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Pressures on Green Supply Chain Management: A Study on Manufacturing Small and Medium-Sized Enterprises in China

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Abstract

This study aims to empirically investigate the pressures for adopting green supply chain management (GSCM) among Chinese small and medium-sized enterprises (SMEs). Data is collected through the use of mail distributed questionnaires administered to participants at a national trade fair held in Suzhou and two rounds of data collection were carried out to make a more reliable result for the research. ANOVA and Factor analysis are used to analyze the data. Some key findings are found from this study. Firstly, there is indifference among the four industrial sectors in terms of facing pressures in adopting GSCM practices. Secondly, all of the pressures from environmental laws and regulations, the pressures in the process of selling the products and the pressures in the supply chain in the relation with the suppliers and customers have impacted on the decisions of SMEs to employ GSCM practices. The main limitation to this paper is the relatively small manufacturing sample of SMEs. The paper explores the GSCM pressures faced by Chinese SMEs which may be different from the findings through the studies on large enterprises in China.

Key words: Supply chain management; Pressures on green supply chain management small and medium-sized enterprises; Chinese manufacturing industry

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INTRODUCTION

With the globalization of economies, supply chain management has become a promising area in achieving sustainability due to international environmental pressures and the concept of "green supply chain management (GSCM)". As stated by Wycherly (1999), the management of the supply chain is an important element that can help businesses to lower their environmental and social costs.

Facing an increasingly competitive global market, in order to achieve the balance of cost reduction, economic growth and environmental friendship, a number of large multinational enterprises have established networks of their suppliers globally to increase their competitiveness. As such, an increasing number of Chinese enterprises are continually looking at prevalent strategies to improve their supply chain systems for the purpose of cutting costs, increasing productivity and improving environmental performance.

The larger businesses have been the pioneers in embracing the concept of GSCM and the focus of numerous studies (Henriques and Sadorsky, 1996; Wycherley, 1999; Zhu, and Sarkis, 2004). In contrast, very few studies, if any, have been carried out on small and medium-sized enterprises (SMEs). With increasingly globalised economy and integrated international supply chain, GSCM for SMEs in China has become more and more important in the global market. However, SMEs, due to their various constraints – finance, infrastructure, human resources and so on – have found that it is significantly difficult to adopt GSCM strategies effectively. This underlies the impor-

tance of this research.

The aim of this study is to find out whether the Chinese SMEs are currently under pressures or whether they have motivations to implement GSCM strategies, and to identify the influencing factors to the motivations. In addition, how the pressures or motivations influence the development of these enterprises in different sectors are also investigated. The study is conducted in the Chinese context because many multinational enterprises which effectively implement GSCM have opened plants in China and a large number of Chinese SMEs are or will be involved in these businesses as suppliers. As a result, these SMEs have or will become part of these supply chains. Therefore, it is necessary to investigate into these Chinese SMEs to identify the problems or barriers to the development of GSCM strategies and to propose approaches to improve the development of the strategies.

The first part of the paper will discuss the related literatures, including SMEs and green supply chain management. Next, the research methodology will be discussed, followed by a presentation of key findings and analysis. The paper is then concluded with directions for future research.

1. RELEVANT RESEARCH

It has been a consensus among the academics and researchers that there is no uniform definition for a small and medium-sized enterprise (SME) nationally or internationally and definitions vary from country to country (Do, et al, 2006; Eikebrokk and Olsen, 2007; Mohibul and Alejandra, 2008). As this study is conducted in the Chinese context, the definition used in China is of great importance for the investigation. This research has used the definition of SME by the Chinese government as shown in Table 1 (The State Economic and Trade Commission, 2011). This research focuses on manufacturing companies, explicitly, the SMEs who have no more than 2,000 employees and their total assets are no more than 400 million RMB with an annual profit no more than 300 million RMB.

Table 1

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).

The environmental concern in the framework of supply chain management consists the use of natural resources, carbon emission, waste, hazardous substances, energy use, loss of biodiversity and deforestation, nuclear radiation, ozone depletion and global warming. The green issues are considerably growing with the developing arguments upon how industry faces the changes of sustainability (Faisal, 2010). According to Schaper (2002), "green" supply chain management has continued to develop during the past forty years and the history of the development of "green supply chain management" can be divided into several stages. The importance of environmental factors to economic development is first highlighted in the developed countries in the 1960s. In the following decade, the governments from the developed nations and regions responded by putting increasing attention to the environmental concern through enacting laws to protect the environment (Scott, 2009). Many senior managers and entrepreneurs began to accept the idea of sustainable development from the 1980s. Since then, researchers began to pay more attentions to the "green" issues. However, only large enterprises have been studied, while SMEs have so far been neglected.

Due to increasing concerns on environmental improvement, many researchers have provided explanations of GSCM implementations for enterprises. For example, according to Henriques and Sadorsky (1996), there were four important environmental stakeholder groups which could exert pressures on enterprises to adopt GSCM practices: regulatory stakeholders, organizational stakeholders, community groups and environmental. There are also others, including the media, while Hall (2000) pointed out the importance of GSCM pressures from the customers of large enterprises. However, as pointed by Singh (2011),

SMEs have played a mainstay role for economic growth in all nations and they are facing a challenge of environment protection with globalization. Therefore, it provides an opportunity to investigate the relationship between SMEs and GSCM to the researchers.

With regards to the development of GSCM in China, very little research have been carried out to study the GSCM adoption and implementation (Zhu and Sarkis, 2004, 2006; Zhu et al., 2008). While Zhu et al. (2006) attempted to study the pressures of GSCM in the Chinese context; they only managed to focus on three industries: automobile industry, thermal power industry and electronic industry, while covering enterprises from a range of diverse sizes. Furthermore, they classified the pressures that the enterprises were facing into five categories: regulations, marketing, suppliers, competitors, and other internal factors. Also, these studies focused mainly on the pressures/drivers, practices and performances of GSCM among Chinese manufacturing enterprises and determined that Chinese enterprises, with higher levels of GSCM adoptions will have better environmental performance outcomes.

In addition, those enterprises that have higher level GSCM strategy adoption practices tend to report improved positive economic performance improvements (Zhu and Sarkis, 2004). Furthermore, in the Chinese context, there are differences in the drivers and pressures for GSCM strategy adoption, while the adoption rates also differ in different industries (Zhu and Sarkis, 2006). For example, the pressures and drivers for the automobile industry are greatest and the two most important facets are environmental regulations of the import countries and the export or sales to foreign customers. According to Zhu et al. (2008), the extent of GSCM practice adopted by Chinese organizations is positively related to the level of organizational learning capabilities and management support.

As part of the research, it can be concluded that relevant literatures on green supply chains for SMEs in China are scarce. Thus, work carried out and presented in this paper can contribute to the field of knowledge on GSCM, specifically the GSCM pressures faced by SMEs in China.

There are some considerations as to where the pressures of GSCM for SMEs come from. In addition to the environmental improvements, there may be potential pressures arising from regulations, sales and supply chains of SMEs. Firstly, Bai and Hidefumi (2001) argued that Chinese government has released tax policies and employed quota-pricing regulations to control overexploitation and overconsumption of resource like water. Zhu et al. (2005), on the other hand, added that developed countries such as Japan, the United States, the Netherland, Norway, France and Sweden have proposed their environmental regulatory requirements for importing fabrics and dyes of clothes from China. Secondly, the growing environmental awareness among Chinese consumers, especially for those younger consumers may result in higher pressures for Chinese SMEs to manufacture green products (Lo and Leung, 2000). Thirdly, supplier pressures may also exist for Chinese SMEs to engage in GSCM activities. For example, Zhu and Geng (2001) found that many foreign direct investment (FDI) enterprises in China preferred to purchase raw materials from their home countries or from their upstream enterprises in their supply chain which have already operated in China as they doubted the ability of Chinese enterprises to provide environmentally-friendly or ecologically-friendly products for them. Given these arguments, the pressures from regulations, sales and supply chain to manufacturing SMEs will be examined in this study and it seeks to determine where the pressures come from for Chinese SMEs to adopt GSCM practices.

2. RESEARCH METHODOLOGY

Questionnaire survey is used in this study. Survey strategy is popular and commonly used in business and management research (Saunders et al., 2009) and, is favorably welcomed among researchers for several reasons. Survey is quite helpful to obtain straightforward information from the respondents (McIntyre, 2005) and allows researchers to obtain data from a large number of samples in a cost-efficient way (Easterby-Smith et al. 2002). In addition, the findings from a survey are likely to be used as the representative of the whole population but it is highly economical to sample rather than to target on the whole population. Another interesting point is that surveys are always regarded as authoritative by common people, as they are relatively easier to explain and to understand in comparison to other data collection techniques.

During the first round of data collection, 100 SMEs were randomly chosen from the list of exhibiters at the 2010 China Suzhou International SME Fair. The questionnaires were sent to the SMEs through emails. 22 copies of the questionnaire were returned and the data output was then processed. The statistical analyzing software, SPSS, is used to analyze the data collected. Explicitly, analysis of variance (ANOVA) and factor analysis are used in this study. In the second round, 40 other SMEs exhibiters who are from the original 100 SMEs chosen, but did not return the first round of questionnaires, were resent the questionnaires. The participants were not randomly chosen this time and ten SMEs each from the four different industrial sectors were selected with the aim to further verify whether there is any difference between each of the different industrial sectors. 11 SMEs responded and among them, which 3 are from Food and Drink sector, 1 from Clothing, Textile and Tannery sector, 4 from Electronics facility sector and another 3 from Wood processing and Furniture sector.

Combining the results from the two rounds of data

collection, a response rate of 33% is achieved. Also, the 33 SME respondents are from four different industrial sectors, including 12 from Food and Drink sector, 9 from Clothing, Textile and Tannery sector, 7 from Electronics facility sector and another 5 from Wood processing and Furniture sector.

Six questions are listed in the first section of the questionnaire to obtain the basic information of these enterprises, including "how old" the enterprises are, which sectors they operate in, as well as their location. The aim of asking for the numbers of their employees, the total assets and the annual turnover is to ensure that the respondents belong to the scope of SMEs. There are 17 questions in the questionnaire referring to the three kinds of pressures that the SMEs may face in the Chinese context; they are the pressures from environmental laws and regulations, the pressures in the process of selling the products and the pressures in the supply chain in relation to the suppliers and customers of these SMEs. The three pressures are identified according to the process of the production, from the designing to the end user. Besides, these are the pressures incurred in many international journals (Christmann and Taylor, 2001; Del Brío JÁ and Junquera, 2003; King and Lenox, 2000; Lyon and Maxwell, 2000; Zhu and Geng, 2001). When using SPSS to analyse the data, all the variables should be coded. Therefore, the four sectors are labelled by 1, 2, 3, 4 respectively; in addition, the three kinds of pressures are also given 1, 2, 3 as coding for ANOVA and Factor analysis (see Table 2).

Table 2

	ANOVA	Factor Analysis
1	Food and Drink sector	Pressures from regulations
2	Clothing, Textile and Tannery sector	Pressures from sales
3	Electronics facility sector	Pressures from the supply chain
4	Wood processing and Furniture sector	

3. KEY FINDINGS FROM THE ANALYSIS OF THE SURVEY RESULT

This research tries to identify some of the pressures for Chinese SMEs in the manufacturing industry and whether SMEs from different sectors face different pressures on GSCM. SPSS is used to test the data and both ANOVA and Factor analysis are used to explain the data.

3.1 ANOVA Analysis

In order to test whether those SME respondents in this survey, who are from different industrial sectors differ from the pressures on GSCM in their operations, one-way ANOVA analysis is used to identify if there is a difference or not.

Findings

The Sig from the table of test of Homogeneity of Variances is 0.055, which is larger than the significance level 0.05. Thus, the population variances are the same for all the four different industrial sectors.

The four p-values (Sig.) from the F-test in the ANOVA table are more than 0.05, implying that there is no significant difference among SMEs from the four different industrial sectors in terms of feeling pressures to adopt GSCM practices (Table 3).

Table 3

Pressure Mean		ANOVA					
			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		.349	3	.116	1.270	.303
	Linear Term	Unweighted	.322	1	.322	3.515	.071
		Weighted	.348	1	.348	3.799	.061
		Deviation	001	2	000	005	995
Within Groups			2.655	29	.092		
Total			3.003	32			

All the Sig from the table below are larger than 0.05, which help to further verify that there is no significant difference between any two different industrial sectors of these SMEs, in terms of feeling pressures on GSCM

operations.

3.2 Factor Analysis

The number of variables of the questionnaires is directly proportionate to the detailed levels of the results. However, two issues arise when interpreting the data. First, plenty of variances will require an approximately analyzing work to be done. Second, there may be significant correlation between some variables, thus meaning that the statistical outputs are likely to be inaccurate. As a result, factor analysis is proposed to put some correlated factors together into one factor, helping to reduce the factors and to provide clearer evaluations. The seventeen questions asked about the pressures from the three factors are involved and factor analysis is used to provide an initial determination on whether the three kinds of pressures are fit for factor analysis and to also help in identifying what is/are the meaningful factor(s).

Findings

The Correlation Matrix presents the correlation coefficients between every two variables and their respective significance levels (Table 4). Factor analysis uses the correlation matrix to try to determine which sets of variables cluster together.

Table 4

		P1	P2	P3
Correlation	P1	1.000	.769	.594
	P2	.769	1.000	.528
	P3	.594	.528	1.000
Sig. (1-tailer)	P1		.000	.000
	P2	.000		.001
	P3	.000	.001	

a. Determinant=.259

In the upper part, SPSS presents correlation coefficients. Together with the significant levers, there is a great possibility that the pressures from laws and regulations, the pressures from sales are correlated, as well as the pressures from supply chain, as their respective Sig. are nearly zero and their respective correlation coefficients are higher than 0.5.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.677, indicating that the variables are suitable for factor analysis (Table 5). The Sig. is .000 thus concluding that the strength of the relationship among variables is strong, and that the variables are suitable for factor analysis.

Table 5

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.677
Bartlett's Test of Sphericity	Approx. Chi-Square	40.721
	df	3
	Sig.	.000

At the same time, the trend of Screen Plot chart (Figure 1) is almost flat from the second factor on, which verifies that the third factor accounted for a smaller amount of the total variance. Therefore, it can be determined that the first and second factors both make a significant contribution to the explanation of factor analysis

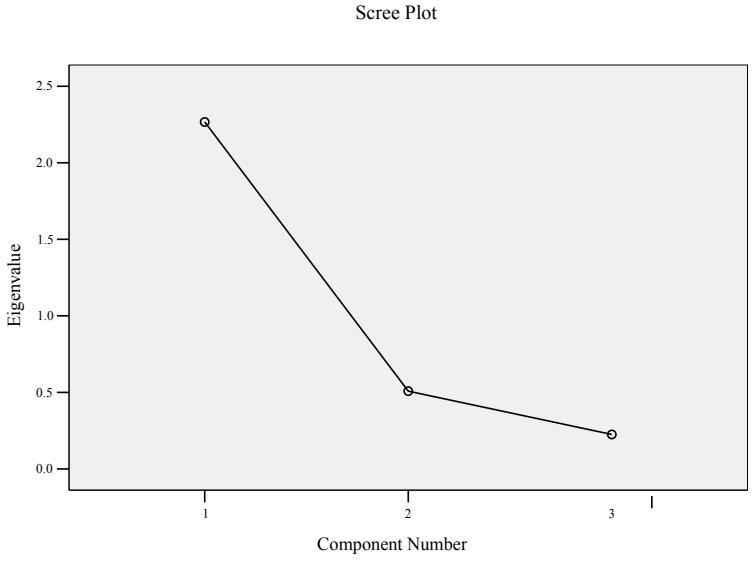

Figure 1

4. DISCUSSION

Three parameters from the one-way ANOVA analysis showed that there is no difference among the four industrial sectors in terms of facing pressures in adopting GSCM practices and the difference does not exist between each of the two sectors either. In other words, the possible conclusion is that although the SMEs in the four industrial sectors are different during production to meet environmental requirements, in sales and in dealing with their suppliers and customers, the differences did not result in different GSCM among them.

The research of Zhu et al. (2006) showed that only the "marketing" factor is verified as the significant difference among the three industries in adopting GSCM practices. Other visible findings include the automobile industry having the highest marketing pressures, much stronger than power plants and slightly stronger than the electronic industry. On the other hand, the automobile industry has slightly stronger internal pressures than the electronics industry. However, the findings of this research among SMEs did not identify similar differences. There might be two main reasons for it. Firstly, the two studies have different focus in terms of the size of the enterprises. This research focused on SMEs while Zhu et al. (2006) looked at enterprises of all sizes. Secondly, the data collected were from different industries or industrial sectors.

From the Factor analysis undertaken, it is believed that all the three pressures identified in this research have an impact on the SMEs to adapt to GSCM practices, with the environmental laws and regulations having the most significant influence, followed by pressures from sales.

Both central and local governments in China have been exerting increasingly heavier pressures on manufacturing enterprises these days through legislation. Moreover, Chinese enterprises are facing increasing pressures from their overseas suppliers or customers in view of fierce competition to meet the statutable requirements from their home countries, especially towards Chinese SMEs. Furthermore, more SMEs have been considering establishing green corporate image and setting up "green brands", which are also regarded as pressure from the sales operation. In addition, according to Bovea and Wang (2003), Chinese consumers are becoming more aware of green issues and are buying more environmental-friendly products and green goods. Therefore, obvious evidences have shown that pressures from legislation, sales and supply chain have put significant impact on Chinese SMEs with regards to GSCM.

CONCLUSION AND FUTURE RESEARCH

This study provided an attempt to examine the GSCM framework in the Chinese manufacturing SMEs. Academic research on GSCM for SMEs is still in the developmental stages and more analytical models will be taken into consideration to analyze and improve the theories of green supply chain management. However, this study is exploratory as little research has been conducted in Chinese SMEs and the findings from this research contribute to the theory of pressures from green supply chain management on enterprises, especially on SMEs.

The findings of this study are able to identify the pressures for SMEs to adopt GSCM practices by testing these variables, using a questionnaire survey of Chinese SMEs randomly chosen from the exhibiters at the 2010 China Suzhou International SME Fair. As GSCM is still a relatively new idea among Chinese SMEs, most of them lack experiences as well as theoretical knowledge to implement GSCM. However, pressures to the SMEs from Food and Drink sector, Clothing, Textile and Tannery sector, Electronics facility sector and Wood processing and Furniture sector are not different though they may be different during production to meet environmental requirements. Furthermore, the pressures from environmental laws and regulations having the most significant influence for Chinese manufacturing SMEs to adopt GSCM practices based on the findings of the study. Therefore, managers of Chinese SMEs can also use the findings from this study to innovate and improve their GSCM practices, while managers of international enterprises can draw references from the study for considerations when working with Chinese partners.

The limitation of this study may be argued to be the sample size of the survey; but it is also reasonable to stress the creditability and initiative of the study due to the homogeneous characteristics of Chinese SMEs. However, a larger number of samples will definitely provide a more creditable and useful source of reference. Future work can include GSCM studies on Chinese manufacturing SMEs to investigate the practices and performance in these enterprises. In addition, comparative analyses to large enterprises or to other countries could also prove beneficial.

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