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Summer 6-26-2019

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Sun, Lianzhi; Liu, Menglin; and Zhang, Xuan, "The Impact of Green Supply Chain Management (GSCM) on Company's Operational Performance-Based on the Mediation Effect of Operation Capabilities" (2019). *WHICEB 2019 Proceedings*. 36.

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# The Impact of Green Supply Chain Management (GSCM) on Company's Operational Performance-Based on the Mediation Effect of Operation Capabilities

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**Abstract:** Practitioners and researchers are increasingly paying great attention to green supply chain management (GSCM). However, no agreement has been reached on whether GSCM can directly improve company's operational performance. From the perspective of resource-based view, this paper divides GSCM into internal environment management (IEM) and supplier environment management (SEM), and studies the mechanism of operation capabilities in the relationship between GSCM and company's operational performance. Our findings suggest that (1) IEM partially improves company's operational performance through operation capabilities. (2) SEM has positive impact on company's operational performance through operation capabilities. The conclusion reveals the role of operation capabilities in the relationship between GSCM and company's operational performance, opening up the "black box" of the relationship to some extent, which provides guidance for manufacturing companies.

Key words: green supply chain management (GSCM), company's operational performance, operation capabilities, mediation effect

## 1. INTRODUCTION

The development of traditional manufacturing industry has led to environmental deterioration and resource exhaustion, which has attracted the attention of scholars and practitioners to the green development of manufacturing industry. Therefore, manufacturing companies have strengthened their internal environmental management in order to promote the sustainable development of themselves as well as the society. Surprisingly, some manufacturing companies also take supplier environment management into account, for example, ESQUEL Group in HK evaluates its suppliers monthly, in case that the suppliers don't live up to the environment standards. Many scholars have also proposed that green manufacturing should not only stay at the internal level of companies, but also cooperate with suppliers. Therefore, importance has gradually been attached to green supply chain management (GSCM).

Green supply chain management (GSCM) refers to the integration of internal and external environmental factors in the process of supply chain management in order to achieve the goal of improving company's performance<sup>[1][2][3]</sup>. However, there are still disputes about whether GSCM can improve company's performance. Some scholars have found that there is a direct and significant relationship<sup>[3][4][5]</sup>, i.e, Vachon and Klassen (2008)<sup>[4]</sup> indicates that GSCM can improve company's operational performance in terms of product quality, delivery and flexibility. But no significant conclusions were found in other researches. The conflicting results reveals that the relationship between GSCM and company's performance is still in the "black box", and deeply exploration should be taken.

By sorting out the relevant literatures, we can find that different theories are used to analyze this topic, Aguinis and Glavas (2012)<sup>[6]</sup>, Grewatsch and Kleindienst (2015)<sup>[7]</sup> based on stakeholder theory, found that the

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relations with stakeholders mediates the relationship between GSCM and firm's performance. From the perspective of resource-based view, most scholars believe that GSCM can affect company's performance through improving corporate resources or capabilities<sup>[6][8][9]</sup>. What's more, we find the existing research focuses on analyzing the role of corporate resources in the relationship between GSCM and company's performance<sup>[6][7][8]</sup>, for example, Surroca (2010)<sup>[9]</sup> found that GSCM affects financial performance by enhancing intangible resources such as corporate innovation, human resources, reputation and organizational culture. Only a few scholars have explored the role of corporate capabilities<sup>[8]</sup>. For example, Reuter (2010)<sup>[10]</sup> based on dynamic capability theory (the extension theory of resource-based view) finds sustainable global suppliers management (GSCM) can be transformed into internal sustainability capabilities to enhance corporate reputation and operational performance.

As important corporate capabilities, operation capabilities are formed in the long-term operation and management process of the company and are scarce, valuable and non-replicable. It is considered to be the source of the company's competitive advantage and performance, and the key factors that lead to performance differences. At the same time, through the review of existing literature (Table 1 column 4), we can find that most of the literature discusses the impact of GSCM on financial performance<sup>[6][8][9]</sup>. However, in recent years, more and more scholars have found that GSCM indirectly affects financial performance through operational performance<sup>[11]</sup>. As the relationship between operational performance and financial performance has been very clear, this article will not repeat this research. In summary, this paper will focus on the role of operation capabilities in the relationship between GSCM and operational performance.

According to the point of Kannan and Tan(2007)<sup>[2]</sup>, the operation capabilities closely related to GSCM mainly include quality management capability and risk management capability. From the perspective of quality management capability, on the one hand, companies through internal environmental management can improve their own production technology, reduce production process waste and product defects, and improve product quality. On the other hand, supplier environmental management enables companies to strengthen the control of raw material quality, which is conducive to enhancing the quality management capabilities of corporates and improving product quality and reliability. From the perspective of risk management capability, the company's GSCM reduces the institutional pressure and fines companies faced with, enhances the company's ability to prevent risks beforehand. What's more, GSCM makes companies strengthen collaboration and information sharing with suppliers to improve manufacturing flexibility and agility.

In summary, we take internal environmental management and supplier environmental management into consideration, and study the mechanism of operation capabilities (quality management capability and risk management capability) in GSCM and company's operational performance. Using structural equation model analysis with six round data of International Manufacturing Strategy Survey, this paper finds that (1) internal environment management partially improves company's operational performance through operation capabilities. (2) Supplier environmental management has positive impact on company's operational performance through operation capabilities.

This paper mainly has two contributions. Firstly, extant research about the mechanism of the relationship between GSCM and company's operational performance is not clear. This paper proposes that GSCM can affect operational performance through enhancing operation capabilities, which is verified in this empirical research. To some extent, it has unveiled the "black box" of the mechanism of the relationship between GSCM and operational performance, thus having some managerial implications. Secondly, this paper finds that the operation capabilities has different effects on operational performance under different GSCM situations.

The rest of the paper is arranged as follows: In Section 2, we provide literature review and hypotheses. Section 3 presents the methodology. Section 4 discusses the results, following by Section 5, the discussion and

conclusion.

## 2. LITERATURE REVIEW AND HYPOTHESES

### 2.1 Literature review

#### 2.1.1 Green supply chain management (GSCM)

Green supply chain management refers to the integration of internal and external environmental factors in the process of supply chain management in order to achieve the goal of improving company's performance<sup>[3]</sup>. Early GSCM research focused only on internal organizations, for example, Darnall (2008)<sup>[12]</sup> only discusses the internal environmental management system. With the deepening of social labor division, suppliers and manufacturers are increasingly connected, and the influence of supplier activities on manufacturers' green management is becoming more and more obvious. For example, Foxconn Group promotes environment management system (EMS) for highly polluting suppliers. By the end of 2011, more than 99% of suppliers have established an EMS, and played a huge role in energy conservation and pollution reduction of Foxconn Group. More and more scholars have also proposed that supplier environmental management should be incorporated into manufacturing companies' GSCM activities<sup>[10][13]</sup>.

Therefore, GSCM studied in this paper includes both internal environmental management and supplier environmental management<sup>[14]</sup>. Internal environmental management mainly refers to a series of environmental management activities carried out independently within the organization, including the promotion of environmental certification (such as EMAS, ISO14001), social certification (such as SA8000, OHSAS1800), implementation of relevant emission reduction and energy reduction plans and so on. The supplier environmental management is mainly to integrate suppliers into the company's green supply chain management, including formal assessment, monitoring and auditing of suppliers, training of suppliers and related education to improve sustainability performance<sup>[15][16]</sup>.

#### 2.1.2 Operation capabilities

Operation capabilities reflects the effectiveness of the company's operations management process, and is expressed as a timely response capability, while quality management capability and risk management capability are two important aspects of operation capabilities playing important roles in GSCM<sup>[2]</sup>. Through GSCM, manufacturing companies can reduce product defects and waste by improving advanced green manufacturing technologies and total quality management, and improve quality management capabilities, which in turn affects operational performance. On the other hand, it can effectively reduce the risk of institutional punishment and the uncertainty of the manufacturing process, improve the risk management capability, and enhance the flexibility of manufacturing companies.

Quality management capability refers to the ability of a company to improve and control the quality of products and services through the implementation of total quality management, to enhance the usability of equipment through the implementation of a comprehensive production maintenance plan, and to combine self-quality assessment with benchmarking learning. Risk management capability mainly refers to the ability to establish specialized work groups and contingency plans, to clarify the responsibilities of different departments and employees, and to predict, monitor, identify, respond to and manage supply chain environmental risks with their suppliers.

#### 2.1.3 Operational performance

Scholars commonly used indicators including cost, quality, innovation, customer service, flexibility and delivery time, delivery speed to measure operational performance. This article will continue to use the predecessor's measurement indicators, including product quality and reliability, batch flexibility, product

customization, and product distribution speed<sup>[4][17]</sup>.

## 2.2 Hypotheses

According to RBV, the company's resources and capabilities have significant impact on its performance. Companies have developed operation capabilities in the long-term operational management process. Such capabilities are often scarce, valuable, and non-replicable, which is important to enhance operational performance. Recent studies have also validated this view. For example, Wiengarten and Pagell (2012)<sup>[18]</sup> focus on internal environmental management, and indicates that internal environmental management can not only meet the requirements of environmental regulations, but also enhance the quality management capabilities to effectively improve operational performance, including cost, flexibility and delivery. It's found that the company's internal environmental management is the main source of the quality advantage. In the process of learning to reduce environmental pollution and recycling waste, companies will produce "spillover effect" and enable companies to obtain higher quality advantages and enhance product quality and reliability.

At the same time, through internal environmental management, companies adopt clearer and safer production procedures, which reduces the possibility of operational disruption risks and enhances the detectability of risks, that is, enhances the companies' risk management capabilities. The implementation of environmental standards such as EMAS and ISO14001 complies with the requirements of environmental regulations, reduces the manufacturing company's pressure risks such as suspension of production and rectification caused by institutional factors<sup>[19]</sup>, so that manufacturing companies can continue to operate. In summary, we assume that:

*H1: internal environmental management has significant positive influence on operational performance through improving quality management capability.*

*H2: internal environmental management has significant positive influence on operational performance through improving risk management capability.*

The outsourcing trend of manufacturing companies makes their product quality and production risks closely related to upstream suppliers<sup>[13]</sup>, which in turn affects their operational performance<sup>[11][20]</sup>. The outsourcing trend has led suppliers to control the quality of raw materials and product components to a large extent, which affects the product quality and reliability. By strengthening supplier environmental management, manufacturing companies can fulfill process coordination and information sharing with suppliers and control the of unqualified product parts, as well as to achieve timely supply, reduce waste in transportation and manufacturing processes, and increase their quality management capability, thereby improving product quality and batch flexibility.

In addition, a slight move in one part may affect the situation as a whole in supply chain, and the environmental management problems of suppliers may also lead to production disruption crisis of manufacturing companies. Therefore, manufacturing companies who conduct supplier environmental management and work together with suppliers to improve the environment, are conducive to enhancing their risk management capability and therefore improving the sustainability of their operations<sup>[21]</sup>. In addition, supplier environmental management can also enable manufacturing companies to more flexibly respond to changes in market demand, enhance risk management capability, and finally enhance product customization capabilities. In summary, we assume that:

*H3: supplier environmental management has significant positive influence on operational performance through improving quality management capability.*

*H4: supplier environmental management has significant positive influence on operational performance through improving risk management capability.*

### 3. METHODOLOGY

#### 3.1 Questionnaire design

This article uses the sixth round of International Manufacturing Strategy Survey (IMSS-VI), which was initiated in 1992 by the London Business School and Chalmers University of Technology, in collaboration with researchers in the international community who focus on manufacturing strategy research, practice and performance, the project launched research every 4-5 years and now the six round research have been conducted in 2013-2014. The survey mainly included 931 manufacturing plants from 22 countries, covering various aspects of the manufacturing strategy, including GSCM, quality management, risk management, supplier integration capabilities, as well as company's financial performance, operational performance etc. The questionnaire indicators are derived from multiple maturity table with very high credibility and uses 5-point Likert scale. The specific measurement index is shown in Table 1 below.

**Table 1 Measurement index**

Latent variable	Number	Observed variables	Reference
Internal environment management	SM1a	Implementation level of environmental certification (e.g. EMAS, ISO14001)	Zhu and Geng(2006) Teuscher et al. (2006)
	SM1b	Implementation level of social certification (such as SA8000, OHSAS1800)	
	SM1c	Implementation level in reducing energy and water consumption projects	
	SM1d	Implementation level in reducing pollution emissions and developing water resources recycling projects	
	SM1e	Implementation level in occupational health and safety management system	
Supplier environment management	SM1f	The company formally assessed, monitored and audited the process of supplier's sustainable development performance evaluation through established guidelines and procedures.	Krause et al. (2000) Zhu et al.(2011)
	SM1g	<b>The company pays attention to the training of suppliers in the aspect of sustainable development.</b>	
	SM1h	<b>The company and suppliers are working together to improve their sustainable development performance.</b>	
Operation performance	B6a	<b>Products quality and reliability</b>	Gonzalez-Benito and Gonzalez-Benito (2005); Paulraj (2011)
	B6b	<b>Flexibility</b>	
	B6c	Customized capability	
	B6d	Delivery speed	
Quality management capability	Q1a	The company can carry out quality improvement and control (such as total quality management, 6 Sigma project, and quality discussion group).	Yang et al. (2011)
	Q1b	The company can improve equipment utilization (including total production and maintenance projects).	
	Q1c	The company can carry out benchmarking / self-assessment (such as quality award, EFQM model).	
Risk management capability	R2a	The company can prevent operational risks (such as selecting a more reliable supplier, adopting clearer and safer procedures, preventive maintenance, etc.).	Zsidisin et al. (2001) Kleindorfer and Saad (2005)
	R2b	The company can detect operational risks (such as internal or supplier monitoring, inspection and tracking).	
	R2c	The company is able to respond to operational risks in time (for example, alternative suppliers, extra capacity, alternative transportation).	
	R2d	The company can quickly recover from operational risks (such as special working groups, contingency plans, clear responsibilities).	

### 3.2 Variable measurement

The following sections discussed the construct validity and reliability. Specifically, reliability was examined through Cronbach's  $\alpha$ , and the construct validity was examined through convergent validity and discriminant validity as illustrated in the following sections.

#### 3.2.1 Reliability

The reliability test is used to test the consistency and reliability of the test results. The commonly used reliability measure is Cronbach's  $\alpha$ . When the Cronbach's  $\alpha$  is larger than 0.7, indicating that the reliability is acceptable. In this paper, SPSS20.0 is used to test the reliability of the scale. The results show that the Cronbach's  $\alpha$  coefficient of each measure of the scale is higher than the criterion of 0.7 and the overall reliability is 0.933, showing good reliability. The Cronbach's  $\alpha$  is shown in Table 4 below.

#### 3.2.2 The convergent validity

The convergent validity can be examined by factor loadings, the composite reliability, and the average variance extracted (AVE). In other words, the loading should be highly loaded and statistically significant in measuring variables with at least 0.7 of factor loadings. For AVE the values should be at least 0.5 for each construct, and at least 0.7 of the composite reliability. In Table 2 below, the results show mostly above the recommended valued mentioned before, so the convergent validity is accepted.

**Table 2 The reliability and convergent validity analysis**

variables	items	Cronbach's $\alpha$	Factor loading	AVE	C.R
Internal environmental management (IEM)	SM1a	0.884	0.742	0.620	0.891
	SM1b		0.737		
	SM1c		0.835		
	SM1d		0.808		
	SM1e		0.81		
Supplier environmental management (SEM)	SM1f	0.770	0.620	0.537	0.774
	SM1g		0.820		
	SM1h		0.744		
Quality management capability (QMC)	Q1a	0.854	0.795	0.668	0.858
	Q1b		0.863		
	Q1c		0.792		
Risk management capability (RMC)	R2a	0.890	0.768	0.673	0.892
	R2b		0.863		
	R2c		0.839		
	R2d		0.809		
Operational performance (OP)	A1a	0.807	0.843	0.511	0.801
	A1b		0.833		
	A1c		0.594		
	A1d		0.536		

#### 3.2.3 The discriminant validity

In the literature of SEM, the discriminant validity is defined as the degree of set of items can differentiate a variable from other variable in the model. In other words, the construct's items should have variances between them more than the variance shared with other constructs. Test of discriminant validity criterion was suggested

by Fornell and Larcker (1981)<sup>[22]</sup>. The below Table 3 has a diagonal line of elements represent the square roots of AVE with the correlation of the constructs below that. Therefore, the comparison can be taken place between that diagonal and off diagonal lines. The most diagonal line values are greater the other in the rows and columns values and the discriminant validity can be confirmed.

**Table 3 Correlations of Discriminant Validity**

	SEM	IEM	RMC	QMC	OP
SEM	<b>0.787</b>				
IEM	0.982***	<b>0.733</b>			
RMC	0.741***	0.639***	<b>0.817</b>		
QMC	0.857***	0.816***	0.699***	<b>0.820</b>	
OP	0.453***	0.419***	0.448***	0.497***	<b>0.715</b>

Note: \*\*\*:  $p < 0.001$ ; \*\*:  $p < 0.01$ ; \*:  $P < 0.05$

#### 4. RESULTS

In view of the high correlation between internal environmental management practices and supplier environmental management practices (correlation coefficient is 0.982,  $P < 0.001$ ), some scholars have found that internal environmental management and external environmental management practices have a mutual driving effect, in order to avoid the mutual influence of these two variables, we will test the mediating effect of internal environmental management and supplier environmental management and operational performance respectively.

In order to test hypotheses H1 and H2, a SEM for internal environmental management, operational capabilities, and operational performance is set,  $\chi^2/df=2.325 < 3$ , RMSEA=0.044<0.05, CFI=0.981>0.9, GFI=0.961>0.9, NFI =0.968>0.9, AGFI=0.943>0.9, the model fitting index is good, suitable for further analysis. In the absence of quality management capability and risk management capability (model 1 in Table 5 below), internal environmental management has a direct positive impact on operational performance with a path coefficient of 0.374 ( $P < 0.001$ ). After adding quality management capability and risk management capability (model 2 in Table 6 below), internal environmental management has a positive impact on quality management capability ( $\beta=0.872$ ,  $P < 0.001$ ) and risk management capability ( $\beta=0.708$ ,  $P < 0.001$ ). Quality management capability and risk management capability have a positive impact on operational performance, while internal environmental management has a negative impact on operational performance under the influence of the two capabilities. The path coefficient is -0.287 ( $P < 0.05$ ), but the total effect of management on operational performance is 0.402, which is still positive in general, indicating partial mediating effect exists, so H1 and H2 are partially supported.

In order to test the hypothesis H3 and H4, a structural equation model for supplier environmental management, operational capabilities and operational performance is set,  $\chi^2/df=2.468 < 3$ , RMSEA=0.047<0.05, CFI=0.980>0.9, GFI=0.967>0.9, NFI=0.967>0.9, AGFI=0.948>0.9, the model fitting index is good, suitable for further analysis. In the absence of quality management capability and risk management capability (model 1 in Table 4 below), supplier environmental management has a direct positive impact on operational performance with a path coefficient of 0.418 ( $P < 0.001$ ). After adding quality management capability and risk management capability (model 2 in Table 4 below), supplier environmental management positively impacts quality management capability ( $\beta=0.878$ ,  $P < 0.001$ ) and risk management capability ( $\beta=0.768$ ,  $P < 0.001$ ). After adding quality management capability and risk management capability, there is no longer a significant direct relationship between supplier environmental management and operational performance ( $\beta=-0.229$ ,  $P > 0.05$ ), which proves that supplier environmental management is completely transformed into quality management capability and risk management capability, which further affect operational performance, so H3 and H4 are

supported.

**Table 4 The mediation model of GSCM and operational performance**

Internal environmental management model	Model 1	Model 2
IEM→QMC	-	0.872***
IEM→RMC	-	0.708***
IEM→OP	0.374***	-0.287*
QMC→OP	-	0.590***
RMC→OP	-	0.246***
Indirect effect	-	0.689***
Total effect	-	0.402***
Supplier environmental management model		
SEM→QMC	-	0.878***
SEM→RMC	-	0.768***
SEM→OP	0.418***	-0.158
QMC→OP	-	0.541***
RMC→OP	-	0.240**
Indirect effect	-	0.659***
Total effect	-	0.659***

Note: \*\*\*:  $p < 0.001$ ; \*\*:  $p < 0.01$ ; \*:  $P < 0.05$

## 5. CONCLUSION AND DISCUSSION

### 5.1 Main conclusions

The above empirical research results prove that the operation capabilities play different roles in different GSCM. Internal environment management are partially turned into quality management capability and risk management capability, to improve company's operational performance, while supplier environmental management is completely transformed into quality management capability and risk management capability, thus has positive impact on company's operational performance.

Internal environment management are partially turned into operation capabilities to improve company's operational performance. This conclusion partly confirms previous scholars' research results, indicating that companies can invest their resources into internal environmental management to directly affect its operational performance, such as establishing formal occupational health and safety management system can enhance the health of employees, thereby improves employee productivity and distribution efficiency<sup>[12]</sup>. Another part of internal environmental management needs to be translated into operation capabilities to affect operational performance.

Surprisingly, after eliminating the mediating effect of operation capabilities, internal environmental management has a direct negative impact on operational performance. A reasonable explanation is that the motivation for manufacturing companies to carry out internal environmental management may be to meet the environmental standards and requirements, so as to obtain the "legality" of continuing production<sup>[12][16]</sup>. This kind of GSCM can't really improve the performance of the company<sup>[6]</sup> even if it improves the operational capability to some extent.

Supplier environmental management must be fully transformed into quality management capability and risk management capability to improve operational performance. By auditing, evaluating, and urging suppliers to implement GSCM, manufacturing companies can get more environmentally-friendly raw materials, enhance

their quality management capability, and improve their operational performance. In addition, the manufacturing company improves the environmental protection requirements of suppliers through supplier environmental management, avoids the risk of suppliers suspending production and rectification, and enhances their risk prevention capability, which is conducive to the continuous operation and flexible production.

## 5.2 Managerial implications

Firstly, “supply chain competes, not companies”. In order to improve operational performance, it is often not enough for manufacturing companies to only focus on their own green development. Supplier environmental management must be included in the scope of green development.

Secondly, operation capabilities play an irreplaceable role in the relationship between GSCM and operational performance. Manufacturing companies should focus on the development of operation capabilities in their daily operations to improve their operational performance.

Thirdly, some manufacturing companies take GSCM out of institutional pressure, but the manufacturing companies must learn to turn this institutional pressure into its motivation to optimize internal management and improve performance. If manufacturing companies only take GSCM in order to meet environmental protection policies, the increased cost brought by such coping policies may exceed the benefits brought by GSCM, and finally achieve counterproductive results.

## 5.3 Limitations

This paper only studies the role of internal environmental management and supplier environmental management in business performance. However, the content of GSCM is very rich, including green design and green cooperation with customers. In addition, this paper separately studies the impact of internal environmental management and supplier environmental management on operational performance, but in reality, the two often interact to affect business performance.

## ACKNOWLEDGEMENT

This research was supported by the National Social Science Foundation of China under Grant (Grant No. 13CGL004).

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