enterprises investigated by Zhu and Sarkis (2006). This difference could be due to the different sizes and industrial characteristics of the two samples.

The means identified here could also indicate that SMEs from the food and beverage sector, furniture sector, and vehicle sector face more significant pressure from their customers to implement GSCM, with the relatively high means of 3.81, 3.92 and 3.82, respectively compared with data from other sectors, which showed similar findings to those identified by Walker et al. (2008). In addition, it is notable that Chinese SME manufacturers from the plastic and rubber sector feel clear pressures from their end-consumers in particular, with a mean of 4.07. This is reflected in the prevalence of the paid use of plastic shopping bags in Chinese supermarkets and shopping malls. Supermarkets were ordered to stop giving away free plastic bags to customers from 1 June, 2008, and there has been an increasing demand for greener plastic products among Chinese end-users since then (Watts, 2008).

It is still notable that the lowest means were related to the SMEs in the paper making and printing sector, that is 2.63, 2.75 and 2.75, respectively, which suggests that SME manufacturers from this sector are not subject to strong pressures from their

customers, either abroad or domestically, or from end-users. This might also be related to regulations: the paper making and printing sector is always deemed an offender with respect to environmental and forest resources, and consumers may be used to them failing to implement GSCM.

With regards to the standard deviations, the lowest was obtained from the chemistry and chemical sector, in relation to their overseas or joint venture purchasers, with 0.66. This could indicate that those SMEs have had similar experiences with GSCM when dealing with their non-domestic buyers. As one of the primary product manufacturers, SMEs from the chemistry and chemical sector are more likely to act as suppliers in the chain, especially to multinational enterprises, sole proprietorships or joint ventures, who usually have higher standards and requirements in relation to GSCM for their suppliers. The low standard deviations here show that all the chemistry and chemical SME suppliers are treated equally by their overseas and joint venture buyers.

5.4.3 Public pressures

The high degree of public pressures that the respondents indicated for GSCM in this study was unexpected. As seen from Table 4.2, the means for public pressures experienced by SME manufacturers are relatively high compared with either other pressures or other sectors, especially for those SMEs from the food and beverage and wood processing and furniture sectors, with means of 4.29 and 4.08, respectively. This may indicate that Chinese SME manufacturers from both sectors are currently experiencing heavy pressures as a result of the increasing public awareness of GSCM. It is also remarkable that the standard deviation is low for SMEs from the food and beverage sector as well, which could imply that food and beverage manufacturers are under heavy pubic pressures including pressures to build a green brand, pressures to establish a green corporate image and pressures from rapidly increasing environmental awareness. The rising concerns about food safety could also explain why SMEs from the food and beverage sector are facing severe regulatory pressures for GSCM. The strong pressures regarding GSCM from SMEs in the wood processing

and furniture sector, on the other hand, may be resulting from the mounting social worries and discontent over the greenhouse effect and global warming.

Environmental awareness is increasing rapidly within both purchasing and selling parties. On one hand, the concerns regarding environmental or green aspects from the public have drastically increased due to the deterioration of the environment and a shortage of resources. On the other hand, the increase in environmental concerns has lead to a preference among the public when making purchasing decisions for businesses with higher reputations in terms of being environmentally friendly or green (Drumwright, 1994).

However, this attention from the public with regards to environmentally friendly policies from enterprises might lead to undesirable responses in some circumstances. According to Greer and Bruno (1996), green or environmental strategies within an enterprise can easily be falsified with the aim of increasing publicity, and this is known as corporate "greenwashing". According to Kanthor (2009), in China the problem is even more severe. LEs or multinational enterprises that are labelled as advanced green firms may cooperate with suppliers who are easily found on the air pollution database with consecutive six years of records. Those enterprises mainly care about their public image apparently with little deep-going and solid work to green their supply chain.

5.4.4 Supplier pressures

The results from this study also suggest that there have been some collaborative effects of suppliers on their SME customers in terms of GSCM, with 91.7% of the means falling between 3 and 4. But it is clear that the pressures from suppliers on SME manufacturers are not particularly strong; as Carter and Dresner (2001) suggested, suppliers might not be seen as direct external forces for GSCM, but rather an important influencing factor in injecting their ideas and resources into the environmental management of downstream enterprises.

The highest mean of 4.14 is the only one that is greater than four among this group of statistics; this is distinctive, and indicates that Chinese manufacturing SMEs from the food and beverage sector are experiencing strong pressures from their suppliers with regards to cooperation with each other to provide products with greener packaging. With the increasing concerns about food safety and provision of cleaner and healthier food from consumers, it is a good strategy for food factories to shift their risks to their suppliers when it comes to providing greener and more environmentally friendly packaging. However, the p-value of 0.319 from Table 4.6 implied that this kind of pressures were not significantly different among different industrial sectors of the research sample.

The findings of this research regarding supplier pressures thus seem to complement those presented by Carter and Dresner (2001), which are also in contrast to the work carried out by Walker et al. (2008).

5.4.5 Internal drivers

It is relatively obvious from the results of the study that Chinese manufacturing SMEs are being encouraged by internal drivers in terms of GSCM, as shown by the fact that 92.4% of the means are higher than 3. For instance, SMEs from the food and beverage sector, the clothing, textile and tannery sector, and the plastic and rubber sector have been positively swayed by the top management support of their green strategy (means of 4.14, 4.07 and 4.07, respectively) as well as middle management support of GSCM (means of 3.57, 3.75, and 3.73, respectively). It is interesting and notable that the above three sectors can be viewed as those that are most closely related to people's daily lives among the 12 sectors investigated in this research. The personnel within these enterprises, including the top and middle management, are also themselves end-consumers of everyday items like food, drinks, clothes and plastic products, and this might also explain the high stimuli from leadership within those SMEs with respect to GSCM.

Moreover, the highest mean of 4.29 found within the food and beverage sector

suggests that these SMEs view corporate “green marks” as strong encouragement for GSCM implementation. Green marks are labels that indicate environmentally friendly products. They consist of graphics stuck or printed on the product or packaging to show that the production, use and recycling aspects of the product are all in accordance with environmental protection requirements, and cause no harm to human health and little or no waste, and are helpful for resource regeneration and recycling.

Green marks can be viewed as means of identification for green products, and should be issued by authorities. A group of countries and regions have proposed green mark certificate schemes or programmes since the 1970s, and to date there are approximately 30 different green label schemes worldwide (Green Council, n.d.), most of which are run on a voluntary basis. For instance, Germany's “Blue Angel” eco-label, the first national scheme in the world, was introduced in 1977.

A number of Asian countries and regions such as China, Hong Kong, Japan, India, and Singapore have also established their own green mark schemes. For example, a Green Mark Program was launched in 1992 by Taiwan Environmental Protection Administration as a voluntary and positive eco-labelling programme with the purpose of guiding consumers to buy, and encouraging manufacturers to design and produce, “green” products. The aim of the Green Mark is to “promote the concept of recycling, pollution reduction, and resource conservation” (Industrial Technology Research Institute, 1996). A similar green mark programme launched in Hong Kong is called the Hong Kong Green Label Scheme, and aims to help identify, control and monitor the environmental effects of the operations of an enterprise (Green Council, n.d.). It can help enterprises to leverage a green management system in order to keep an eye on the impacts of corporate activities on the environment, and to establish environmental performance benchmarks for further improvement.

With regards to the findings of this research project and green mark development in China, it is logical that SMEs from the food and beverage sector are pursuing a green food mark as it can contribute to their reputations. Green food mark is the quality

proof label that develops a centre to be versed in in the country management board of commercial firm politics is registered formally by Chinese green food (China Green Food Development Centre, n.d.). A green food mark logo stuck or printed on the packaging of a product indicates a higher level of food safety in the Chinese context.

It is also particularly worth mentioning that the findings of this study are consistent with the results found by Zhu et al. (2008). Commitment to GSCM initiatives from senior managers, support for GSCM from mid-level managers, and execution and cross-functional cooperation from employees within the organisation are all contributions to GSCM initiatives for enterprises. In addition, Zhu et al.'s (2008) study, which considered 314 participants, also suggested that enterprises are encouraged by the reserve costs for the disposal of hazardous materials and green product R&D, including green packaging; this is also verified in this research project.

So far, the answer to the second research question from the findings and discussions above is that Chinese manufacturing SMEs in the Chang Chiang River Delta are under the regulatory pressures, customer pressures, public pressures and supplier pressures and are motivated by internal drivers with respect to GSCM. It is also notable that several differences exist in terms of the extent to which these pressures and drivers are experienced among SMEs from different industrial sectors investigated in the project. These differences may be explained by their differing characteristics and emission amounts with respect to pollution, different needs to compete in a global context, different production processes leading to varying levels of cooperation with their suppliers, and different desires to establish a green corporate image.

5.5 Research question 3: What initiatives are SMEs in Chang Chiang Delta using to green their SCM for sustainability?

Similarly to the findings discussed in section 5.4, the means and standard deviations from Table 4.3 seem to suggest that several GSCM practices are being employed by manufacturing SMEs in the focal region of China. Each individual practice will be

discussed in the following sections.

5.5.1 Green purchasing

Data from Table 4.3 suggests that SME manufacturers in the fixed geographic base have already implemented green purchasing in their businesses, as all the means were greater than 3, and 21.88% of the values were over 4. SME manufacturers from the plastic and rubber sector seemed to be slightly more advanced in applying green purchasing practices, with 87.5% of the means larger than 4, as well as low values in standard deviations – especially for their practices of communicating with suppliers that have clear requirements for environmental protection outlined in their product design book (4.47), and active collaboration with suppliers for other environmentally friendly activities (4.40). SMEs from the food and beverage sector follow this, with 62.5% of the means higher than 4. However, these SMEs had different focuses on green purchasing and were active with respect to the demands of suppliers relating to green packaging (4.29), and reducing packaging materials (4.29). SMEs from the plastic and rubber sector were shown to be environmentally active, especially after the policy of paying for plastic bags in supermarkets and shopping malls was implemented. Thus, plastic manufacturers may shift their burden onto their suppliers through higher demands on green packaging, green logistics, and so on, in purchasing. It might be a similar case for SMEs from the food and beverage sector, who are becoming more and more concerned with the increasingly prominent issue of food safety, and aim to shift some of the related risks onto their suppliers.

From the perspective of individual practice, the most popular action was to create a design book with clear environmental protection requirements for suppliers, followed by demanding ISO 14001 certification and green packaging. Similar findings also emerged from the case study. The case study enterprise has clear statements regarding their requirements on environmental protection and resource saving in its product books, and their suppliers should definitely have ISO 14001 certification, as it is a direct symbol and guarantee of green production.

5.5.2 Eco-design

Contrary to expectations, SMEs have already implemented eco-design practices in their manufacturing at a high level. All the means were greater than 3, with up to 51.67% over 4. In addition, the relatively low standard deviations indicate that SMEs within one industrial sector have had the same or similar experience regarding individual practice. This might demonstrate that more enterprises, or at least SMEs, are paying increasing attention to technology improvement and innovation development for greening. This is most obvious within those from the food and beverage, wood processing and furniture, chemistry and chemical, plastic and rubber, metal, and machine and machinery sectors in this research. Unlike others, like the pharmaceutical and biological products, and electronic telecommunications facilities sectors, the above sectors are viewed as traditional manufacturing sectors; thus, they are more interested in and keen to adopt technological innovation.

With regards to individual practice, conservation of energy and resources, avoidance of using non-environmentally friendly materials, and avoidance or reduction of negative influence on the environment in designing products or production, are gaining popularity among SMEs.

5.5.3 Investment recovery

With only one mean below 3, and 27.27% of means over 4, it is accepted that manufacturing SMEs in Chang Chiang River Delta have adopted the GSCM practice of investment recovery, such as using disposal systems for waste water, emissions and rejectamenta. This may well reflect the impact of the energy conservation and emission reduction policies of the central and local governments in recent years.

It is also noteworthy that SMEs from the plastic and rubber sector are the most active adopters of investment recovery practices among the 12 groups, followed by those from the food and beverage sector. The reasons for this might be the same as those discussed as reasons for green purchasing previously. It also might result from different production processes or techniques for different sectors.

5.5.4 Cooperation with customers

It seemed that certain practices of cooperating with customers for greening are not as popular as others. In this research, cooperation with customers relates to areas including eco-design, clean production, green packaging, green logistics, reclaiming used products and reclaiming stocks. The results show that Chinese SMEs, especially those in the food and beverage sector (means for the above practices are 3.86, 4.00, 4.14, 4.29, 4.14, and 4.14, respectively) have employed practices to cooperate with their customers. The distinction within the food and beverage sector may be due to its increased closeness with end consumers, compared to that of other sectors.

5.5.5 Internal environmental management

The results of this study shown in Table 4.3 suggest that Chinese SMEs from the twelve sectors are making significant attempts in terms of internal environmental management, with 98.55% of all the means over 3 and 22.08% of them over 4. Among all 12 sectors investigated in this research, SMEs within the food and beverage sector pay the most attention to their practices of internal environmental management, which include updating and learning about the latest environmental protection policies, obtaining ISO 9000 certification and incorporating social responsibility costs into accounting (means for all three practices are 4.29). The second most active adopter of internal environmental management practices are SMEs from the plastic and rubber sector, and the most important practice for them is gaining ISO 9000 certification (mean = 4.47), followed by gaining ISO 14001 certification (mean = 4.33). The same reasons as those discussed in previous paragraphs of this section, such as the closeness with consumers and strict enforcement from environmental regulations, might explain why both of these sectors are the most active adopters of internal environmental management practices.

It is also interesting that receiving ISO 14001 and ISO 9000 certification seems to be highly valuable to SME manufacturers. This may be because certifications are direct and powerful proofs of green development for SMEs, and enable enterprises to improve their performance environmentally, economically and operationally.

Taken together, the findings from this research project provide solid evidences to answer the third research questions. SME manufacturers in Chang Chiang River Delta are implementing the GSCM initiatives of green purchasing, eco-design, investment recovery, cooperation with customers and internal environmental management. In addition, the results show that these SMEs have had different experiences in employing GSCM practices. There might be several reasons contributing to the results obtained in this study. First, the SMEs from different sectors have different requirements on green purchasing for their products. For example, an orange juice manufacturer may not pay attention to whether the oranges were grown in a green environment or not, and may also not need its suppliers to have ISO 14001 certification. On the other hand, clothing and textiles enterprises may have higher requirements for their suppliers to use safe dyeing techniques, and to adopt environmentally sound practices. Similarly, SMEs from different industrial sectors may have different considerations about their product design, as discussed by Zhu and Sarkis (2006) and Testa and Iraldo (2010).

5.6 Research question 4: How are the GSCM practices used by SMEs in Chang Chiang Delta related to GSCM performance?

To answer the fourth research question, data from the questionnaire survey was processed and analysed by factor analysis, correlation and regression, as introduced in Section 3.8.2.

The GSCM factors, both practices and performances, should be grouped prior to examining their relationships. In addition, before grouping the factors, it is important to examine the appropriateness of factor analysis; that is, whether the results of the factor analysis make sense. Both Bartlett's test of sphericity and the KMO test are useful here. Bartlett's test of sphericity was used to test the null hypothesis that the variables are uncorrelated in the population (Hinton et al., 2004). If this hypothesis cannot be rejected, then the appropriateness of factor analysis should be questioned. A *p* value of less than 0.05 indicates that it is meaningful to continue with the factor

analysis. The results from Table 4.4 show that the *p* value < 0.001, implying the Bartlett's test was significant and factor analysis is appropriate. Moreover, high values (between 0.5 and 1.0) from the KMO test indicate that factor analysis is appropriate (Hinton et al., 2004). For this research project, a high KMO value of 0.915 can be seen from Table 4.4, indicating that factor analysis is appropriate.

In Table 4.5, it is clear that the 20 items of GSCM performance have been grouped into four factors with a total variance of 72.27%, which implies that the four GSCM performance factors explain 72.27% of the inherent variation in the total 20 items. So far, it is acceptable that the four factors suggested could be retained for rotation. Table 4.6 shows the rotated components – that is, the factors – which were labelled environmental performance, operational performance, positive economic performance and negative economic performance. To make this simpler and clearer, the positive economic performance factor and the negative economic performance factor were merged into one, and labelled economic performance for this research.

The relationships between GSCM practices and performances were then regressed. The Pearson correlation matrix shown in Table 4.7 indicates the significances of the correlations between the independent variables and the dependent variable. The results imply that as all the GSCM practices are strengthened, environmental performance, economic performance, and operational performance also improve, and they all are correlated. But it is still unclear whether the correlations are positive or negative, and the most significant influence on GSCM practice for different GSCM performance can be found in Table 4.8 to Table 4.16.

The results show that some relationships between GSCM practices and environmental, economic and operational performance expectations are significant; especially for the internal environmental management implementations adopted for Chinese manufacturing SMEs which is verified to lead to positive organizational performances for those SMEs. Thus the "win-win" relationship potentially exists for Chinese manufacturing SMEs to seek opportunities to implement GSCM practices which will be helpful for them to expect positive environmental, economic and

operational performances. Although the relationships between some of the GSCM initiatives adapted by those Chinese SME manufacturers and the corresponding environmental and economic outcomes are not as significant, the internal environmental management implementations do result in good GSCM performances in terms of positive environmental, economic and operational outcomes to those SMEs. It should be noted that the improved operational performances have been led with the practices of green purchasing, investment recovery and internal environmental management. Furthermore, the specificity and particularity of individual SME should also be considered.

The economic performances should be further studied as this study only looks at the relationships between the GSCM practices and economic performance, rather than investigate the actual financial results of SMEs. The respondents of this study may have used and compared the financial numbers to provide information when filling the questionnaires, but they have not been used directly in this study to test whether the economic outcomes are positive or negative. Therefore, the expectations can be held by Chinese manufacturing SMEs that with more GSCM practices adopted within their organizations and with more participants involved in the industrial chain, the win-win relationship will become increasingly significant. Actually, the early GSCM adopters of this study have provided some positive improvements in all the environmental, economic and operational performances for the potential participants. For example, according to Zhu and Sarkis (2004), more and more enterprises have began to pick the “low hanging fruit” and “ten dollar bills on the floor” as a result of GSCM practices.

The internal environmental management practices have led to positive environmental, economic and operational performances, which has been verified with the findings of this study. These findings are consistent with the research results from Zsidisin and Siferd (2001) and Rice (2003). There are some possible reasons for this. Firstly, those practices are directly related to environmental issues and

significantly helpful for the improvement of the environment through pollution control and resource conservation. Secondly, top management commitments, which have been considered as one aspect of internal environmental management, directly impact the financial outcomes, as argued similarly by Bowen et al. (2001).

GSCM practices which are closely developed and applied with suppliers and customers are not verified to significantly improve any of environmental, economic and/or operational performances. Green purchasing has not positively led to the environmental and economic performances of Chinese manufacturing SMEs as shown by this study, which is not consistent with the argument from Leire (2006). However, the operational performances have improved with green procurement. The situation of collaborations with customers is even weaker; the initiatives have not shown any positive relationships with the performances in the three perspectives investigated in the study. This may be the consequences as a result from the lack of resources, time, money, capabilities, skills and knowledge, flexibility and so on in terms of the size of the enterprises (Hilton, 2000). The problems can gradually be resolved with the development of globalization and better developed GSCM practices; thus improved GSCM practices can be expected. Globalization development will bring in more investment from multinational enterprises (MNEs) in China where their subsidiaries will initiate self-regulations to improve their environmental, economic and operational performances more than domestic enterprises. Therefore, domestic enterprises can learn from the experiences and lessons of foreign enterprises for positive GSCM performances. Moreover, it is also important to be aware that more Chinese SME manufacturers are now involved with the global supply chain as the suppliers for MNEs or FDI subsidiaries. Thus, these LEs may use GSCM as a supplier-selection criterion to identify their suppliers or even the second-tier suppliers (Huang et al., 2012).

Though Lewis et al. (2001) argued that most of the product impact is determined at the design stage of the product life cycle, when the materials are selected and product performance is largely determined; this study did not provide enough

evidences to demonstrate that eco-design practices do have positive effects on environmental, economic and operational performance. The reason for the failure of the eco-design initiatives might be caused by the immature internal cross-functional cooperation within the enterprise and the external cooperation with other parties throughout the supply chain. Thus the improved GSCM performances can be expected with more practices implementation and these SME manufacturers in China will become more skillful and professional in GSCM.

As claimed by Zsidisin and Hendrick (1998), investment recovery is highly emphasized as one of the GSCM practices for enterprises in the developed countries like the USA and Germany. However, it is argued that investment recovery practices have not received as much attention in China as in developed countries (Zhu and Sarkis, 2004). This study agrees with Zhu and Sarkis (2004) with the findings of investment recovery initiatives among SME manufacturers in China not positively related to their environmental and economic performance. The possible reason may be the lack of recycling systems and advanced technologies, as well as the lack of comprehensiveness of the waste management policy system leading to difficulties in the recycling and recovery for Chinese SMEs. However, the findings identified the positive relationship between investment recovery initiatives and operational performances among Chinese manufacturing SMEs.

To sum up, it is notable that internal environmental management initiatives have had impacts on the environmental, economic and operational performance among Chinese SME manufacturers. Yet, the results of this study show that the practices of eco-design and collaboration with customers have not been positively related with GSCM performances. There are, however, some evidences that the investment recovery and green purchasing practices have positive relationship with operational performance for the SMEs. Thus, more improvement in terms of better GSCM performances are expected in China.

Also noted above, in light of the inadequate literature on individual GSCM practices

(Menguc and Ozanne, 2005), this study contributes to the research framework by examining the relationships between each of the GSCM practices including GP, ECO, IR, CC and IEM, and environmental, economic and operational performance. The identification of GSCM practices and performances are similar to those used by Green et al. (2012), though the findings are not consistent with theirs.

Analysing data through factor analysis, correlation and regression analysis helped to answer the fourth question of this research project. GP is positively related to environmental, economic and operational performance, but it is not a significantly influential practice; the same goes for IR and IEM, but IEM has significant effects on GSCM performance. ECO are positively related to environmental improvement, but negatively related to economic growth and operational efficiency, while CC is positively related to environmental and economic improvements for SMEs, but negatively related to operational performance.

5.7 The case study – experiences, barriers and possible solutions

5.7.1 Experiences gained from unclearly promoted GSCM initiatives

Although the case study enterprise does not have clearly define or publish GSCM policies, it does employ some initiatives with the aim of gaining both economic and environmental benefits. For example, one of the top managers explained during an interview that residues and co-products are used in other areas of production within the chain. The first motivation for the usage of residues and co-products is cost saving, but there are also beneficial effects relating to environmental performance. Moreover, the positive effects arising from technological developments and advancements have also stimulated the firm to implement GSCM initiatives to some extent.

Although there seems to be ambiguity in terms of GSCM initiatives, SMEs such as the case study enterprise, do benefit from GSCM adoptions operationally, economically and environmentally. As discussed in section 5.3.2 and 5.3.3, the enterprise has seen a 4% efficiency increase, a 20% residue decrease and a 30% extraction increase.

However, more investigation is needed in order to accurately calculate the economic and environmental earnings from these, such as how much can be saved from one production line or for one unit of product if residues are used.

The investigation into the pharmaceutical SME also showed that GSCM has not received popular support throughout the enterprise, and the difficulties in adopting GSCM might explain this unpopularity. This will be discussed in the following section.

5.7.2 Potential barriers for overall GSCM

Whenever the limitations of SMEs are discussed in relation to their development, financial insufficiencies will always bear the brunt. The case study enterprise is no exception. Although it may be very interested in GSCM, the lack of money is a real problem for the firm. Moreover, achievements from GSCM implementation may not emerge immediately, and are probably only visible in the long run; this means that investment may be required over a long period of time. It is obvious that most SMEs in China do not have such strong economic power. Consequently, the lack of capital can be regarded as a central problem for SMEs like the case study enterprise in relation to GSCM implementation within their businesses.

As discussed in Chapter 4, the case study enterprise already sees the need of technology innovation for further development. However, they still face problems in relation to R&D, and the shortages they are experiencing in terms of advanced technology are probably caused by insufficient human resources. This also brings about difficulties relating to advancements in GSCM or sustainable development for the enterprise. Therefore, the lack of human resources for GSCM represents another obstacle to SMEs like the case.

Besides the lack of money and human resources, environmental protection regulations also have negative effects on GSCM development for the case study enterprise. The government does not currently have an effective framework in place to monitor and penalise enterprises that use environmentally damaging activities.

Additionally, enterprises only face light punishment for pollution under the existing environmental regulations in China. For example, the national pollutant discharge standards are far lower than the costs of comprehensive treatment for pollution. Therefore, enterprises prefer to pay the pollutant discharge fee rather than commit to reducing pollution; this relates to the fact that profit maximum is the ultimate goal of every enterprise, and this conflicts with the entire target of GSCM and sustainable development. Thus, the incompleteness of environmental protection regulations/systems represents the third obstacle for GSCM development.

Furthermore, the traditional supply chain model which is still dominant for the majority of enterprises, such as the case of the pharmaceutical SME, may also represent barriers to GSCM development. For example, the traditional supply chain can only facilitate the flow of goods, information and capital from the original supplier to the end user, and this is a one-way movement. However, the GSCM model asks for the integration of green purchasing, eco-design, green production, green packaging, green marketing, and so on, which emphasises the prevention of environment problems and stresses the bidirectional movements of goods flow, information flow and capital flow. Thus, breaking down old perceptions of SCM and making GSCM grow in popularity involves difficulties that SMEs must overcome.

5.7.3 Possible solutions to overcome barriers

The case study enterprise, as an SME, also faces obstacles for GSCM development, and must actively work to overcome the barriers.

Firstly, it should forge ahead and break the old unidirectional perceptions on SCM, and it is desirable for the enterprise to make GSCM a long-term goal that it can work towards. Thus, support with respect to implementing GSCM from both top and middle management are key factors for the enterprise, and it is also important for its employees to follow the GSCM policies formulated by the enterprise. In order to ensure the successful implementation of GSCM practices, the case study enterprise can run training sessions to help its front-line managers and employees to

understand and accept the idea of GSCM. In addition, an attractive human resource policy would help to facilitate GSCM development and progress for the enterprise.

Secondly, the enterprise can strengthen its cooperation with its suppliers and customers in order to green the whole chain. Cooperation with suppliers involves encouraging chemical factories to provide finer products to the enterprise, while cooperating with customers involves working with buyers to implement green packaging, green logistics, and so on, at this stage.

Thirdly, seeking help from local government might be another effective way to improve GSCM implementation for the enterprise. For example, in order to overcome the financial problems faced by the enterprise, the government may encourage local banks to provide interest-free or low-interest loans to SMEs like the case to aid with their GSCM development so that the SMEs can set up a special fund for their GSCM initiatives and implementation. Additionally, the local government could raise pollutant discharge standards, while giving encouragement to the GSCM adopters in the form of finances or awards, which will also inspire others to work towards GSCM.

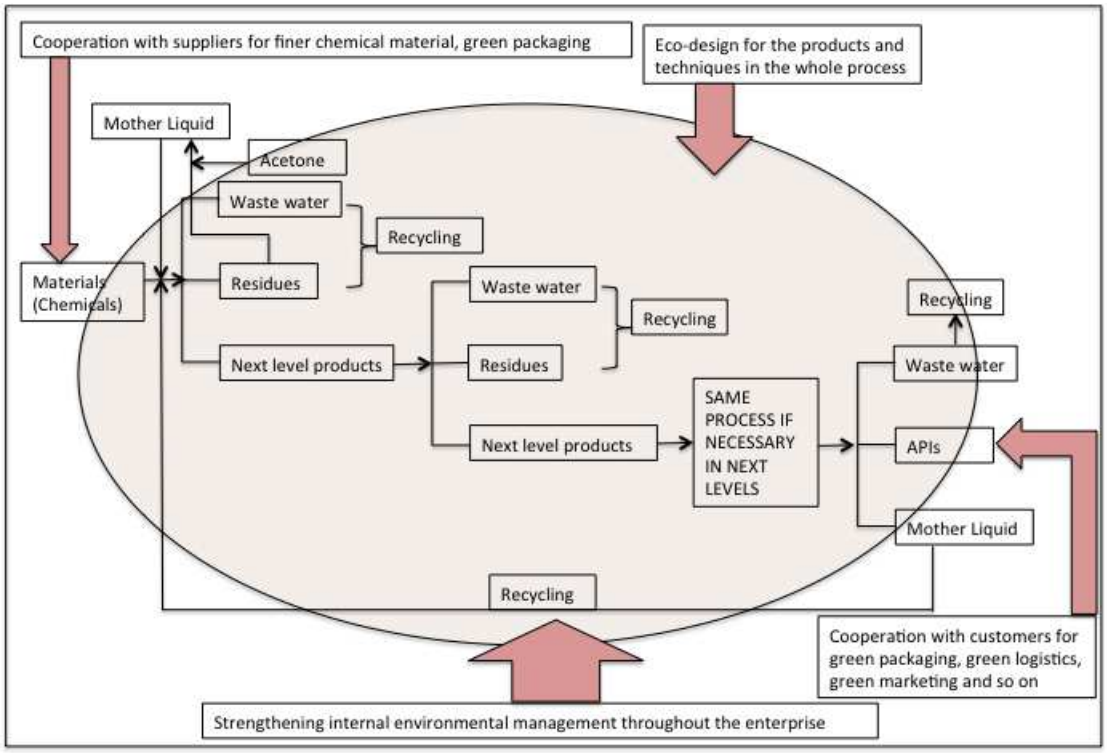
A final note about these solutions is that are of great importance to other SMEs as well because of their generalisability. The solutions are not specific to the green activities of the case study enterprise alone, but are suggestions in general for similar SMEs. Thus, other SMEs, especially pharmaceutical manufacturers, could compare their development, problems and concerns about GSCM with the findings of this study, and take the suggestions and solutions into consideration for future reference.

5.7.4 An improved model for the case study enterprise based on the findings from both the survey and the case study

Based on the investigation of and the discussion above, an improved model of GSCM can be suggested for the pharmaceutical enterprise to improve its GSCM development. The current GSCM model was discussed in section 4.3.3, and the

improved one is shown in Figure 5.3.

Figure 5.3 An improved model of GSCM for the case study enterprise



From the questionnaire survey, the identified five GSCM practices, including green purchasing, eco-design, investment recovery, cooperation with customers and internal environmental management, were examined and the findings showed that Chinese manufacturing SMEs in Chang Chiang River Delta have initiated these GSCM practices for improved corporate performances. Thus, the green practices which were still weak within the case study enterprise were emphasized for further development in GSCM for the pharmaceutical SME and the emphasized points were labelled with red arrows towards the supply chain in the improved model of Figure 5.3. Besides, these emphasized practices were also mentioned and discussed from the interviewees in Section 4.4.3. For example, a clear and quantizable corporate handbook or organizational policy for GSCM was extremely desired as a strengthened method of internal environmental management. In addition, further cooperation with suppliers on green packaging of the raw materials was stressed by the sales department manager from the narrative data from the interview. And more

systematic training on updated environmental regulations and laws was needed as insisted by Interviewee B (employee from the quality department). Combining the data from both quantitative survey and the case study, the improved model for further GSCM development was suggested to the case study enterprise.

Using this improved model, GSCM will run through the whole chain of the case study enterprise. Compared with the current model used by the enterprise, in which only production is considered, all the links of the chain, including purchasing, design, production, packaging, transportation, operation, marketing and so on now take GSCM into consideration.

5.8 Chapter summary

Firstly, because all of the Cronbach's alpha values for the GSCM factors are significantly higher than 0.7, under each different GSCM factor, all questions asked within the research were highly interrelated with the corresponding GSCM factors. This indicates the high degree of reliability and relevance of the questionnaire survey for the research project.

This section answered the research questions asked within this project were answered in this section. A conceptual framework was proposed by linking sustainability with SCM from a CSR perspective in order to involve theories of stakeholder theory, IE, DfE and LCA, together with the empirical evidences that emerged from this research, so as to answer the first research question. The rest of the questions were mainly answered using the findings from the survey, with complementary information obtained from the case study.

Using descriptive statistics, the research supported the hypotheses from H1a to H1e, which address the question of what the current GSCM pressures for SMEs in the fixed geographical base are. The results show that Chinese manufacturing SMEs in Chang Chiang River Delta are under regulatory pressures, customer pressures, public pressures and supplier pressures, and are motivated by internal drivers of GSCM. The

ANOVA demonstrated that some differences exist in the extent to which these pressures are experienced among SMEs from the different industrial sectors investigated in this research project.

Similarly, hypotheses H2a to H2e were supported, and these answer the third research question, which addressed the GSCM initiatives used by SMEs in this area. SME manufacturers have implemented the GSCM initiatives GP, ECO, IR, CC and IEM. In addition, the discussion on the results explained that SMEs have had different experiences in employing these GSCM practices.

Hypotheses H3a to H3o were relatively more complex, and were tested by employing factor analysis, correlation and regression, in order to answer the fourth research question. GP, IR and IEM are positively related to environmental, economic and operational performance. CC is positively related to environmental and economic improvements for SMEs, but negatively related to their operational performances, while ECO practices are only positively related to environmental improvement, and negatively related to economic growth and operational efficiency increase.

The remainder of the chapter discussed the case of a medium-sized pharmaceutical enterprise, about its GSCM experiences, difficulties and possible solutions, and this served to complement the findings from the survey and thus increase the generalisability of the study. The discussion on the case study concluded by presenting an optimised model proposed by suggesting GSCM practices that can be embedded into the weak links in the current model used by the case study enterprise.

The next chapter will conclude the research by summarising the key discussions carried out in the thesis. Both theoretical and practical contributions will be included, as well as the limitations of the research project and suggestions for future work.

6. Conclusion

6.1 Introduction

Chapter 4 presented the key findings from this study, while explanations and discussions about these were provided in Chapter 5. This chapter will conclude the thesis with summaries of the research project and discussions on the key contributions, theoretically and practically, that this research has made. This chapter will also discuss the limitations of the research, and suggest areas for future research.

6.2 Summary of the research

This study investigated the pressures for SMEs to implement GSCM practice, and examined the relationship between these practices and corresponding performance at a regional level within the Chang Chiang Delta area of China. The overarching research questions were:

1. How does “green” relate to SCM for SMEs?
2. What are the current pressures of GSCM on SMEs in Chang Chiang Delta?
3. What initiatives are SMEs in Chang Chiang Delta using to green their SCM for sustainability?
4. How are the GSCM practices used by SMEs in Chang Chiang Delta related to GSCM performance?

Therefore, this study aimed to identify the GSCM pressures, practices and performances among SMEs in the Chang Chiang Delta region, which has seen prosperous development of SMEs. It also tried to provide solutions to help SMEs overcome barriers to their implementation of GSCM based on the current findings of the study.

In order to identify the answers to the research questions, this study employed triangulation by using both questionnaire research and case study, underpinned by

the philosophy of epistemology. The investigation focused on the pressures, practices and performances for SMEs with respect to implementing GSCM. GSCM is an innovative management technique which integrates environmental concerns into the operations of the supply chain within an enterprise, with the aim of obtaining economic, environmental and social achievements, because the three dimensions interact with one another in terms of SCM. As discussed in section 2.2.3, GSCM is believed to have been officially introduced upon publication of the book *Silent Spring* by Rachel Carson in 1962. Since this time, investigation of the relations between industries and the environment has become increasingly popular. Competition between enterprises has come to be focused on SCM, and this, along with the upsurge of environmental consciousness from the public, has lead to a great deal of debate on how to integrate the ideas like environmental protection and resource conservation into SCM to gain and improve competitiveness in an increasingly fierce business world.

This study used mixed methods for data collection. Quantitative methods were used via a questionnaire survey consisting of two rounds, a pilot test and a main study. Qualitative methods were used via a case study. The quantitative data collected from the pilot test and the online questionnaire survey were analysed using the statistical package SPSS, and hypotheses were also proposed. The qualitative data was collected from the investigation into a pharmaceutical SME from the focal area.

The findings that emerged from the quantitative data analysis using descriptives, factor analysis, correlations and regression analysis, provided base-line data, tested the hypotheses and provided a general understanding of the pressures, practices and performances of GSCM among Chinese SMEs in Chang Chiang Delta. The findings of the qualitative data analysis provided greater insights into GSCM implementation, and the pressures and difficulties faced by the enterprise, its current GSCM model and the corresponding performance. The results of both the quantitative and qualitative data provided strong evidence to verify that Chinese manufacturing SMEs are under regulatory pressures, customer pressures, supplier pressures, public pressures and internal drivers from different stakeholder parties in terms of GSCM to

varying degrees. In light of these pressures, SMEs have implemented a number of GSCM practices, including green purchasing, eco-design, investment recovery, cooperation with customers and internal environmental management, and these practices differ in terms of different industrial sectors in this study. However, these practices do contribute to improving the SMEs' performance economically, environmentally and operationally. This is demonstrated in the example of the case study enterprise. The findings of this study lead to the conclusion that Chinese SMEs are under pressures to take GSCM into consideration, and their GSCM initiatives have lead to improvements in their economic, environmental and operational performances. However, these SMEs are still facing barriers, such as insufficient funds, lack of technical talents, negative impacts from traditional SCM, and environmental protection regulations, which are affecting their further GSCM implementation. Therefore, enhancing cooperation with customers, suppliers and local government are all good ways in which to overcome the difficulties in implementing GSCM.

It is also important to point out that the findings of this study which focused on SMEs were generally consistent with results among LEs from Green et al. (1996), Walton et al. (1998), Beamon (1999), Hall (2001), Min and Galle (2001), Zhu et al. (2005), Walker et al. (2008), Zhu et al. (2008) and Diabat and Govindan (2011) in terms of GSCM pressures undertaken and GSCM practices adopted. However, the findings of the relationships between GSCM practices and performances were unique in this study in comparison with studies conducted in LEs as discussed in Section 5.3.

6.3 Contribution to theory

This research contributes towards the body of existing literature in GSCM, and SME sustainable development. With the dominant research footholds relating to the exploration of GSCM pressures, GSCM practices and GSCM performances, this research project attempts to provide a broad picture of how green development relates to SCM. As emphasised by Ageron et al. (2011) and Groznik and Eriavec (2012), and discussed in Section 2.2.3, sustainability is expected to be the ultimate

goal of GSCM. However, it might not be the initial purpose when an enterprise considers or implements GSCM. Rather, the first attempts may arise from the demands of a variety of parties, as outlined by stakeholder theory (see section 2.4), with the discussions on actual bearings (see section 2.5), or from the introspective and voluntary motives suggested by the theory of IE (see section 2.6); both of which can be traced to CSR (see section 2.3). All discussions on theories in the literature review chapter try to identify why green strategy is needed for enterprises. Furthermore, the discussions show that enterprises will benefit from the greening process.

As product makers, supply chains can be seen as lifelines for manufacturers who are in charge of all the functions enabling the production, delivery, and recycling of materials, components, end-products and services across the "chain". For manufacturers, greening the supply chains means increasing management efficiency within every single link throughout the chain. Thus, what should be done and what the magnitude of improvements to efficiency within their SCM should be might form the next questions they should ask. DfE and LCA are very helpful to provide broad answers to these questions, as discussed in section 2.6.6, in light of the existing footholds of GSCM practices and performances (section 2.7 and 2.8).

Previous studies examined the improvements CSR can make to an enterprise's sustainability. This study contributes to the sustainability literature by providing a tangible approach to how GSCM can be used to effect sustainability within SMEs. How adopters understand CSR strategy and transfer these concerns into their SCM will be key to implementing GSCM, and further to reaching sustainability.

A main contribution of this research to the knowledge base is the incorporation of stakeholder theory into a conceptualised framework to identify the GSCM pressures faced by enterprises. Stakeholder theory is a useful approach by which to identify the groups that can affect or can be affected by the achievement of an enterprise's goals. When stakeholder theory is used to analyse the GSCM achievements of SMEs, the stakeholder parties throughout the supply chain should be taken into account with

respect to their pressures and practices relating to GSCM.

In addition, the study contributes to the GSCM literature by incorporating the theory of industrial ecology into the conceptualised framework in order to achieve GSCM performance and sustainability. The primary goal of IE is to achieve sustainable development via the sustainable use of resources, ecological and human health, and environmental equity. Though IE sets general goals for sustainability, this study provides one feasible way to do this by implementing GSCM practices and evaluating GSCM performances for SMEs to make the theoretical framework quantifyable and operable.

In addition, this study contributes to the research framework by empirically examining the relationships between each of the GSCM practices, including GP, ECO, IR, CC and IEM, and environmental, economic and operational performance. This area has received little attention in literature to date.

6.4 Practical implications and recommendations

This study has several practical implications and the key implications are discussed below.

Firstly, as an effective stakeholder, governments have been playing a critical role in encouraging and stimulating SMEs to consider and implement GSCM. Thus, regulatory stakeholders should note the importance of SMEs in terms of both their economic and environmental contribution to society, and try to transform regulatory pressures into proactive encouragements or effective assistance to SMEs in order to maintain their motivation towards GSCM, and increase the benefits they obtain from their GSCM initiatives.

Secondly, public stakeholders are also important in exerting GSCM pressures on Chinese manufacturing SMEs. In order to promote GSCM to Chinese SMEs as far as possible, public stakeholders could continuously pay attention to the environmental

improvement of SMEs; for example, they can be safeguarded from a perspective of the whole society's benefits through media.

Thirdly, the research identifies clear pressures throughout the supply chain, including pressures to collaborate with suppliers, and pressures to meet requirements from both large customers and individual end-consumers. Actually, both supplier stakeholders and customer stakeholders in the supply chain can regulate the environmental behaviours and activities of SMEs. Customers in particular can be regarded as the ultimate stakeholders in terms of determining the revenues of Chinese manufacturing SMEs. As a result, effective collaboration with the upstream and downstream stakeholders will definitely be helpful in alleviating the GSCM pressures on SMEs, and further to provide a strategic way by which to implement GSCM initiatives.

Fourthly, the study found that SMEs are more likely to be encouraged in terms of GSCM with support from management, cooperation among employees, appropriate budgets for GSCM practices, and even the ownership of corporate green marks or trademarks, which can inspire confidence within the enterprises to improve their environmental performance. Therefore, clear and effective communications and well-managed cooperation throughout the organisations make significant contributions towards helping organisations to achieve their objectives with respect to GSCM. Increasing environmental awareness via training and education of both management and employees, investing more into pollution preventive solutions, and integrating environmental strategies into the whole production process are all recommended as effective tactics by which SMEs can improve their environmental performance.

Fifthly, based on the case study, a model can be suggested by which the company can improve its GSCM. The model tries to make the GSCM idea run through the whole supply chain of the enterprise. Compared with the current model used by the case study enterprise, all the links of the supply chain, including purchasing, design, production, packaging, transportation, operation, marketing and so on now take

GSCM into consideration. Thus, the GSCM performance is expected to improve. Although the model has limited universality as it was proposed for a particular SME, it still can be serve as a reference for others, especially pharmaceutical SMEs. These SMEs can develop models which are more appropriate for their GSCM development on the basis of this optimised one, combined with their own production characteristics.

Finally, it is quite necessary to talk about the big issue of severe smog caused by pollution in China. Many cities in Eastern and Northern China have witnessed a heavy smoggy weather recently, which pushed the PM (particulate matter) 2.5 index to a record high. The situation was even worse in Beijing and residents were urged to stay indoors for the sake of their health (CCTV, 2013). It is also pointed out that air pollution from coal-powered industries and exhaust gas emission from vehicles are the main source for the hostile environment. Though China has experienced prominent economic growth through accelerated production in the past decade, it is believed that the resulting pollution takes toll on people's health (BBC News, 2012). This emergent event justified the necessity of this research in that it be increasingly important and urgent for enterprises to green their supply chains for environmental protection and further for sustainability in the Chinese context.

Authorities took some short-term measures to fight against the crisis, halting work for several construction sites, shutting down some factories and limiting government auto usage; however, long-term solutions are still unreachable – there has been no long-term policy or project proposed by authorities to the pollution haze (Branigan, 2013). Therefore, combining with the findings from this study, it is recommended that government should release stricter regulations on environment protection and issue more inviting green policies for industries to promote the development of GSCM. Besides, consumers are encouraged to be more environmentally concerned for greener products which also can be provided with GSCM.

6.5 Limitations of the research

Even though this study provides strong evidence to identify the current GSCM pressures, practices and performances among Chinese SMEs in Chang Chiang Delta, and outlines an optimised GSCM model, it still suffers from some imitations.

Firstly, the sample size is limited in relation to the huge number of SMEs in China. Due to the challenges relating to data collection in the Chinese context, only 202 valid responses were obtained for this study. Given the extremely large number of Chinese SMEs, the issue of universality may arise. However, as an initiative to investigate GSCM practices and performances among Chinese manufacturing SMEs, this study can be treated as an exploratory attempt to fill in the research gap discussed in earlier sections.

Secondly, the questions listed in the questionnaire used in this research were closed-ended; thus, other practices and performances experienced by SMEs may have been overlooked. Further refined studies should take this limitation into consideration, and open-ended questions may be asked for further identification of GSCM practices and performances.

Thirdly, the improved model suggested for the case study enterprise was not examined and tested for effectiveness in real production due to the time limits of this study. If time allows, the optimised model could be applied to production and the corresponding GSCM performances assessed, evaluated and compared with previous results from the old model in order to examine how the new model effectively works.

6.6 Recommendations for future research

This study also provides new research opportunities for future studies.

Firstly, future research may include more participants within the Chang Chiang Delta or across the geographical boundary. Given the difficulties related to collecting data from SMEs in the Chinese context, a larger sample would make for a more convincing

study, as long as more time can be allocated for data collection. Studies may expand the geographical boundary to Pearl River Delta, where SMEs are also prevalent. A comparative analysis of the data among those countries may also yield interesting results.

Secondly, this is the first time that many theoretical models have been taken into consideration with respect to GSCM, including CSR, stakeholder theory, IE, DfE, and LCA. Thus, new studies may use additional theories which could be employed for GSCM development.

Thirdly, it is possible to expand the research to other stakeholders in the supply chain. This study only assessed the general stakeholder groups, and other stakeholders may have an effect on different industries that have been not examined in this study; thus, future research should explore this perspective.

Fourthly, by expanding the research in the area of GSCM initiatives like GP, ECO, IR, CC and IEM to other core activities in the supply chain, such as logistics or marketing, the literature can be effective developed. For example, logistical functions can be investigated to assess their effects on the environment, and how to achieve green logistics for SMEs. The results of such studies may aid sustainable theory development concerning the role of SCM.

Fifthly, it would be interesting to compare the differences between GSCM development of Chinese SMEs, and SMEs from other geographic areas, or Chinese LEs. As discussed above, previous studies that have investigated LEs in China have provided different findings to those of the present study (Zhu, et al., 2006). Therefore, systematically identifying the differences between SMEs and LEs in terms of GSCM development would be an interesting avenue for research. Besides this, interesting findings may be obtained by drawing comparisons between Chinese SMEs and SMEs in other countries in terms of GSCM.

Sixthly, development of GSCM from different industrial sectors also remains an

interesting topic to future researchers. More and deeper investigations are required to examine whether enterprises from different sectors have different GSCM, like Zhu and Sarkis (2006) and Huang et al. (2012a).

Finally, the case study method was found to be useful for obtaining more detailed information in this research. Thus, in order to learn more about GSCM development for SMEs in China, researchers could investigate other enterprises and suggest appropriate GSCM models to those enterprises on a case-by-case basis.

6.7 Chapter summary

This chapter concludes the thesis with a summary and discussions of the key findings of the research project. Both theoretical and practical contributions of the research were discussed with respect to CSR, stakeholder theory, IE, DfE and LCA, and the Chinese context. The limitations of the study were also discussed; these include the relatively small sample and the risk of missing information due to the use of closed-ended questions within the questionnaire survey. Finally, directions for future research as a result of the findings from this research project were proposed, and it was suggested that different research methods, different theoretical perspectives and different samples can be taken into consideration for further studies.

References

Ackerman, R.W. (1975), *The Social Challenge to Business.* Cambridge, MA: Harvard University Press.

Adams, W.M. (2006), "The future of sustainability: re-thinking environment and development in the twenty-first century", *Report of the IUCN Renowned Thinkers Meeting*, 29–31 January 2006. Zurich.

Agan, Y., Acar, M.F. and Borodin, A. (2013), "Drivers of environmental processes and their impact on performance: a study of Turkish SMEs", *Journal of Cleaner Production*, Vol. 51, pp. 22-33.

Ageron, B., Gunasekaran, A. and Spalanzani, A. (2012), "Sustainable supply management: An empirical study", *International Journal of Production Economics*, Vol. 140 No. 1, pp. 168-182.

Allenby, B.R. (1991), "Design for environment: A tool whose time has come", *Semiconductor Safety Association Journal,* September, pp. 5-9.

Allenby, B.R. (1999), *Industrial Ecology: Policy Framework and Implementations.* Englewood Cliffs, NJ: Prentice-Hall: Englewood Cliffs.

AmChamChina (n.d.), "Environmentally Friendly Manufacturing", [online] Available at: http://www.amcham-china.org.cn/amcham/show/pdfs/Environment/csr_Nike.pdf.

Amelia, L., Wahab, D.A., Che Haron,C.H. Muhamad, N. and Azhari, C.H. (2009), "Initiating automotive component reuse in Malaysia", *Journal of Cleaner Production*, Vol.17 No.17, pp. 1572-1579.

Annan, K. (2001), *Remarks to the United States Chamber of Commerce*, Washington, D.C., 1 June 2001. [online] Available at: http://www.un.org/ga/aids/uscc.htm.

Associated Press (2008), "China auto production sales climb 20 percent", January, 13, 2008. [online] Available at: www.msnbc.com/id/22637142.

Ayres, R.U. (1978), *Resources, Environment, and Economics: Applications of the Materials/Energy Balance Principle*, New York: Wiley Interscience.

Ayres, R.U. and Kneese, A.V. (1969), “Production, consumption and externalities”, *The American Economic Review*, Vol. 59 (June), pp. 282-297.

Ayyagari, M., Beck, T. and Demirguc-Kunt, A. (2007), “Small and Medium Enterprises Across the Globe”, *Small Business Economics*, Vol. 29, pp.415–434.

Azevedo, S. G., Carvalho, H. and Machado, V. C. (2011), “The influence of green practices on supply chain performance: A case study approach”, *Transportation Research Part E,* Vol. 47, pp. 850-871.

Backer, L. (2007), “Engaging stakeholders in corporate environmental governance”, *Business and Society Review*, Vol. 112 No. 1, pp. 29-54.

Bagheri, A. and Hjorth, P. (2007), “Planning for sustainable development: a paradigm shift towards a process-based approach”, *Sustainable Development*, Vol. 5 No. 2, pp. 83-96.

Bahuet, C. (2012), “Energy Efficiency in China’s Air Conditioning Industry”, *Speech at Launch Ceremony of Green Pioneer of Room Air Conditioner*, 14 June, 2012, United Nations Development Programme. [Online] Available at: http://www.undp.org.cn/modules.php?op=modload&name=News&file=article&catid=25&topic=21&sid=44834&mode=thread&order=0&thold=0

Bannock, G. (1981), *The Economics of Small Firms: Return from the Wilderness.* Oxford, UK: Basil Blackwell.

Barnes, J.H. (1982), "Recycling: a problem in reverse logistics", *Journal of Macro-marketing*, Vol. 2 No. 2, pp. 31-37.

Barry, H. and Milner, B. (2002), "SMEs and electronic commerce: a departure from the traditional prioritization of training?", *Journal of European Industrial Training*, Vol. 26 No. 7, pp. 316-326.

Batterman, S. and Amann, M. (1991), "Targeted acid rain strategies including uncertainty," *Journal of Environmental Management*, Vol. 32, pp. 57-72.

Baumann, H. and Tillman, A. (2004), *The Hitch Hiker’s Guide to LCA*, Sweden: Studentlitteratur AB.

BBC News (2012), *Pollution from China's growth 'takes toll on health'*, 18 October, 2012. [Online] Available at: http://www.bbc.co.uk/news/world-asia-19995748

Beamon, B.M. (1999), "Designing the green supply chain", *Logistics Information Management*, Vol. 12 No. 4, pp. 332-342.

Benn, S., Dunphy, D. and Martin, A. (2009), "Governance of environmental risk: new approaches to managing stakeholder involvement", *Journal of Environmental Management,* Vol. 90, pp. 1567–1575.

Berry, D., Towill D.R. and Wadsley, N. (1994), "Supply chain management in the electronics products industry", *International Journal of Physical Distribution & Logistics Management*, Vol. 24 No. 10, pp. 20-32.

Bhateja, A. K., Babbar, R., Singh, S. and Sachdeva, A. (2011), "Study of green supply chain management in the Indian manufacturing industries: A literature review cum an analytical approach for the measurement of performance", *International Journal of Computational Engineering & Management*, Vol. 13, pp.84-99.

Biswas, W.K. (2012), "The importance of industrial ecology in engineering education for sustainable development", *International Journal of Sustainability in Higher Education*, Vol. 13 No. 2, pp.119–132.

Bloemhof-Ruwaard, J.M., Beek, P., Hordijk, L. and Van Wassenhove, L.N. (1995), "Interactions between operational research and environmental management", *European Journal of Operational Research*, Vol. 85, pp. 229-243.

BOCOM International (2010), *China becomes the largest auto consumption country*, Sector report, Bank of Communications, 12 January, 2010. [Online] Available at: http://www.bocomgroup.com/mediafiles/documents/p2_2674_en.pdf

Bolton Report (1971), *Small Firms: Report of the Committee of Inquiry on Small Firms*. Chaired by Bolton, J. E. Cmnd. 4811, London: HMSO.

Boons, F.A.A. and Baas, L.W. (1997), "Types of industrial ecology: the problem of co-ordination", *Journal of Cleaner Production*, Vol. 51 No. 2, pp.79-86.

Boothroyd, G., Dewhurst, P. and Knight, W. (1994), *Product Design for Manufacture and Assembly.* New York: Marcel Dekker Inc.

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

Bowen, H. (1953), *Social Responsibilities of the Businessman*. New York: Harper & Row.

Bowersox, D. J., David, J. C. and Bixby, M. C. (2002), *Supply Chain Logistics Management*, New York: McGraw-Hill.

Bralla, J. (1986), *Handbook of Product Design for Manufacturing*. New York: McGraw Hill.

Branigan, T. (2013), "Beijing smog continues as Chinese state media urge more action", *The Guardian*, 14 January, 2013. [Online] Available at: http://www.guardian.co.uk/world/2013/jan/14/beijing-smog-continues-media-action

Brick, J.M., and Kalton, G. (1996), "*Handling missing data in survey research*", Statistical Methods in Medical Research, Vol. 5 No. 3, pp. 215-238.

Bryman, A. and Bell, E. (2007), *Business Research Methods. 2nd ed*. Oxford: Oxford University Press.

Buck de, A.J., Hendrix, E.M.T. and Schoorlemmer, H.B. (1999), "Analysing production and environmental risks in arable farming system: A mathematical approach", *European Journal of Operational Research*, Vol. 119, pp. 416-426.

Business Week (2005), "Europe's push for less-toxic tech", August 9 [online] Available at: http://www.businessweek.com/technology/content/aug2005/tc2005089_9729_tc_215.html

Cahill, H.A. (1996), "A qualitative analysis of student nurses' experiences of mentorship", *Journal of Advanced Nursing*, Vol. 24 No. 4, pp. 791-199.

Carroll, A. (1979), "A three-dimensional conceptual model of corporate performance", *Academy of Management Review*, Vol. 4, pp. 497-505.

Carroll, A. (1999), "Corporate social responsibility: Evolution of a definitional construct", *Academy of Management Review*, Vol. 4, pp. 268-296.

Carter, C. and Carter, J. (1998), "Inter-organizational determinants of environmental purchasing: initial evidence from the consumer products industries", *Decision Sciences,* Vol.29 No.3, pp. 659-684.

Carter, C.R. and Dresner, M. (2001), "Purchasing's role in environmental management: cross-functional development of grounded theory", *Supply Chain Management*, Vol. 37 No. 3, pp. 12-26.

Carter, C.R. and Jennings, M.M. (2002a), “Social responsibility and supply chain relationships”, *Transportation Research, Part E,* Vol. 38 No.1, pp. 37-52.

Carter, C.R. and Jennings, M.M. (2002b), “Logistics social responsibility: an integrative framework”, *Journal of Business Logistics,* Vol. 23 No. 1, pp. 145-180.

Carter, C.R., Ellram, L.M. and Ready, K.J. (1998), “Environmental purchasing: benchmarking our German counterparts”, *International Journal of Purchasing & Materials Management*, Vol. 34 No. 4, pp.28-38.

Carter, C.R., Kale, R. and Grimm, C.M. (2000), “Environmental purchasing and firm performance: an empirical investigation”, *Transportation Research Part E*, Vol. 36 No. 3, pp. 219-228.

Castka, P., Balzarova, A. and Bamber, C. (2004), ‘‘How can SMEs effectively implement the CSR agenda? A UK case study perspective’’, *Corporate Social Responsibility and Environmental Management*, Vol. 11 No. 3, pp. 140-149.

Central Intelligence Agency (2010), “The World Factbook”, [online] Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html

CERFE Group (2001), *Action Research on Corporate Citizenship among European Small and Medium Enterprises*. Rome: CERFE Laboratory.

Chan, R.Y.K. and Lau, L.B.Y. (2001), "Explaining green purchasing behavior: a cross-cultural study on American and Chinese consumers", *Journal of International Consumer Marketing*, Vol. 14 No. 2/3, pp. 9-41.

Chan, R.Y.K., He, H., Chan, H.K. and Wang, W.Y.C. (2012), “Environmental orientation and corporate performance: The mediation mechanism of green supply chain management and moderating effect of competitive intensity”, *Industrial Marketing Management*, Vol. 41 No. 4, pp. 621-630.

Chen, C. (2005), “Incorporating green purchasing into the frame of ISO 14000”, *Journal of Cleaner Production*, Vol.13, pp. 927-933.

Chen, J. (2006), “Development of Chinese small and medium-sized enterprises”, *Journal of Small Business and Enterprise Development*, Vol. 13 No. 2, pp. 140–147.

Chestermann, M. (1982), *Small Businesses.* London: Sweet and Maxwell.

China Central Television (CCTV) (2013), “Beijing Smog”, *World Insight*, 3 Febuary, 2013. [Online] Available at: http://english.cntv.cn/program/worldinsight/20130204/102649.shtml

China Green Food Development Centre (n.d.), *The Concept of Green Food*. [Online] Available at: http://www.greenfood.org.cn/sites/GREENFOOD/List_3675_3812.html

China International Association of Small and Medium Enterprises (2006), *Yearbook of China Small and Medium Enterprises*. Beijing, China: CICASME.

China Statistics Press (1999-2003), C*hina Industry Economy Statistical Yearbook*. Beijing, China: China Statistics Press.

China Statistics Press (2006), *China Industry Economy Statistical Yearbook*. Beijing, China: China Statistics Press.

Christian Nordqvist. (2010), "Air And Water Pollution Remain Major Cause Of Death And Disease In China." *Medical News Today*. 26 March, 2010. [Online] Available at: http://www.medicalnewstoday.com/articles/183567.php.

Christmann, P. and Taylor. G. (2001), “Globalization and the environment: determinants of firm self-regulation in China”, *Journal of International Business Studies*, Vol. 32 No. 3, pp. 439-458.

Choi, B.C.K., and Pak, A.W.P. (2005), “A catalog of biases in questionnaires”, Preventing Chronic Disease, Vol. 2 No. 1, pp. 1-13. [online] Available at: http://www.cdc.gov/PCD/issues/2005/jan/pdf/04_0050.pdf.

Ciliberti, F., Pontrandolfo, P. and Scozzi, B. (2008), “Investigating corporate social responsibility in supply chains: a SME perspective”, *Journal of Cleaner Production*, Vol.16 No.15, pp. 1579-1588.

Clarke, P. (1972), *Small Businesses: How they survive and succeed.* Newton Abbot, UK: David and Charles.

Clarksson, M.B.E. (1995), “A Stakeholder Framework for Analyzing and Evaluating Corporate Social Performance”, *Academy of Management Review*, Vol.29 No.1, pp. 92-117.

Claver, E., Lopez, M.D., Molina, J.F. and Tari, J.J. (2007), “Environmental management and firm performance: A case study”, *Journal of Environmental Management*, Vol. 84, pp. 606-619.

Clift, R., Doig, A. and Finnveden, G. (2000), “The application of life cycle assessment to integrated solid waste management. Part 1-Methodology”, *Transactions of the Institution of Chemical Engineers*, Vol. 78B, pp. 279-287.

Cohen-Rosenthal, E. (2004), “Making sense out of industrial ecology: a framework for analysis and action”, *Journal of Cleaner Production*, Vol. 12, pp. 1111-1123.

Collis, J. and Hussey, R. (2003), *Business Research*. *A Practical Guide for Undergraduate and Postgraduate Students, 2nd ed.* New York: Palgrave Macmillan.

Commission of the European Communities (2002), *Communication from the Commission Concerning Corporate Social Responsibility: A business contribution to sustainable development.* Brussels: EU Commission.

Common, M., and Perrings, C. (1992), "Towards an ecological economics of sustainability", *Ecological Economics*, Vol. 6, pp. 7-34.

Comte, A. (1853), *The Philosophie Positive of Auguste Comte*. London: John Chapman.

Cook, C., Heath, F., and Thompson, R.L. (2000), “*A meta-analysis of response rates in web- or internet-based surveys*”, *Educational and Psychological Measurement*, Vol. 60 No. 6, pp. 821–36.

Cooper, M., Lambert, D. and Pagh, J. (1997), “Supply chain management: More than just a name for logistics”, *The International Journal of Logistics Management*, Vol. 8 No.1, pp. 1-14.

Corbett, C.J. and Pan, J.N. (2002), “Evaluating environmental performance using statistical process control techniques”, *European Journal of Operational Research*, Vol. 139, pp. 68-83.

Cordano, M. and Frieze, I.H. (2000), “Pollution reduction preferences of U.S. environmental managers: applying Ajzen’s theory of planned behavior”, *Academy of Management Journal*, Vol. 43, pp. 627–641.

Cortina, J.M. (1993), “What is coefficient alpha? An examination of theory and applications”, *Journal of Applied Psychology*, Vol. 78, pp. 98-104.

Coˆte´, R. P. and Cohen-Rosenthal, E. (1995), “Designing eco-industrial parks: a synthesis of some experiences”, *Journal of Cleaner Production*, Vol. 6, pp. 181-188.

Crals, E. and Vereeck, L. (2005), "The affordability of sustainable entrepreneurship certification for SMEs", *International Journal of Sustainable Development and World Ecology*, Vol. 12 No. 2, pp. 173-183.

Croom, S., Romano, P. and Giannakis, M. (2000), “Supply chain management: an analytical framework for critical literature review”, *European Journal of Purchasing and Supply Management*, Vol. 6, pp. 67-83.

Cronbach, L. J. (1951), Coefficient alpha and the internal structure of tests. *Psychometrika,* Vol.16, pp. 297–334.

Crosbie, L. and Knight, K. (1995), *Strategy for Sustainable Business,* New York: McGraw-Hill.

Crow, K. (2002), Design for the Environment, [online] Available at: http://www.npd-solutions.com/dfe.html.

CSCMP (Council of Supply Chain Management Professionals), (n.d.), [Online] Available at: http://www.clm1.org/about-us/supply-chain-management-definitions

Daily, B.F. and Huang, S. (2001), “Achieving sustainability through attention to human resource factors in environmental management”, *International Journal of Operations and Production Management*, Vol. 21 No. 12, pp. 1539–1552.

Dambach, B.F. and Allenby, B.R. (1995), “Implementing design for environment at AT&T”, *Total Quality Environmental Management*, Vol. 4, pp. 51-62.

Darnall, N., Henriques, I. and Sadorsky, P. (2008), “Do environmental management systems improve business performance in an international setting?”, *Journal of International Management*, Vol. 14 No. 4, pp. 364–376.

Davis, K. (1960), “Can business afford to ignore social responsibilities?“, *California Management Review,* Vol. 2 No. 3, pp. 70-76.

Davis, K. (1967), “Understanding the social responsibility puzzle: What does the businessman owe to society?”, *Business Horizons*, Vol.10, pp.45-50.

Dawkins, J. (2004), *The Public's Views of Corporate Responsibility 2003*, MORI [online] Available at: http://www.smbsuj.republika.pl/abc%5CKOS%5CZalacznik_A-Publics_views_of_CR.pdf.

De Giovanni, P. and Vinzi, V.E. (2012), "Covariance versus component-based estimations of performance in green supply chain management", *International Journal of Production Economics*, Vol.135, pp. 907–916.

Delfmann, W. and Albers, S. (2000), "Supply chain management in the global context", working paper [online] Available at: http://www.uni-keoln.de/wiso-fak/planung/

Delmas, M.A. and Montiel, I. (2007), "The adoption of ISO 14001 within the supply chain: when are customer pressures effective?'' *Institute for Social, Behavioral, and Economic Research.* ISBER Publications, Paper 10 [online] Available at: http://repositories.cdlib.org/isber/publications/10.

Den Hond, F. and Groenewegen, P. (1993), "Solving the automobile shredder waste problem: co- operation among firms in the automotive industry", in: Fischer, K. and Schot, J. (eds.), *Environmental Strategies for Industry: International Perspectives on Research Needs and Policy Implications*, pp. 243-368. Washington, DC: Island Press.

Denzin, N.K. (1978), *The Research Act (2nd Edition)*. New York: McGraw-Hill.

Department of Trade and Industry (DTI) (1997), *Small Firms in Britain Report,* London: Department of Trade and Industry.

Department of Trade and Industry (2002a), *Business and Society: Corporate Social Responsibility Report 2002*, London: Department of Trade and Industry.

Department of Trade and Industry (2002b), *Engaging SMEs in Community and Social Issues (research report)*, London: Department of Trade and Industry.

Devi, J.T. and Hemant, K. (2009), "Corporate Social Responsibility Perspectives of Small and Medium Enterprises (SMEs) - A case study of Mauritius", *Advances in Management*, Vol.2 No.12, pp. 44-53.

Diabat, A. and Govindan, K. (2011), "An analysis of drivers affecting the implementation of green supply chain management", *Resources, Conservation and Recycling*, Vol. 55 pp. 659-667.

Do, D., Svedberg, C., and Karlsson. J. (2006), "Characteristics of SME outsourcing: a quantitative study of manufacturing SMEs in Småland" [online] Available at: www.diva-portal.org.

Drumwright, M.E. (1994), "Socially responsible organizational buying: environmental concern as a non-economic buying criterion", *Journal of Marketing*, Vol. 58, pp. 1-19.

Duber-Smith, D. (2005), "The Green Imperative", *Soap, Perfumery and Cosmetics*, Vol.78 No.8, pp. 24-26.

Easterby-Smith, M., Thorpe, R. and Lowe, A. (2002), *Management Research: An Introduction*. London: Sage Publications.

Economic Research Institute for ASEAN and East Asia (ERIA) (2008), "*SME development in China: A policy perspective on SME industrial clustering*" [online] Available at: www.eria.org/research/images/pdf/PDF%20No.5/No,5-2-China.pdf.

Eesley, C. and Lenox, M.J. (2006), "Firm responses to secondary stakeholder action", *Strategic Management Journal*, Vol.27 No.8, pp. 765-781.

Egri, C.P. and Herman, S. (2000), "Leadership in the North American environmental sector: values, leadership styles, and contexts of environmental leaders and their organizations", *Academy of Management Journal*, Vol. 43 No. 4, pp. 571-604.

Ehrenfeld, J. R. (1997), "Industrial ecology: a framework for product and process design", *Journal of Cleaner Production*, Vol. 5 No.1-2, pp.87-95.

Ehrenfeld, J.R. (2000), "Industrial ecology: paradigm shift or normal science?", *American Behavioral Scientist,* Vol. 44 No. 2, pp. 229-244.

Ehrenfeld, J.R. (2003), "Putting the spotlight on metaphors and analogies in industrial ecology", *Journal of Industrial Ecology,* Vol. 7, pp.1-4.

Eikebrokk, R.T. and Olsen H.D. (2007), "An empirical investigation of competency factors affecting e-business success in European SMEs", *Information & Management*, Vol. 44, pp. 364-383.

Eisenhardt, K. M. (1989), "Building theories from case study research", *Academy of Management Review***,** Vol. 14, pp. 532–550.

El-Haggar, S. (2007), *Sustainable Industrial Design and Waste Management: Cradle-to-Cradle for Sustainable Development*. Burlington: Elsevier Academic Press.

Elsayed, K. and Paton, D. (2005), "The impact of environmental performance on firm performance: static and dynamic panel data evidence", *Structural Change and Economic Dynamics,* Vol. 16, pp. 395-412.

Emmelhainz, M. and Adams, R. (1999), "The apparel industry response to 'sweatshop' concerns: A review and analysis of codes of conduct", *Journal of Supply Chain Management*, Vol. 35 No. 3, pp. 51-57.

Enderle, G. (2004), "Global competition and corporate responsibilities of small- and medium-sized enterprises", *Business Ethics: A European review*, Vol. 13 No. 1, pp. 51-63.

Environics (1999), *The Millennium Poll on Corporate Social Responsibility,* Executive Briefing, Environics International Inc. [Online] Available at: http://www.globescan.com/news_archives/MPExecBrief.pdf

Erkman, S. (1997), "Industrial ecology: A historical view", *Journal of Cleaner Production,* Vol. 5, pp. 1–10.

Esterman, M. and Ishii, K. (2001), "Concurrent product development across the supply chain: Development of integrator/supplier risk and coupling indicies", Proceedings of ASME 2001 Design Engineering Technical Conferences and Computer and Information in Engineering Conference, 9-12 September, Pittsburgh, USA.

Eurobarometer (1998), *Europeans and their Holidays.* Brussels: European Commission DG XXIII Enterprise policy, Distributive Trades, Tourism and Cooperatives.

European Commission (2001), *Green Paper: Promoting a European Framework for Corporate Social Responsibility*, Brussels: European Commission.

European Commission (2012), "Regulatory barriers to industrial symbiosis in metal sector", *Science for Environmental Policy, News Alert Issue* 291. 5 July, 2012. [Online] Available at: http://ec.europa.eu/environment/integration/research/newsalert/pdf/291na2.pdf

Faick, O. and Heblich, S. (2007), "Corporate social responsibility: doing well by doing good", *Business Horizons,* Vol. 50, pp. 247-254.

Fatoki, O. and Chiliya, W. (2012), “An Investigation into the Attitudes towards Business Ethics and Corporate Social Responsibility by Local and Immigrant SME Owners in South Africa”, *Journal of Social Science*, Vol.21 No.1, pp. 13-21.

Fergusson, J. (2006), “A brief history of air-conditioning”, Prospect, [online], Available at: http://www.prospectmagazine.co.uk/magazine/abriefhistoryofairconditioning/.

Fernandez, E., Junquera, B. and Ordiz, M. (2003), “Organizational culture and human resources in the environmental issue: a review of the literature”, *International Journal of Human Resource Management*, Vol. 14 No. 4, pp. 634-656.

Fiksel, J. (1993), “Design for environment: an integrated system approach”, *Proceedings of the 1993 IEEE International Symposium on Electronics and the Environment*, pp. 126-131. IEEE. 10-12, May, 1993, Arlington, VA.

Fiksel, J. (1996), *Design for Environmental: creating eco-efficient products and processes*. New York: McGraw Hill Inc.

Fiksel, J. (2000) “Measuring sustainability in eco-design”, in Charter, M. and Tischner, U. (eds.), *Sustainable Solutions: Developing Products and Services for the Future*. Sheffield: Greenleaf Publishing.

Frankel, R., Bolumole, Y.A., Eltantawy, R.A., Paulraj, A. and Gundlach, G.T. (2008), "The domain and scope of SCM's foundational disciplines insights and issues to advance research", *Journal of Business Logistics*, Vol. 29 No. 1, pp. 1-30.

Fredrick, W.C. (1960), “The growing concern over business responsibility”, *California Management Review*, Vol. 2, pp. 54-61.

Freeman, E.R. (1984), *Strategic Management: A stakeholder approach*. Boston: Pitman.

Freeman, E.R. (2004), “The stakeholder approach revisited”, *Zeitschrift für Wirtschafts – und Unternehmensethik,* Vol. 5 No. 3, pp. 228-241.

Friedman, M. (1970), “The social responsibility of business is to increase its profits”, *New York Times Magazine*, Vol. 13, pp. 32-33 & 122-126.

Friedman, A.L. and Miles, S. (2006), *Stakeholders: Theory And Practice.* Oxford: Oxford University Press.

Frooman, J. (1999), “Stakeholder influence strategies”, *Academy of Management Review,* Vol. 24 No. 2, pp. 191-205.

Frosch, R.A. and Gallopoulos, N. E. (1989), “Strategies for manufacturing”, *Scientific American*, Vol. 261 No. 3, pp. 144-152.

Fry, G., Chantavanich, S. and Chantavanich, A. (1981), “Merging quantitative and qualitative research techniques: toward a new research paradigm”, *Anthropology and Education Quarterly,* Vol. 12 No. 2, pp. 145-158.

Gallagher, K.S. (2006), *China Shifts Gear.* Cambridge: MIT Press.

Gephart, R. (2004), “What is qualitative research and why is it important”, *Academy of Management Journal*, Vol. 7, pp. 454-462.

Gerrard, J. and Kandlikar, M. (2007), “Is European end of life vehicle legislation living up to expectation?”, *Journal of Cleaner Production*, Vol. 15, pp. 17-27.

Gershenson, J. and Ishii, K. (1992), “Life-cycle serviceability design”, in: Kusiak, A. (ed.), *Concurrent Engineering: Theory and Practice*, pp.19-39. New York: John Wiley and Sons.

Gevirtz, C.D. (1994), *Developing New Products with TQM*. New York: McGraw-Hill.

Gilbert, S. (2001), *Greening Supply Chain: enhancing competitiveness through green productivity*, Taiwan: Asian Productivity Organization, pp. 1-6.

Gillham, B. (2000), *Developing a Questionnaire*, London: Continuum.

Giurco, D., Cohen, B., Langham, E. and Warnken, M. (2011), “Backcasting energy futures using industrial ecology”, *Technological Forecasting and Social Change*, Vol. 78, No. 5, pp. 797-818.

Global Environmental Management Initiative (GEMI) (2001), *New Paths to Business Value*, March. GEMI, Washington, DC.

Goldstein, H.B. and Wiest, C.D. (2007), “Shareholders beware! When individual shareholders may be left holding the bag for environmental liability”, *Journal of Taxation of Investments*, Vol. 24 No. 3, pp. 226-237.

Gondrand, F. (1992), *Eurospeak: A User’s Guide. The Dictionary of the Single Market.* London: Nicholas Brealey.

González-Benitoa, J and González-Benitoa, O. (2006), “The role of stakeholder pressure and managerial values in the implementation of environmental logistics practices”, *International Journal of Production Research*, Vol.44 No.7, pp. 1353-1373.

Gottberg, A., Morris, J., Pollard, S., Mark-Herbert, C. and Cook, M. (2006), “Producer responsibility, waste minimisation and the WEEE Directive: case studies in eco-design from the European lighting sector”, *Science of The Total Environment*, Vol. 359 No. 1-3, pp. 38-56.

Goulding, C. (2002), *Grounded Theory: A Practical Guide for Management, Business and Market Researchers*. London: Sage.

Graedel, T.E. and Allenby, B.R. (1995), *Industrial Ecology*, Englewood Cliffs, NJ: Prentice-Hall.

Grassel, E. and Schirmer, B. (2006), “The use of volunteers to support family careers of dementia patients: results of a prospective longitudinal study investigating expectations towards and experience with training and professional support”, *Zeitschrift Fur Gerontologie Und Geriatrie,* Vol. 39 No. 3, pp. 217-226.

Green Council, (n.d.), *Hong Kong Green Label Scheme* [online] Available at: http://www.greencouncil.org/eng/greenlabel/intro.asp.

Green, K., Morton, B. and New, S. (1996), "Purchasing and environmental management: interaction, policies and opportunities", *Business Strategy and the Environment*, Vol. 5, pp. 89-95.

Green, K. W. Jr., Zelbst, P. J., Meacham, J. and Bhadauria, V. S. (2012), “Green supply chain management practices: impact on performance”, *Supply Chain Management: An International Journal,* Vol. 17 No. 3, pp. 1-44.

Greenan, K., Humphrey, P. and McIvor, R. (1997), "The green initiative: improving quality and competitiveness for European SMEs", *European Business Review*, Vol. 97 No. 5, pp. 208-214.

Greer, J. and Bruno, K. (1996), *Greenwash: The Reality Behind Corporate Environmentalism*. Penang: Third World Network and New York: Apex Press.

van der Grijp, N.M. and den Hond, F. (1999) *Green supply chain initiatives in the European food and retailing industry*, Institute for Environmental Studies, Amsterdam [online] Available at: http://dare.ubvu.vu.nl/bitstream/handle/1871/10430/f2.pdf?sequence=1.

Groznik, A. and Erjavec, J. (2012), “Environmental impact of supply chains”, in Groznik, A. (Ed.) *Pathways to Supply Chain Excellence*, pp.115-124. Rijeka: In Tech.

Gubrium, J.F. and Holstein, A. (2000), “The self in a world of going concerns”, *Symbolic Interaction*, Vol. 23, pp. 95-115.

Gulsecen, S. and Kubat, A. (2006), “Teaching ICT to teacher candidates using PBL: A qualitative and quantitative evaluation”, *Educational Technology & Society,* Vol. 9 No. 2, pp. 96-106.

Gunningham, N.A., Robert, A.K. and Thornton, D. (2004), “Social license and environment protection: why businesses go beyond compliance”, *Law & Social Inquiry,* Vol. 29, pp. 307-341.

Hall, J. (2001), "Environmental supply chain innovation", *Greener Management International*, Vol.35, pp. 105-119.

Halliday. T. (2012), “Are SMEs forced to choose between keeping their costs down or being environmentally friendly?”, I*nsight Logistic*s, Vol.11, pp. 67. [online] Available at: http://www.aeb.com.sg/multi-media/sg/docs/articles/insight-logistics-**11-2012**-green-smes.pdf

Hamann, R., Agbazue, T., Kapelus, P. and Hein, A. (2005), “Universalizing corporate social responsibility? South African challenges to the International Organization for Standardization’s new social responsibility standard”, *Business Society Review,* Vol. 110 No. 1, pp. 1-19.

Hamel, G. and Prahalad, C.K. (1989), “Strategic intent”, *Harvard Business Review*, Vol. 67, pp. 63-76.

Hammond, D. and Beullens, P. (2006), “Modelling oligopolistic closed loop supply chains”, *Proceedings of the 13th CIRP International Conference on Life Cycle Engineering, Towards a Closed Loop Economy,* Leuven, Belgium, pp. 595-600 [online] Available at: http://www.mech.kuleuven.be/lce2006/098.pdf.

Handfield, R., Walton, S.V., Seegers, L.K. and Melnyk, S.A. (1997), "Green value chain practices in the furniture industry", *Journal of Operations Management*, Vol. 15 No. 4, pp. 293-315.

Hanna, M.D., Newman, W.R. and Johnson, P. (2000), “Linking operational and environmental improvement through employee involvement”, Inter*national Journal of Operations and Production Management*, Vol. 20 No. 2, pp. 148-165.

Haynes, P.J. and Helms, M.M. (1991), “An ethical framework for purchasing decisions”, *Management Decision*, Vol. 29 No. 1, pp. 35-38.

van Hemel, C. G. (1998), *Ecodesign Empirically Explored – Design for Environment in Dutch small and medium sized enterprises*, PhD thesis, Netherlands: Delft University of Technology.

Hemingway, C. A. and Maclagan, P. W. (2004), “Managers’ personal values as drivers of corporate social responsibility”, *Journal of Business Ethics,* Vol. 50, pp. 33-45.

Henriques, I. and Sadorsky, P. (1996), "The determinants of an environmentally responsive firm: an empirical approach", *Journal of Environmental Economics and Management*, Vol. 30 No. 3, pp. 381-395.

Herd, R., Hu, Y. and Koen, V. (2010), “Improving China’s health care system”, *OECD Economics Department Working Papers*, No.751, OECD Publishing [online] Available at: http://www.oecd-ilibrary.org/docserver/download/5kmlh4v2fv31.pdf?expires=1358921347&id=id&accname=guest&checksum=255A8E836FEAF45F0227950D0F5FD846.

Hillary, R. (2000), *Small and Medium Sized Enterprises and the Environment: Business Imperatives*. London: Greenleaf Publishing.

Hilton, M. (2000), "SME support for sustainable development: principles and practice", in: *European Foundation for the Improvement of Living and Working Conditions, Sustainable Development, SMEs and New Enterprises (Conference Report)*, Luxembourg: Office for Official Publications of the European Communities, pp. 25-27.

Hinton, P.R., Brownlow, C., McMurray, I. and Cozens, B. (2004), *SPSS Explanied*. New York: Routledge.

Hoffman, A. (2000), *Competitive Environmental Strategy: A Guide to the Changing Business Landscape*. Washington, DC: Island Press.

Holt, D. and Ghobadian, A. (2009), "An empirical study of green supply chain management practices amongst UK manufacturers", *Journal of Manufacturing Technology Management*, Vol. 20 No. 7, pp. 933-956.

van Hoof, B. and Lyon, T.P. (2013), “Cleaner production in small firms taking part in Mexico’s Sustainable Supplier Program”, *Journal of Cleaner Production*, Vol. 41, pp. 270-282.

Hoskin, P. (2011), “Why business needs to green the supply chain”, *University of Auckland Business Review*, Vol.13 No.1, pp. 16-18.

Houlihan, J.B. (1988), “International supply chains: a new approach”, *Management Decision*, Vol. 26 No. 3, pp. 13-19.

Huang, X.M. and Tan, B.L. (2010), “Study on Green Supply Chain Management Pressures on Manufacturing SMEs in China”, *Proceedings of 1st International Conference on Advanced Management Perspectives in Asia (ICAMPA 2010): Business and Management Issues in the Post Financial Crisis?,* 15th-17th, October, 2010. Suzhou, China,

Huang, X. M., Tan, B.L. and Ding, X. M. (2012a), "Green Supply Chain Management Practices: A Sectoral Investigation in to Manufacturing SMEs in China", *International Proceedings of Economics Development and Research,* Vol. 29, pp. 147 - 151. International Conference on Economics Business and Marketing Management (CEBMM, 2012), 26th-28th February, 2012. Singapore.

Huang, X.M., Tan, B.L. and Li, D. (2012b), "Pressures on green supply chain management: a study on manufacturing small and medium-sized enterprises in China", *International Business and Management*, Vol. 4 No. 1, pp. 76-82.

Hutchison, A. and Chaston, I. (1994), "Environmental management in Devon and Cornwall's small and medium-sized enterprise sector", *Business Strategy and the Environment*, Vol. 3 No. 2, pp. 15-22.

Industrial Technology Research Institute (1996), *Green Mark; The Environmental Labelling Program in Taiwan, Republic of China*. Taiwan.

Information Office of the State Council (2004), “*China's Social Security and Its Policy*”, [Online] Available at: http://english.gov.cn/official/2005-07/28/content_18024.htm

International Union for Conservation of Nature (IUCN) (1980), *The World Conservation Strategy,* Geneva: International Union for Conservation of Nature and Natural Resources, United Nations Environment Programme, World Wildlife Fund. [Online] Available at: http://data.iucn.org/dbtw-wpd/html/WCS-004/cover.html

International Union for Conservation of Nature (IUCN) (2005), *The IUCN Programme 2005-2008 – Many Voices, One Earth* [online] Available at: https://cmsdata.iucn.org/downloads/programme_english.pdf.

Ishii K., Eubanks, C.F. and Marco, P. Di (1994), "Design for product retirement and material life- cycle", *Materials & Design*, Vol. 15 No. 4, pp. 225-233.

Jarutirasarn, P. and Aiyeku, J.F. (2010), "Management attitude towards incorporating corporate social responsibility and the impact on firm's performance: Analysis of Thai SMEs", *International Journal of Business Strategy*, Vol.10 No.2, pp. 90-98.

Jelinski, L.W., Graedel, T.E., Laudise, R.A., McCall, D.W. and Patel, C.K.N. (1992), "Industrial ecology: Concepts and approaches", *Proceedings of the National Academy of Sciences*, Vol. 89, pp. 793-797.

Jenkins, H. (2006), "Small business champions for corporate social responsibility", *Journal of Business Ethics*, Vol. 67, pp. 241-246.

Jiang, Y., Wang, Y. and Yan, X. (2001), "Chinese pharmaceutical companies: an emerging industry", *Drug Discovery Today*, Vol. 6, pp. 610-612.

Jick, T. D. (1979), "Mixing qualitative and quantitative methods: triangulation in action", *Administrative Science Quarterly*, Vol. 24, pp. 602-611.

Johannsson, L. (1994), "How can a TQEM approach add value to your supply chain?", *Total Quality Environmental Management*, Vol. 3 No. 4, pp. 521-530.

Johnson, M.P. (2006), "Decision models for the location of community corrections centers", *Environment And Planning B-Planning & Design,* Vol. 33 No. 3, pp. 393-412.

Kailer, N. and Scheff, J. (1999), "Knowledge management as a service: cooperation between small and medium-sized enterprises (SMEs) and training, consulting and research institutions", *Journal of European Industrial Training*, Vol. 23 No. 7, pp. 319-328.

Kanthor, R. (2009), "Green or Green Washed? 7 Lessons in Green Supply Chain in China ", *CHaINA Magazine* [online] Available at: http://www.resourcesystemsconsulting.com/blog/green-or-green-washed/#.UQTksI49w7A.

Keoleian, G. (1993), “The application of life cycle assessment to design”, *Journal of Cleaner Production*, Vol. 1 No. 3-4, pp. 143-149.

Keoleian, G. A. and Menerey, D. (1994), "Sustainable development by design: review of life cycle design and related approaches", *Air & Waste*, Vol. 44 (May), pp. 644-668.

Keoleian, G. A., Koch, J. E., and Menerey, (1995), *Life Cycle Design Framework and Demonstration Projects*, US EPA, Document EPA/600/R-95/107 [online] Available at: http://www.epa.gov.

King, A.A. and Lenox, M.J (2000), “Industry Self-regulation Without Sanctions: The Chemical Industry’s Responsible Care Program”, *Academy of Management Journal*, Vol.43. No.4, pp.698-716.

Klassen, R. (1993), "The integration of environmental issues into manufacturing: toward an interactive open-system model", *Production and Inventory Management*, Vol. 34 No. 1, pp. 82-88.

Klassen, R.D. and Awaysheh, A. (2006), “Building the triple-bottom line: integrating social issues into supply chain management”, in Mendibil, K. and Shamsuddin, A. (eds.), *Moving up the Value Chain*, Vol. 2, pp. 699-708. Glasgow: University of Strathclyde.

Klassen, R.D. and Vachon, S. (2003), "Evaluation and collaboration in the supply chain: their impact on plant-level environmental investments", *Production and Operations Management*, Vol. 12 No. 3, pp. 336-352.

Kmenta, S. (2000), *Advanced Failure Modes and Effects Analysis: A method for predicting and evaluating failures in products and processes*, PhD Thesis, Stanford University.

Kmenta, S., Fitch, P. and Ishii, K. (1999), "Advanced failure modes and effects analysis of complex processes," *Proceedings of the 1999 ASME Design Engineering Technical Conferences,* September 12-15, Las Vegas, Nevada.

Kok, P., van der Wiele, T., McKenna, R. and Brown, A. (2001), “A corporate social responsibility audit within a quality management framework”, *Journal of Business Ethics*, Vol. 31, pp. 285-297.

Kollk, A. and Tudder, R.V. (2002), “The effectiveness of self-regulation: corporate codes of conduct and child labour”, *European Management Journal*, Vol. 20 No. 3, pp. 260-271.

Konar, S. and Cohen, M.A. (1997), "Information as regulation: the effect of community right to know laws on toxic emissions", *Journal of Environmental Economics and Management*, Vol. 32, pp. 109-24.

Kumar, R.S. and Subrahmanya, M.H.B. (2010), "Influence of subcontracting on innovation and economic performance of SMEs in Indian automobile industry", *Technovation*, Vol. 30, pp. 558-569.

Lai, K-H. and Cheng, T.C.E. (2009), *Just-in-Time Logistics*. Burlington, VT: Gower Publishing Company.

Lai, R.S.Q., Hsu, L. and Chen, J.C.H. (2012), "Green Supply Chain Management systems: A case study in the textile industry", *Human Systems Management,* Vol.31, pp. 111-121.

Lam, J.C.K., Salahuddin, S. and Tsoi, C.S.J. (2003), *Corporate Governance as a Competitive Necessity,* Corporate Environmental Governance Research Report, March, The University of Hong Kong.

Lan, X. (2011), "Small, Medium and Micro – China revises its standards for SMEs to provide additional support to theses burgeoning businesses", *Beijing Review*, 18th, July, 2011. [Online] Available at: http://www.bjreview.com.cn/business/txt/2011-07/18/content_377271.htm

Lanren, H. (2009), "SMEs in China", *Insight*, Vol. April, pp.19-21.

Lau, K.H. (2011), "Benchmarking green logistics performance with a composite index", *Benchmarking: An International Journal*, Vol. 18 No. 6, pp. 873-896.

Laumer, J. (2007), "Pollution estimated to cause 750,000 premature deaths each year in China", *Treehugger* [online] Available at: http://www.treehugger.com/corporate-responsibility/pollution-estimated-to-cause-750000-premature-deaths-each-year-in-china.html.

Lee, K-H. (2008a), "Corporate environmental management and practices of SMEs: the case of Korean manufacturing industry", *Journal of Sustainable Management*, Vol. 8 No. 1, pp. 73-86.

Lee, S-Y. (2008b), "Drivers for the participation of small and medium-sized suppliers in green supply chain initiatives", *Supply Chain Management: An International Journal*, Vol. 13 No. 3, pp. 185-198.

Lee, S-Y. and Klassen, R.D. (2008), "Drivers and enablers that foster environmental management capabilities in small- and medium-sized suppliers in supply chains", *Production and Operation Management Society*, Vol. 17 No. 6, pp. 573-586.

Leire, C. (2006), "The application of green purchasing tools in the corporate sector", *Environmental Engineering and Management Journal*, Vol. 5 No. 5, pp. 1159-1179.

Leopold, A. (1933). "The conservation ethic", *Journal of Forestry*, Vol.31. pp.634-643.

Lepoutre, J. and Heene, A. (2006), ''Investigating the impact of firm size on small business social responsibility: a critical review'', *Journal of Business Ethics*, Vol. 67, pp. 257-73.

Lewis, S. (2003), *Corporate Brand and Corporate Responsibility,* Report from Ipsos MORI [online] Available at: http://www.ipsos-mori.com/publications//sl/corporate-brand.pdf.

Li, B., Wu, S., and Lui, C. (2009), *China Pharmaceuticals: time to look at the neglected China drug sector*, Morgan Stanley Research.

Li, Z.B. (2011), *The Blue Book of Small and Medium Enterprises in China: To Promote The Small and Medium Enterprises Independent Innovation Policy and Mechanism,* Beijing: China Development Press.

Lin, R.J., Chen, R.H. and Nguyen, T.H. (2011) "Green supply chain management performance in automobile manufacturing industry under uncertainty", *Procedia-Social and Behavioral Sciences*, Vol. 25, pp. 233-245.

Lincoln, Y.S. and Guba, E.G. (2000), "Paradigmatic controversies, contradictions, and emerging confluences", in Denzin, N.K. and Lincoln, Y.S. (Eds.), *The Handbook of Qualitative Research* (second edition). London: Sage, pp. 163-188.

Lind, S. (2007), "Adaptation of eco-design methods for SMEs in India: Experiences from the electronics industry", Master of Science Thesis, [online] Available at: http://www.diva-portal.org/smash/get/diva2:23798/FULLTEXT01.pdf

Linton, J.D., Klassen, R.D. and Jayaraman, V. (2007), "Sustainable supply chains: An introduction", *Journal of Operations Management*, Vol. 25, pp. 1075-1082.

Lo, C.W. and Leung, S.W. (2000), "Environmental agency and public opinion in Guangzhou: the limits of a popular approach to environmental governance", *The China Quarterly,* Vol. 163, pp. 677-704.

Lovell, G.I. (2006), “Justice excused: the deployment of law in everyday political encounters”, *Law & Society Review,* Vol. 40 No. 2, pp. 283-324.

Luken, R. and Stares, R. (2005), “Small business responsibility in developing countries: a threat or an opportunity?”, *Business Strategy and the Environment*, Vol.4, pp. 38-53.

Luthra, S., Kumar, V., Kumar, S. and Haleem, A. (2011), "Barriers to implement green supply chain management in automobile industry using interpretive structural modelling technique: an Indian perspective", *Journal of Industrial Engineering and Management*, Vol.4 No.2, pp. 231-157.

Lytle, M. H. (2007), *The Gentle Subversive: Rachel Carson,* Silent Spring*, and the rise of the environmental movement.* New York: Oxford University Press.

Ma, J. (2012), “The status que of, problems and policies for the development of SMEs”, *Speech at Dong Xing Securities The First Forum of Investment on Securities Market of SMEs*, 26 April, 2012, Beijing. [Online] Available at: http://finance.sina.com.cn/hy/20120426/100211929864.shtml

Málovics, G., Csigéné, N.N. and Kraus, S. (2008), “The role of corporate social responsibility in strong sustainability”, *The Journal of Socio-Economics*, Vol. 37 No. 3, pp. 907-918.

Maloni, M.J. and Brown, M.E. (2006), “Corporate social responsibility in the supply chain: An application in the food industry”, *Journal of Business Ethics*, Vol. 68 No. 1, pp. 35-52.

Management Centre Europe (2012), “New Opportunities and Strategies in the Pharmaceutical Industry”, *The Executive Issue*, No. 38. [Online] Available at: http://www.mce-ama.com/executive-issue-38-pharma-industry-2012/

Mangan, J., Lalwani, C. and Gardner, B. (2004), “Combining quantitative and qualitative methodologies in logistics research”, *International Journal of Physical Distribution and Logistics Management,* Vol. 34 No. 7, pp. 565-578.

Mann, P.S. (1995), *Introductory Statistics (2nd Edition)*. New York: Wiley.

Martin, M.K. and Ishii, K. (2002), “Design for variety: developing standardized and modularized product platform architectures”, *Research in Engineering Design*, Vol. 13, pp. 213-235.

Martinsons, M.G., So, S.K.K., Tin, C. and Wong, D. (1997), "Hong Kong and China: emerging markets for environmental products and technologies", *Long Range Planning*, Vol. 30 No.2, pp. 277-90.

McDougall, F.R., White, P., Frankle, M. and Hindle, P. (2001), *Integrated Solid Waste Management (2nd Edition)*. Cambridge: Blackwell Science.

McGuire, J. (1963), *Business and Society,* New York: McGraw-Hill.

McIntyre, L.J. (2005), *Need to Know: Social Science Research Methods*. New York: McGraw-Hill.

Menguc, B. and Ozanne, L.K. (2005), "Challenges of the 'green imperative': a natural resources based approach to the environmental orientation-financial performance relationship", *Journal of Business Research*, Vol. 58 No. 4, pp. 430-438.

Michael, L. and Ehrenfeld, J.R. (1995), "Design for environment: a new framework for strategic decisions", *Environmental Quality Management*, Vol. 4 No. 4, pp. 37-52.

Min, H. and Galle, W.P. (1997), "Green purchasing strategies: trends and implications", *International Journal of Purchasing and Materials*, Vol. 4, pp. 410-417.

Min, H. and Galle, W.P. (2001), "Green purchasing practices of US firms", *International Journal of Operations and Production Management*, Vol. 21 No. 9, pp. 1222-1238.

Mintzberg, H. (1979), *The Structure of Organization: a synthesis of the research*. Englewood Cliffs, NJ: Prentice-Hall.

Mitchell, M.L. and Jolley, J.M. (2010), *Research Design Explained.* Belmont, CA: Wadsworth.

Mitchell, R.K., Agle, B.R. and Wood, D.J. (1997), "Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts", *Academy of Management Review*, Vol. 22, pp. 853-886.

Mizuki, C., Sandborn, P.A. and Pitts, G. (1996), "Design for environment – a survey of current practices and tools", P*roceedings of the 1996 IEEE International Symposium on Electronics and the Environment*, pp. 1-6. IEEE. 6-8 May, 1996, Dallas, TX, U.S.A.

Mohibul, I.M. and Alejandra, F. (2008), *Internationalization Process of SMEs: Strategies and Methods*, [online] Available at:

http://www.eki.mdh.se/uppsatser/foretagsekonomi/VT2008-FEK-D-1964.pdf (accessed 23 March 2009).

Montabon, F., Sroufe, R., and Narasimhan, R. (2007), “An examination of corporate reporting, environmental management practices and firm performance”, *Journal of Operations Management,* Vol. 2 No. 5, pp. 998-1014.

Moriones, A.B. and Merino, J. (2002), “Human resource management strategy and operational performance in the Spanish manufacturing industry”, *Management*, Vol. 5 No. 3, pp. 175-199.

Murillo, D. and Lozano, J. (2006), “SMEs and CSR: An approach to CSR in their own words”, *Journal of Business Ethics*, Vol. 67, pp. 227-240.

Murphy, P.R. and Poist, R.F. (2002), “Socially responsible logistics: an exploratory study”, *Transportation Journal*, Vol. 41 No. 4, pp. 23-35.

Murphy, P.R., Poist, R.F. and Braunschwieg, C.D. (1994), "Management of environmental issues in logistics: current status and future potential", *Transportation Journal*, Vol. 34 No. 1, pp. 48-56.

Narasimhan, R. and Carter, J.R (1998), *Environmental Supply Chain Management*. Tempe, AZ: Center for Advanced Purchasing Studies.

Näslund, D. (2002), “Logistics needs qualitative research – especially action research”, *International Journal of Physical Distribution and Logistic Management*, Vol. 32 No. 5, pp. 321-338.

Naylors, J. (2002), *Introduction to Operations Management*. Harlow: Financial Times Management.

New, S., Green, K. and Morton, B. (2000), "Buying the environment: the multiple meanings of green supply", in: Fineman, S. (ed.), *The Business of Greening*. London: Routledge, pp. 33-53.

Nulty, D.D. (2008), “The adequacy of response rates to online and paper surveys: what can be done?”, *Assessment & Evaluation in Higher Education*, Vol. 33 No. 3, pp. 301-314.

Núñez, Y., Irusta, R. and García, N. (2006), “The Spanish Eco-design Standard: Implementation in SMEs”, *Proceedings of 13th CIRP International Conference on Life*

Cycle Engineering, pp. 255-260. [online] Available at: http://www.mech.kuleuven.be/lce2006/118.pdf

Nunnally, J. C. (1978), *Psychometric Theory (2nd ed.).* New York: McGraw-Hill.

Organisation for Economic Cooperation and Development (OECD) (1997), *Globalisation and Small and Medium Enterprises*, Paris: OECD Publishing.

Orr, S. and Menzies, J. (n.d.), *Using Your Guanxi in China Case Study Research*, Deakin Graduate School of Business [online] Available from: http://www.wbiconpro.com/461-Stuart.pdf.

Ottman, J. (1998), *Green Marketing: Opportunity for Innovation*. Chicago: NTC Business Books.

Palmer, A. (2005), *Principles of Services Marketing*, New York: McGraw-Hill Education.

Palmisano, S.J. (2006), "The globally integrated enterprise", *Foreign Affairs*, Vol. 85 No. 3, pp. 127-136.

Parsons, S and Kriwoken, L.K. (2010), "Maximizing recycling participation to reduce waste to landfill: a study of small to medium-sized enterprises in Hobart, Tasmania, Australia", *Waste Management & Research*, Vol.28 No.5, pp. 472-477.

Pastore, M. and Lombardi, L. (2001), "On the sensitivity of Cronbach's alpha to fake data", *Proceedings of ASME 2011 International Mechanical Engineering Congress & Exposition*, pp. 1080-1087. November 11-17, 2011, Denver.

Perkowski, J. (2012), "China Leads In Foreign Direct Investment", *Forbes*, 5 November, 2012. [Online] Available at: http://www.forbes.com/sites/jackperkowski/2012/11/05/china-leads-in-foreign-direct-investment/

Perrini, F., Russo, A. and Tencati, A. (2007), ''CSR strategies of SMES and large firms. Evidence from Italy'', *Journal of Business Ethics*, Vol. 74, pp. 285-300.

Pharma China (2009), *Chinese Pharma Industry Performance in 2008 and Outlook in 2009*, Princeton: WiCON.

Pigou, A.C. (1920), *The Economics of Welfare.* London: McMillan & Co.

Pil, F.K. and Rothenberg, S. (2003), "Environmental performance as a driver of superior quality", *Production and Operations Management*, Vol. 12 No. 3, pp. 404-415.

Pillath, C., Li, K. and Pan, J.H. (2002), “Problems in the development of small and medium-size industrial enterprises in China: results of 2001 National Sample Survey”, *China Information*, Vol. 16 No. 2, pp. 54-84.

Pohlen, T. L. and Farris, T. M. (1992), "Reverse logistics in plastic recycling", *International Journal of Physical Distribution and Logistics Management,* Vol. 22 No. 7, pp. 35-47.

Porter, M.E. and van der Linde, C. (1995), “Toward a new conception of the environment-competitiveness relationship”, *Journal of Economic Perspectives*, Vol. 9 No. 4, pp. 97-118.

Qio, Z., Prato, T. and McCamley, F. (2001), “Evaluating environmental risks using safety-first constraints”, *American Journal of Agricultural Economics*, Vol. 83, pp. 402-413.

Quinn, B. (1999), “E-System manage inventory to reduce risk”, *Pollution Engineering*, Vol. 31, pp. 27-28.

Raar, J. (2011), “Australian SMEs and the Environment: Some Insights”, *Journal of Enterprising Culture*, Vol.19 No.4, pp. 341-371.

Rao, P. (2007), "Greening of the supply chain: an empirical study for SMEs in the Philippine context", *Journal of Asia Business Studies*, Vol. 1 No. 2, pp. 55-66.

Rao, P. H. (2003), *Greening the Supply Chain – A Guide for Managers in South East Asia*. Makati: Asian Institute of Management.

Rao, P. and Holt, D. (2005), “Do green supply chains lead to competitiveness & economic performance?”, *International Journal of Operations and Production Management*, Vol. 25 No. 9, pp.898-916.

Rao, S.S., Metts, G. and Mora Monge, C.A. (2003), "Electronic commerce development in small and medium-sized enterprise: a stage model and its implications", *Business Process Management Journal*, Vol. 9 No. 1, pp. 11-32.

Razzaque, M.A. and Hwee, T.P. (2002), “Ethics and purchasing dilemma: a Singaporean view”, *Journal of Business Ethics*, Vol. 35 No. 4, pp. 307-326.

Reinhardt, F.L. (1999), “Bringing the environment down to earth”, *Harvard Business Review*, Vol. 77 No. 4, pp. 149-157.

Reinhardt, F.L., Stavins, R.N. and Vietor R.H.K. (2008), “Corporate social responsibility through an economic lens”, *Review of Environmental Economics and Policy,* Vol. 2 No. 2, pp. 219-239.

Reuter, M.A., Boin, U.M.J., Van Schaik, A., Ver- hoef, E., Heiskanen, K., Yongxiang, Y. and Geor-galli, G. (2005), “The metrics of material and metal ecology”, *Developments in Mineral Processing*, Vol. 16. Amsterdam: Elsevier Science.

Rice, S. (2003), “Commitment to excellence: practical approaches to environmental leadership”, *Environmental Quality Management*, Vol. 12 No. 4, pp. 9-22.

Riley, M., Wood, R.C., Clark, M.A., Wilkie, E. and Szivas, E. (2000), *Researching and Writing Dissertations in Business and Management*. London: Thomson Learning.

Rivoli, P. (2003), “Labor standards in the global economy: issues for investors”, *Journal of Business Ethics*, Vol. 43 No. 3, pp. 223-232.

Roberts, S. (2003), ‘‘Supply chain specific? Understanding the patchy success of ethical sourcing initiatives’’, *Journal of Business Ethics*, Vol. 44 No. 2/3, pp. 159-70.

Roberts, S., Lawson, R. and Nicholls, J. (2006), “Generating regional-scale improvements in SME corporate responsibility performance: lessons from Responsibility Northwest”, *Journal of Business Ethics*, Vol. 67 No. 3, pp. 275-286.

Roome, N. and Wijen, F. (2006), “Stakeholder power and organizational learning in corporate environmental management”, *Organization Studies*, Vol. 27 No. 2, pp. 235-263.

Rose, C.M., Stevels, A.L.N. and Ishii, K. (2000), "A new approach to end-of-life design advisor (ELDA)", *Proceedings of the 2000 IEEE International Symposium on Electronics and the Environment*, pp. 99-104. IEEE. 08-10 May, 2000, San Francisco, CA.

Roy, R. and Whelan, R.C. (1992), “Successful recycling through value-chain collaboration”, *Long Range Planning*, Vol. 25 No. 4, pp. 62-71.

Sabari, R.P., Xavier, M.J. and Israel, D. (2012), “Green Purchasing Practices: A study of E-Procurement in B2B Buying in Indian Small and Medium Enterprises”, *Journal of Supply Chain and Operations Management*, Vol.10 No.1, pp. 13-23.

Santos, G., Mendes, F. and Barbosa, J. (2011), “Certification and integration of management systems: the experience of Portuguese small and medium enterprises”, *Journal of Cleaner Production*, Vol. 19, pp. 1965-1974.

Sarkis, J., Zhu, Q. and Lai, K-H. (2011), “An organizational theoretic review of green supply chain management literature”, *International Journal of Production Economics,* Vol. 130 No.1, pp. 1-15.

Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students (Fifth Edition)*. London: Prentice Hall.

Schaper, M. (2002), "The challenge of environmental responsibility and sustainable development: Implications for SME and entrepreneurship academics", [online] Available at: http://www.kmu.unisg.ch/rencontres/band2002/F_09_Schaper.pdf.

Schischke, K., Hagelüken, M. and Steffenhagen, G. (2005), *An introduction to EcoDesign Strategies – Why, what and how?*, Presentations at Workshops on Awareness Raising Campaign for Electrical & Electronics SMEs. September, 12, 2005, Brussels. [online] Available at: http://www.ecodesignarc.info/.

Sengenberger, W., Loveman G. and Piore, M.J. (eds.) (1990), *The Re-emergence of Small Enterprise: Industrial Restructuring in Industrialized Countries.* Geneva: International Institute of Labour Studies.

Seuring, S., Muller, M. and Morana, R. (2006), “Case study research in the field of sustainable supply chain management”, in Mendibil, K. and Shamsuddin, A. (eds.). *Moving Up the Value Chain*, Vol. 2, pp. 747-756. Glasgow: University of Strathclyde.

Sharma, S. (2000), “Managerial interpretations and organizational context as predictions of corporate choice of environmental strategy”, *Academy of Management Journal*, Vol. 43 No. 4, pp. 681-697.

Sharma, S. and Henriques, I. (2005), “Stakeholder influences on sustainability practices in the Canadian forest products industry”, *Strategic Management Journal*, Vol. 26, pp. 159-180.Sheehan, K. (2001), “E-mail survey response rates: a review”, *Journal of*

Computer-Mediated Communication. Vol. 6 No. 2 [online] Available at: http://jcmc.indiana.edu/vol6/issue2/sheehan.html.

Shi, J.T. (2005), "Pollution in cities and seas the toughest clean-up task", *South China Morning Post*, 3 June. [Online] Available at: http://www.scmp.com/article/502993/pollution-cities-and-seas-toughest-clean-task

Sidiropoulos, M., Mouzakitis, Y., Adamides, E. and Goutsos, S. (2004), "Applying sustainable indicators to corporate strategy: the eco-balanced scorecard", *Environmental research, Engineering and Management*, Vol. 1 No. 27, pp. 28-33.

Silverman, D. (2009), *Doing Qualitative Research, 3rd edition.* London: Sage.

Sisaye, S. (2012), "An ecological analysis of four competing approaches to sustainability development: Integration of industrial ecology and ecological anthropology literature", *World Journal of Entrepreneurship, Management and Sustainable Development*, Vol. 8 No. 1, pp. 18-35.

Skrentny, J. D. (1993), "Concern for the environment: A cross-national perspective", *International Journal of Public Opinion Research*, Vol. 5 No. 4, pp. 335-352.

Society of Environmental Toxicology and Chemistry (SETAC) (1993), *Guidelines for Life-Cycle Assessment: A code of practice.* Workshop report. Pensacola, FL: SETAC.

Spence, L. (1999), ''Does size matter? The state of the art in small business ethics'', *Business Ethics: A European Review*, Vol. 8 No. 3, pp. 163-172.

Spiegelman, J. (2003), "Beyond the food web: connections to a deeper industrial ecology", *Journal of Industrial Ecology,* Vol. 7 No. 1, pp.17-23.

Srivastava, S. (2007), "Green supply-chain management: A state-of-the-art literature review", *International Journal of Management Reviews*, Vol. 9 No. 1, pp. 53-80.

Stake, R.E. (1995), *The Art of Case Study Research*. London: Sage.

Stanworth, J., Curran, J., and Hough, J. (1983), "The franchised small enterprise: Formal and operational dimensions of independence", in Lewis, J. Stanworth, J and Gibb, A. (Eds.) *Success and Failure in Small Business*, Aldershot, UK: Gower Publishing.

State Economic and Trade Commission (2011), “Interim provisions of the small and medium sized enterprises standard”, State Economic and Trade Commission, Beijing [online] Available at: www.chinacp.org.cn.

Streiner, D.L. and Norman, G.R. (1989), *From Health Measurement Scales: A Practical Guide to Their Development and Use*. New York: Oxford University Press.

Studer, S., Tsang, S., Welford, R. and Hills, P. (2008), “SMEs and voluntary environmental initiatives: a study of stakeholders’ perspectives in Hong Kong”, *Journal of Environmental Planning and Management*, Vol.51 No.2, pp.285–301

Suklev, B. (1997), *TQM and Stakeholde*r, Proceedings of the Second International and Fifth National Research Conference on Quality Management, pp. 223. February 8-11. Australia: Quality Management Research Unit, Monash University.

Sun, L. (2000), “Anticipatory Ownership Reform Driven by Competition: China’s Township-Village and Private Enterprises in the 1990s”, *Comparative Economic Studies*, Vol. 42, No. 3, pp. 49-75.

Sun, X. H. (2008), “SEPA Urges Multinationals to Clean Up Their Acts”, *China Daily*, 10 January. [Online] Available at: http://www.chinadaily.com.cn/bizchina/2008-01/10/content_6384885.htm

Swift, L. and Piff, S. (2010), *Quantitative Methods: for Business, Management and Finance*. Hampshire: Palgrave Macmillan.

Szymankiewicz, J. (1993), "Going green: the logistic dilemma", *Logistics Information Management*, Vol. 6 No. 3, pp. 36-43.

Taha, Z., Gonzales, G., Sakundarini, N., Ariffin, R. and Hanim, S. (2010), “Optimization of product design to reduce environmental impact of machining”, *Proceedings of the 11th Asia Pacific Industrial Engineering and Management Systems Conference*, Melaka.

Tao, J.K. and Jiang, C.M (1999), *The Introduction to World Economics*, Tianjing: Tianjin People’s Publishing House.

Taylor-Powell, E. and Renner, M. (2003), “Analysing Qualitative Data”, Program Development & Evaluation, University of Wisconsin-Extension. (G3658-12). [online] Available at: http://learningstore.uwex.edu/assets/pdfs/g3658-12.pdf

Taylor, S. and Berridge, V. (2006), “Medicinal plants and malaria: an historical case study of research at the London School of Hygiene and Tropical Medicine in the twentieth century”, *Transactions Of The Royal Society Of Tropical Medicine And Hygiene,* Vol. 100 No. 8, pp. 707-714.

Tellis, W. (1997), “Introduction to case study”, *The Qualitative Report,* Vol. 3 No. 2 [online] Available at: http://www.nova.edu/ssss/QR/QR3-2/tellis1.html.

Testa, F. and Iraldo, F. (2010), "Shadows and lights of GSCM (Green Supply Chain Management): determinants and effects of these practices based on a multi-national study", *Journal of Cleaner Production*, Vol. 18, pp. 9533-962.

Theyel, G. (2001), "Customer and supplier relations for environmental performance", *Greener Management International*, Vol.35, Autumn, pp. 166-186.

Theyel, G. (2006), “Customer and supplier relations for environmental performance”*,* in Sarkis, J. (ed.), *Greening the Supply Chain*, pp. 139-150. Berlin: Springer.

Thompson, J. and Smith, H. (1991), ‘‘Social responsibility and small business: suggestions for research’’, *Journal of Small Business Management*, Vol. 29 No. 1, pp. 30-45

Tian, F. (2010), “Current development of small and medium-sized enterprises and their influences on economy and society”, *China Statistics*, Vol. 10, pp. 53-55.

Triandis, C. (2000), “Dialectics between cultural and crosscultural psychology”, *Asian Journal of Social Psychology*, Vol. 3, pp. 185-195.

Tseng, M.L., Divinagracia, L. and Divinagracia, R. (2009), "Evaluating firm’s sustainable production indicators in uncertainty", *Computers & Industrial Engineering*, Vol. 57, pp.1393-1403.

Turner, J.R. (1993), “Integrated supply chain management: what’s wrong with this picture”, *Industrial Engineering*, December, pp.52-55.

Ulhoi, J.P. (1997), *A Stakeholder Approach to Green Innovation Management*, Proceedings of the Fourth International Decision Meeting, Decision Science Institute, pp. 74. July 20-23, Sydney.

United Nations (1992), “*Agenda for the 21st Century (Agenda 21)*”, UN Conference on Environment and Development, 3-14 June, 1992, Rio de Janeiro, Brazil.

United Nations World Commission on Environment and Development (WCED) (1987), *Our Common Future,* Oxford: Oxford University Press.

Vachon, S. and Klassen, R.D. (2006), "Extending green practices across the supply chain: the impacts of upstream and downstream integration", *International Journal of Operations and Production Management*, Vol. 26 No. 7, pp. 795-821.

Vancheswaran, A. and Gautam, V. (2011), "CSR in SMEs: Exploring a Marketing Correlation in Indian SMEs", *Journal of Small Business and Entrepreneurship*, Vol.24 No.1, pp. 85-98.

Verband der Automobilindustrie (VDA) (2002), Annual Report [online] Available at: http://www.vda.de/en/publikationen/publikationen_downloads/detail.php?id=1034.

Verschoor, A.H. and Reijnders, L. (1999), "The use of life cycle methods by seven major companies", *Journal of Cleaner Production*, Vol. 7, pp. 375-382.

Veshagh, A. and Li, W. (2006), "Survey of Eco-design and Manufacturing in Automotive SMEs", *Proceedings of 13th CIRP International Conference on Life Cycle Engineering,* pp. 305-310. [online] Available at: http://www.mech.kuleuven.be/lce2006/110.pdf

Vigon, B.W., Tolle, D.A., Cornary, B.W. and Latham, H.C. (1993), *Life Cycle Assessment: Inventory Guidelines and Principles*, US EPA, Document EPA/600/R-92/245, Cincinnati, OH [online] Available at: http://www.epa.gov.

Vives, A. (2006), "Social and environmental responsibility in small and medium-sized enterprises in Latin America", *Journal of Corporate Citizenship*, Vol. 21, pp. 39-50.

Vogel, D. (2005), *The Market for Virtue: The Potential and Limits of Corporate Social Responsibility*. Washington, DC: Brookings Institute.

Walker, D.H.T. (2000), "Client/customer or stakeholder focus? ISO 14000 EMS as a construction industry case study", *The TQM Magazine*, Vol. 12 No. 1, pp. 18-25.

Walker, H., Di Sisto, L. and McBain, D. (2008), "Drivers and barriers to environmental supply chain management practices: lessons from the public and private sectors", *Journal of Purchasing and Supply Management*, Vol. 14 No. 1, pp. 69-85.

Walley, N. and Whitehead, B. (1994), "It's not easy being green", *Harvard Business Review*, Vol. 72, pp. 46-52.

Walton, C.C. (1967), *Corporate Social Responsibilities*. Belmont, CA: Wadsworth Publishing.

Walton, S.V., Handfield, R.B. and Melnyk, S.A. (1998), "The green supply chain: integrating suppliers into environmental management processes", *Journal of Supply Chain Management*, Vol. 34 No. 2, pp. 2-11.

Watts, J. (2008), "China's biggest plastic bag maker closes after ban", *The Guardian*, 27 February [online] Available at: http://www.guardian.co.uk/world/2008/feb/27/china.plasticbags.

Weitz, K., Barlaz, M., Ranjithan, R., Brill, D., Thorneloe, S. and Hanm, R. (1999), "Life cycle management of municipal solid waste", *The International Journal of Life Cycle Assessment*, Vol. 4, pp. 195-201.

Welford, R. (2002), "Globalisation, corporate social responsibility and human rights", *Corporate Social Responsibility and Environmental Management*, Vol. 9 No. 1, pp. 1-8.

Wengraf, T. (2001), *Qualitative Research Interviewing*. London: SAGE Publications.

Wernick, I.K. and Ausubel, J.H. (1997), *Industrial Ecology: Some Directions for Research,* Report commissioned by the Energy and Environmental Systems Division, Lawrence Livermore National Laboratory, Livermore, CA, U.S. Department of Energy.

Wolters, T. (2003), "Transforming international product chains into channels of sustainable production. The imperative of sustainable chain management", *Greener Management International*, Vol. 43, pp. 6-13.

Wooi, G.C. and Zailani, S. (2010), "Green supply chain initiatives: investigation on the barriers in the context of SMEs in Malaysia", *International Business Management*, Vol. 4 No. 1, pp. 20-27.

World Bank (2001), *China: air, land and water: environmental priorities for a new millennium*. Washington, DC: The World Bank.

World Commission for Environment and Development (WCED) (1987), *Our Common Future*. Oxford: Oxford University Press.

Wu, H.J. and Dunn, S.C. (1995), "Environmentally responsible logistics systems", *International Journal of Physical Distribution and Logistics Management,* Vol. 25, pp. 20-38.

Wycherley, I. (1999), "Greening supply chains: the case of the body shop international", *Business Strategy and the Environment*, Vol. 8, pp. 120-127.

Yin, R.K. (2003), *Case Study Research: design and methods (applied social research methods). 3rd ed.*, Thousand Oaks: Sage.

Zaidah Z. (2003), "*An Investigation into the effects of discipline-specific knowledge, proficiency and genre on reading comprehension and strategies of Malaysia ESP students*", PhD Thesis, University of Reading.

Zhang, H. Y. (2005). *The Report of Private Enterprises Development in China.* Beijing: Social Science Academic Press.

Zhu, Q and Geng, Y. (2001), "Integrating environmental issues into supplier selection and management: a study of large and medium-sized state-owned enterprises in China", *Greener Management International*, Vol. 9 No. 3, pp. 27-40.

Zhu, Q. and 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*, Vol. 22, pp. 265-289

Zhu, Q. and Sarkis, J. (2006), "An inter-sectoral comparison of green supply chain management in China: Drivers and practices", *Journal of Clean Production*, Vol. 14, pp. 472-486

Zhu, Q. and Sarkis, J. (2007), "The moderating effects of institutional pressures on emergent green supply chain practices and performance", International Journal of Production Research, Vol. 45 No. 18/19, pp. 4333-4355.

Zhu, Q., Sarkis, J. and Geng, Y. (2005), "Green supply chain management in China: pressures, practices, and performance", International Journal of Operations and Production Management, Vol. 25 No. 5, pp. 449-468.

Zhu, Q., Sarkis, J. and Lai, K. (2007), "Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers", *Journal of Operations Management*, Vol. 85, pp. 179-189

Zhu, Q., Sarkis, J. and Lai, K. (2008), "Green supply chain management implications for 'closing the loop' ", *Transportation Research Part E*, Vol. 44, pp. 1–18.

Zhu, Q., Geng, Y., Fujita, T and Hashimoto, S. (2010), "Green supply chain management in leading manufacturers: case studies in Japanese large companies", *Management Research Review*, Vol. 33 No. 4, pp. 380-392.

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

Zsidisin, G.A., and Hendrick, T.E. (1998), "Purchasing's involvement in environmental issue: a multi-country perspective", *Industrial Management and Data Systems*, Vol. 7, pp. 313-320.

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

Appendix –Survey Questionnaire

SECTION A

Enterprise Information

1. How old is your enterprise?

_____ years

2. How many employees does your enterprise have?

_____ employees

3. What are the total assets of your enterprise (in million RMB)?

_____million RMB

4. What was the turnover of your enterprise in the last financial year (in million RMB)?

_____million RMB

5. In which sector of manufacturing industry does your enterprise operate?

☐Food and Drink ☐Clothing, Textile and Tannery ☐Wood processing and Furniture ☐Print ☐Pharmaceutical ☐Chemical ☐Rubber and Plastic ☐Metal ☐Transport facility ☐Machinery and equipment ☐Electronics facility

6. Where is your enterprise located?

_____

SECTION B

GSCM Pressures

Please indicate the extent to which you agree or disagree with each of the following statements below based on the conditions of your enterprise by using the scale below to circle the appropriate number from 1 to 5.

1		2	3	4	5				
Strongly Disagree		**Disagree**	**Neither Agree Nor Disagree**	**Agree**	**Strongly Agree**				
7.	State environmental laws put pressure on our GSCM, such as “The Law on Environmental Protection of the People's Republic of China”, “The Law of the People's Republic of China on Promoting Clean Production” and so on.					1	2	3	4	5
8.	National laws on resource conservation put pressure on our GSCM.					1	2	3	4	5
9.	Local environmental laws put pressure on our GSCM.					1	2	3	4	5
10.	Local laws on resource conservation put pressure on our GSCM.					1	2	3	4	5
11.	Environmental regulations from the import countries put pressure on our GSCM, such as《WEEE》,《ROHS》,《EuP》and so on.					1	2	3	4	5
12.	The overseas enterprises located in China and joint ventures which purchase our products put pressure on our GSCM.					1	2	3	4	5
13.	The environmental protection demands from our domestic customers put increasing pressure on our GSCM.					1	2	3	4	5
14.	The increasing environmental awareness of the end consumers put pressure on our GSCM.					1	2	3	4	5
15.	Our enterprise is under the pressure of building green brand to our GSCM.					1	2	3	4	5
16.	Our enterprise is under the pressure of establishing green corporate image to our GSCM.					1	2	3	4	5

17.	The increase of environmental awareness of the society boosts pressure on our GSCM.	1	2	3	4	5
18.	The collaboration in environment with our suppliers boosts pressure on our GSCM.	1	2	3	4	5
19.	The improvements in developing green products of our suppliers boost pressure on our GSCM.	1	2	3	4	5
20.	The improvements in products green packaging of our suppliers boost pressure on our GSCM.	1	2	3	4	5
21.	The green strategy of the manufacturers who produce the same products as us boost pressure on our GSCM.	1	2	3	4	5
22.	The green strategy of the manufacturers who produce the substitute products as us boost pressure on our GSCM.	1	2	3	4	5
23.	The requirements of green development from the industry association boost pressure on our GSCM.	1	2	3	4	5
24.	Our environmental vision drives our GSCM.	1	2	3	4	5
25.	The support of the green strategy from the top management drives our GSCM.	1	2	3	4	5
26.	The approval of the green strategy from our employees drives our GSCM.	1	2	3	4	5
27.	The implementation of green strategy from our employees drives our GSCM.	1	2	3	4	5
28.	Our enterprise has human resource for GSCM which provides drive to our GSCM.	1	2	3	4	5
29.	Our enterprise has special budget for green products development which provides drive to our GSCM.	1	2	3	4	5
30.	Our enterprise has special budget for environmental management which provides drive to our GSCM.	1	2	3	4	5
31.	Our enterprise has pollution preventive budget which provides drive to our GSCM.	1	2	3	4	5
32.	Our enterprise has pollution disposal budget which provides drive to our GSCM.	1	2	3	4	5
33.	Our enterprise has by-products disposal budget and scheme which provides drive to our GSCM.	1	2	3	4	5
34.	Our products have healthy corporate image, which provides drive to our GSCM.	1	2	3	4	5

35.	Our products have green trademarks, which provides drive to our GSCM.	1	2	3	4	5

SECTION C

GSCM Practices

Please indicate the extent to which you agree or disagree with each of the following statements below based on the conditions of your enterprise by using the scale below to circle the appropriate number from 1 to 5.

1	2	3	4	5
Strongly Disagree	**Disagree**	**Neither Agree Nor Disagree**	**Agree**	**Strongly Agree**

36.	Our enterprise has clear requirements of environmental protection in the products design book to our suppliers.	1	2	3	4	5
37.	Our enterprise actively collaborates with the suppliers for environmental protection goals.	1	2	3	4	5
38.	Our enterprise has regular environmental audit to the suppliers.	1	2	3	4	5
39.	Our enterprise always selects suppliers with ISO14001 certificate.	1	2	3	4	5
40.	Our enterprise does assessment to the environment-friendly practices to our secondary suppliers (suppliers' suppliers).	1	2	3	4	5
41.	Our enterprise has just-in-time logistics system.	1	2	3	4	5
42.	Our enterprise always makes demands on our suppliers to use green packaging.	1	2	3	4	5
43.	Our enterprise actively collaborates with the suppliers to use less packaging materials.	1	2	3	4	5
44.	Our enterprise always considers the conservation of energy and resource	1	2	3	4	5

	in products design phase.					
45.	Our enterprise always considers the recycling in products design phase.	1	2	3	4	5
46.	Our enterprise always considers avoiding using or using fewer raw materials which will put negative impact on environment in products design phase.	1	2	3	4	5
47.	Our enterprise always considers avoiding putting or reducing the negative influence on environment caused by the production process in design phase.	1	2	3	4	5
48.	Our enterprise always considers avoiding using or using less packaging which will put negative impact on environment in products design phase.	1	2	3	4	5
49.	Our enterprise always considers the minimum waste production in the technological process of production.	1	2	3	4	5
50.	Our enterprise recycles or sells by-products in the production process.	1	2	3	4	5
51.	Our enterprise uses disposal systems of waste water in the production process.	1	2	3	4	5
52.	Our enterprise uses disposal systems of waste emission in the production process.	1	2	3	4	5
53.	Our enterprise uses disposal systems of waste rejectamenta in the production process.	1	2	3	4	5
54.	Our enterprise is quick to adjust the equipment amount in the production process.	1	2	3	4	5
55.	Our enterprise actively collaborates with our customers on Eco design.	1	2	3	4	5
56.	Our enterprise actively collaborates with our customers on clean production.	1	2	3	4	5
57.	Our enterprise actively collaborates with our customers on green packaging.	1	2	3	4	5
58.	Our enterprise actively collaborates with our customers on green logistics.	1	2	3	4	5
59.	Our enterprise actively collaborates with our customers on reclaiming seconds and used products.	1	2	3	4	5
60.	Our enterprise actively collaborates with our customers on reclaiming stocks.	1	2	3	4	5
61.	Our top managers make active commitment to environmental management.	1	2	3	4	5
62.	Our top managers fully take environmental issues into considerations when making big decisions for the enterprise.	1	2	3	4	5

63.	Our middle managers give active support to environmental management.	1	2	3	4	5
64.	Our enterprise has staff training program of environmental management.	1	2	3	4	5
65.	Different departments within our enterprise actively cooperate with each other on environmental management.	1	2	3	4	5
66.	Our enterprise strictly complies and implements with related environmental regulations and requirements.	1	2	3	4	5
67.	Our enterprise updates and learns latest environmental protection policies.					
68.	Our enterprise has got ISO14001 certification.	1	2	3	4	5
69.	Our enterprise has Total Quality Environmental Management system.	1	2	3	4	5
70.	Our enterprise has the monitoring system of Total Quality Environmental Management.	1	2	3	4	5
71.	Related departments of the enterprise solve problems and make improvements in time when problems found.					
72.	Our enterprise has got ISO9000 certification.	1	2	3	4	5
73.	Our enterprise has pollution prevention scheme.	1	2	3	4	5
74.	Our products have got related Eco trademarks.	1	2	3	4	5
75.	The environmental performance is taken into consideration to the internal performance evaluation of our enterprise.	1	2	3	4	5
76.	The environment report is created as a part of internal assessment of our enterprise.	1	2	3	4	5
77.	Our enterprise has rewards and punishment systems to the environmental performance of our top managers.	1	2	3	4	5
78.	Our enterprise has rewards and punishment systems to the environmental performance of our middle managers.	1	2	3	4	5
79.	Our enterprise has rewards and punishment systems to the environmental performance of our employees.	1	2	3	4	5
80.	The cost of social responsibility has been incorporated into accounting.	1	2	3	4	5

SECTION D

GSCM Performances

Please indicate the extent to which you agree or disagree with each of the following statements below based on the conditions of your enterprise by using the scale below to circle the appropriate number from 1 to 5.

1		2	3	4	5			
Strongly Disagree		**Disagree**	**Neither Agree Nor Disagree**	**Agree**	**Strongly Agree**			
81.	Our enterprise has an emission reduction after GSCM adoptions.				1	2	3	4	5
82.	Our enterprise has a wastewater reduction after GSCM adoptions.				1	2	3	4	5
83.	Our enterprise has a solid waste reduction after GSCM adoptions.				1	2	3	4	5
84.	Our enterprise reduced to use materials which have negative impact on environment after GSCM adoptions.				1	2	3	4	5
85.	Our enterprise has lower incidence of environmental accidents after GSCM adoptions.				1	2	3	4	5
86.	Our enterprise has improved environment after GSCM adoptions.				1	2	3	4	5
87.	Our enterprise has increased environmental investment after GSCM adoptions.				1	2	3	4	5
88.	Our enterprise has increased operating costs after GSCM adoptions.				1	2	3	4	5
89.	Our enterprise has increased training costs after GSCM adoptions.				1	2	3	4	5
90.	Our enterprise has increased costs to purchase environmentally friendly materials after GSCM adoptions.				1	2	3	4	5
91.	Our enterprise has a cost reduction by using recycled materials after GSCM adoptions.				1	2	3	4	5

92.	Our enterprise has a cost reduction of energy consumption after GSCM adoptions.	1	2	3	4	5
93.	Our enterprise has a cost reduction of waste disposal after GSCM adoptions.	1	2	3	4	5
94.	Our enterprise has a cost reduction of waste discharge after GSCM adoptions.	1	2	3	4	5
95.	Our enterprise has decreased fines for environmental incidents after GSCM adoptions.	1	2	3	4	5
96.	Our enterprise has increased number of products that can be timely delivered after GSCM adoptions.	1	2	3	4	5
97.	Our enterprise has a reduction in inventory after GSCM adoptions.	1	2	3	4	5
98.	Our enterprise has a reduction in scrap after GSCM adoptions.	1	2	3	4	5
99.	Our enterprise has improved the products quality after GSCM adoptions.	1	2	3	4	5
100	Our enterprise has improved the efficiency of production lines after GSCM adoptions.	1	2	3	4	5