

# Green Supply Chain Management Practices: A Sectoral Investigation into Manufacturing SMEs in China

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**Abstract.** Enterprises pay increasing attention to consider environmental concerns in their manufacturing activities with regard to their supply bases, making green supply chain management (GSCM) a hot topic for academic research and industrial practices. Some researchers become interested in investigating the pressures, practices and performance of GSCM among large enterprises with little research targeting at small and medium-sized enterprises (SMEs). The aim of this paper is to identify whether different SMEs differ in GSCM practices in terms of different sectors in the Chinese context. Research method of questionnaire survey through emails is used for this study and the respondents were chosen randomly from a SME fair in China. Data received from the recipients were processed on SPSS to conduct ANOVA to verify the proposition. The findings confirmed that SMEs from the four different industrial sectors, including Food and Drink sector, Clothing, Textile and Tannery sector, Electronics facility sector, and Wood processing and Furniture sector, differ in their GSCM practices. The results may be caused by factors including differing GSCM pressures or drivers.

**Keywords:** Supply chain management, green supply chain management practices, small and medium-sized enterprises; Chinese manufacturing industry

## 1. Introduction

Green supply chain management (GSCM) has drawn increasing attention among enterprises worldwide. Fierce global competition has pressured a number of large multinational enterprises to establish networks of their suppliers globally to increase their competitive ability, with the purpose of achieving cost reduction, economic growth and environmental friendship. Welford (2002) emphasized that this supply chain relationship has definitely become more critical in today's globalised world. Furthermore, Schaper (2002) summarized the development of green issues during the past fifty years as in Table 1.

Table 1

Time	Key Green Issue Developments
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1960s	Environmental concern emergency from some developed countries
1970s	Government policy initiatives and businesses exclusion
1980s-1990s	Sustainability acceptance and innovations from business senior managers and entrepreneurs
2010s	Fast growing and more systematical research from scholars

Source: Schaper (2002)

With regards to the situation in China, the membership of WTO has exerted more environmental pressures on Chinese enterprises, which have led their supply chains to become more complex and diverse. Large Chinese enterprises, like Guitang Group and Shuanghui Group, have been the pioneers in embracing the concept of GSCM and the focused of a number of surveys (Zhu and Sarkis, 2004; 2006, and Zhu, et al., 2007). However, the situations within the Chinese small and medium-sized enterprises (SMEs) are unclear. With the integration of the global economy, the formation and development of industry chain and industry integration, GSCM of Chinese SMEs had become a very important weight in the market competition. However, SMEs, due to their various constraints – finance, infrastructure, human resources and so on— have found it is significantly challenging to adapt GSCM effectively into their corporate strategies. This study aims to investigate into the Chinese manufacturing SMEs and identify how different SMEs differ in GSCM adoptions and practices in terms of different sectors.

In China, Zhu and Sarkis (2004) studied the relationships between GSCM practices and performance among those early adopters of Chinese enterprises. They compared the automobile, power plants and electronic industries in the Chinese context and found the three industries differ in GSCM practices adoption. From the research, they identified four kinds of GSCM practices, including internal environmental management, external environmental management, investment recovery and eco-design.

As this study is also conducted in the Chinese context, this classification of GSCM practices is used for the questionnaire design for this research. Moreover, the authors proposed the proposition of this research as follows:

**Proposition.** Chinese SMEs from different industrial sectors differ in adopting practices of GSCM.

## 2. Methodology

As part of the exploratory stage of the research, in order to test the proposition, the data collected by ways of a questionnaire survey and through two rounds of data collection was used. The questionnaire was targeted at SMEs from that attended the 2010 China Suzhou International SME Fair. The sample population for the study included 100 SMEs from four different industrial sectors, including Food and Drink sector, Clothing, Textile and Tannery sector, Electronics facility sector and Wood processing and Furniture sector. All the SMEs are contacted by email, together with the cover letter and the allotted time of questionnaire return was set for four months primarily. A total of 33 returned questionnaires contributed to a response rate of 33 per cent after 2 rounds of follow-ups.

The questionnaire includes 45 items of GSCM practices targeting at the five categories from the precedent research of Zhu and Sarkis (2008). The respondents were also required to answer the questions according to the Likert-scale standard: 1=strongly disagree, 2=disagree, 3=neutral; 4=agree, and 5=strongly agree. With regards to the analysis approach, a one-way analysis of variance (ANOVA) was employed to identify the differences that exist within the GSCM practices among the four industrial sectors. The four sectors (variables) are labelled by 1, 2, 3, 4 respectively (see Table 2).

Table 2

Coding	ANOVA
1	Food and Drink sector
2	Clothing, Textile and Tannery sector
3	Electronics facility sector
4	Wood processing and Furniture sector

## 3. Key Findings

As discussed above, ANOVA is used to analyze if the Chinese SMEs from different industrial sectors differ in their GSCM practices.

The Sig from the table of test of Homogeneity of Variances is 0.095 which is larger than the significance level 0.05 (Table 3). Thus, the population variances are the same for all the four different industrial sectors.

Table 3

**Test of Homogeneity of Variances**

Practices			
Levene Statistic	df1	df2	Sig.
2.151	3	176	.095

The F-statistic is 3.638 with the corresponding p-value (Sig.) of 0.014 which is smaller than the significance level 0.05, implying that at least there is one industrial sector have significant difference with the other three different industrial sectors of these SMEs in terms of adopting GSCM practices. However, which two industrial sectors having the difference cannot be identified from this F-test (Table 4).

Table 4

**ANOVA**

Practices						
		Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)	2.285	3	.762	3.638	.014
	Linear Term	.593	1	.593	2.834	.094
	Contrast					
	Deviation	1.692	2	.846	4.040	.019
Within Groups		36.849	176	.209		
Total		39.134	179			

The Multiple Comparison table shows the differences between each two industrial sectors among the four in terms of the GSCM practice adoptions. The Sig between Sector 1 and Sector 3, between Sector 2 and Sector 4, between Sector 2 and Sector 3, and between Sector 3 and Sector 4 from the table below are larger than 0.05, which help to further verify that there is no significant difference between both two different industrial sectors of these SMEs in terms of implementing GSCM practices. On the contrary, the Sig between Sector 1 and 2, and between Sector 1 and 4 are smaller than 0.05, which is 0.003 and 0.017, implying that SMEs from Food and Drink Sector and Clothing, Textile and Tannery Sector have something different in adopting GSCM practices. Moreover, the same differences exist between Food and Drink Sector and Wood processing and Furniture Sector (Table 5).

Table 5

## Multiple Comparisons

Dependent Variable: Practices  
LSD

(I) Sector	(J) Sector	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.29259*	.09646	.003	.1022	.4830
	3	.11058	.09646	.253	-.0798	.3010
	4	.23185*	.09646	.017	.0415	.4222
2	1	-.29259*	.09646	.003	-.4830	-.1022
	3	-.18201	.09646	.061	-.3724	.0084
	4	-.06074	.09646	.530	-.2511	.1296
3	1	-.11058	.09646	.253	-.3010	.0798
	2	.18201	.09646	.061	-.0084	.3724
	4	.12127	.09646	.210	-.0691	.3116
4	1	-.23185*	.09646	.017	-.4222	-.0415
	2	.06074	.09646	.530	-.1296	.2511
	3	-.12127	.09646	.210	-.3116	.0691

\*. The mean difference is significant at the .05 level.

#### 4. Discussion

Overall, it is proved that the GSCM practices differ in different industrial sectors among Chinese SMEs. This initial investigation seeks to explore and attempts to verify and explain whether Chinese SMEs are different in their GSCM practice implementations and the reasons leading to such differences if any.

Zhu et al. (2006) also conducted a study to investigate the implementation of GSCM in the Chinese context; they paid attention to the following four industries: automobile industry, chemical/petroleum industry, power supply chain industry and electronic/electrical industry, but covering enterprises from a range of diverse sizes. Furthermore, over 80 per cent of the respondent enterprises are large enterprises and only a few SMEs have been involved in the study. They used ANOVA to identify what the differences in terms of different GSCM practices are, including GP, ECO, IR, CC and IEM, among the four industries. For example, they indicated that the automobile industry lagged behind the other three industries in adopting GSCM practices and they provided the possible reason might be from a 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 the stakeholder theory.

The findings from this study had similar results in terms of industrial sector differences to Zhu et al. (2006). The ANOVA test verified that some different industrial sector of SMEs differ in their GSCM practices and the Multiple Comparisons showed that such kinds of differences exist between Food and Drink Sector and Clothing, Textile and Tannery Sector, and between Food and Drink Sector and Wood processing and Furniture Sector. There might be several reasons contribute to the results. Firstly, they have different requirements on green purchasing for their products. For example, an orange juice manufacturer may not pay attention to whether the oranges grew in a green environment or not and it may also not need a supplier with the ISO14001 certificate. On the other hand, the clothing and textile enterprises may have higher requirements on their suppliers for safer dyeing without poisonous harm to the environment. Similarly, SMEs from different industrial sectors may have different considerations on their product design, as discussed by Zhu and Sarkis (2006) and Testa and Iraldo (2010).

By comparison, Holt, and Ghobadian (2009) carried out another questionnaire survey which examine both of the operational practices and pressures for GSCM among 149 companies in the UK. These are two main findings of their study related to those of this one; one is that the most common practices are concerning with internal cost saving activities and the other is that size does put impact on GSCM practices and smaller companies may have limitations in adopting GSCM practices.

#### 5. Conclusions and Future research

This study provided an original attempt to investigate the GSCM practices of SMEs in the Chinese context. Academic research on GSCM of Chinese enterprises is still not popular, especially for those studies on SMEs. Therefore, the findings from this study can contribute to the cumulative body of research in both GSCM theories and the use of GSCM practices for SMEs.

The findings are able to confirm that different industrial sector of SMEs differ in their GSCM practices in the Chinese context. Explicitly, SMEs from Food and Drink Sector and Clothing, Textile and Tannery Sector have something different in adopting GSCM practices. Moreover, the same differences exist between Food and Drink Sector and Wood processing and Furniture Sector. The relatively small sample size can be argued as one of the limitations of this study. Secondly, the research only verified that different industrial sector of SMEs differ in their GSCM practices without discussing what the differences are among/between the different industrial sectors of those SMEs. Therefore, future studies can involve more SMEs as participants to create a more credible source of reference. Moreover, the detailed differences among SMEs in different industrial sectors can be identified in a developed study. For example, whether SMEs from Food and Drink Sector lag behind those from Clothing, Textile and Tannery Sector in terms of adopting green purchasing practices for their GSCM can be proposed and tested in the future research.

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