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Influence of Responsible Supply Chain Management Behaviours and Environmental Performance among Pharmaceutical Companies in China

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ABSTRACT

Responsible supply chain management (RSCM) as a growing sub-field of supply chain management (SCM) has gathered increasing consideration from both practitioners and academics for the past two decades. Even though manufacturing firms have implemented RSCM behaviors through this period, there exist, some concerns as to whether these RSCM behaviors are being applied for the effect they have on environmental performance. In recent times, various debates have been opened concerning this RSCM paradox, throwing doubt on whether an investment in the implementation of RSCM behaviors certainly comes with a corresponding environmental performance outcome and, therefore, the commercial benefits of responsibility management in the context of SCM remain open for interrogation. The aim of this study is to explore the impact of responsible supply chain management behaviors on environmental performance among pharmaceutical companies in China. In addition, investigate the intervening roles of process innovation and supply chain integration as mediating and moderating constructs respectively. The research hypothesis were formulated following an extensive study of relevant literature and were based on resource and capability-based theories such as the resource based view, the natural resource based view and the stakeholder theories. The design of the study was explanatory with a confirmatory reach, applied to 123 Chinese pharmaceutical firms selected across, Jiangsu, Shanghai, Zhejiang and Guangdong provinces. The proposed theoretical model was tested using partial least squares structural equation modelling (PLS-SEM). The empirical findings of the study confirmed that an effective application of RSCM behaviors, process innovation(PI), and supply chain integration(SCI) initiatives positively and significantly improves environmental performance outcomes. This confirms the position of extant literature that there is a positive relationship between RSCM behaviors' and environmental performance. It also validated the position that process innovation and supply chain integration positively mediates and moderates respectively the relationship between RSCM and environmental performance. Therefore, the findings herein can be considered as complementary to the existing body of knowledge in the field. The practical implications derived from this study will contribute to sustainable development and expand knowledge both in industry and in academia.

Keywords : Responsible Supply Chain Management, Process Innovation, Supply Chain Integration, Chinese Pharmaceuticals Industry, Environmental Performance, Structural Equation Modeling

I. INTRODUCTION

The objective of this chapter is to explore the impact of responsible supply chain management behaviors on environmental performance as a component of sustainable performance among pharmaceutical companies in China. In this context, responsible supply chain refers to taking into account social and

environmental considerations when managing their relationships with stakeholders. It highlights the management of environmental, social, and economic impacts and the encouragement of good governance practices, throughout the lifecycles of goods and services. On the other hand, environmental in this context refers to how these companies use and consume materials, air emissions, effluent wastes, and solid wastes and to decrease the use of hazardous substances and toxic materials (Zhu et al., 2008a; Schaltegger et al., 2014). The existing literature is unequivocal that companies that practice responsible supply chain management behaviors potentially increase their environmental performance.

While this direct notion had existed in the extant literature over a long period, emerging views suggest the existence of preconditions that can either accelerate or slow down the rate at which responsible supply chain management behaviors can influence organizations' environmental performance indicators such as reduction in air emission/wastewater/solid waste, decrease in consumption of hazardous/harmful/toxic materials, reduction in energy consumption, decrease in frequency for environmental accidents, improvement in the compliance to environmental standards and improvement in the ability of reuse/recycle. In this chapter, two intervening variables, namely process innovation and supply chain integration, are analysed to determine the extent of influence they have on the direct relationship between responsible supply chain management and environmental performance. Supply chain integration is postulated to have a moderating effect on the relationship between responsible supply chain management, while process innovation is hypothesized to have a mediating relationship between responsible supply chain management. Thus the three hypotheses explored in this chapter are as follows;

- H1a: There is a direct relationship between RSCM behaviors and firms' environmental performance
- H1b: Process innovation significantly mediates the relationship between RSCM and environmental performance
- H1c: Supply Chain Integration significantly moderates the relationship between RSCM behaviors and environmental performance.

Figure 5.1 shows the diagrammatic representation of the framework for this section of the analysis of data.

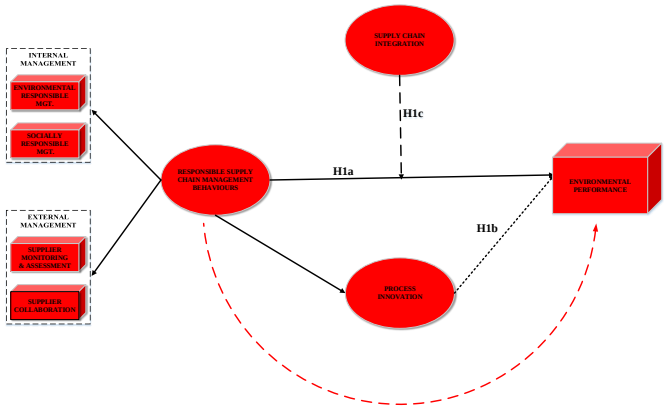

Figure 1 : Effect of RSCM, Process Innovation, SCI on Environmental Performance

II. METHODS

To test the research hypothesis, 8782 pharmaceutical firms were identified and exported in selected provinces. This database of 8782 pharmaceutical firms was considered the population of this research. These pharmaceutical companies were drawn mainly from the EMIS database, yet not all the companies could participate in the study due to the large number. Initial contact with the companies received 287 responses from potential companies that were willing to participate in the study. Subsequently, a total of 287 questionnaires were sent to pharmaceutical companies in designated provinces in China, namely Shanghai, Shenzhen, Guangdong, Zhejiang, and Jiangsu provinces. They ranged from private sector companies, joint ventures, and foreign direct investment enterprises. Most of the companies were involved in pharmaceuticals diversified, pharmaceuticals generic and specialty and diagnostic substances.

The questionnaire was designed to be predominantly open-ended in order to encourage as many people as

possible to participate in the research, and each company was given only a single questionnaire since multiple responses from companies were inconsequential to the objectives of this research. A softcopy of the questionnaire was translated into Chinese with the assistance of colleagues at the Centre for Medical Insurance and Public Policy Research of the School of Management at Jiangsu University. The questionnaire was designed with the proposed model in mind. This proposed model consists of seven theoretical constructs, each of which had five observed variables, namely responsible supply chain management behaviors, environmental performance, process innovation, and supply chain integration. Responsible supply chain, which is the primary independent variable, is a composite value of internal management factors (environmental responsible management and socially responsible management) and external management factors, which includes supplier and monitoring & assessment (SMA) and supplier collaboration(SC).

Further, the mediating variable, which is process innovation, is a composite of three variables, while supply chain integration, which is the moderator variable, is a composite of three-factor namely supplier integration, customer integration, and internal integration. Each of these specific individual variables also had specific questions attached to them to elicit responses. The questions were framed from previous studies and models that have used similar systems and strategies to explore the responsible supply chain. Before administering the questionnaire, it was pretested to determine the reliability with 10 pretest samples, which were eventually not added to the final sample of respondents. The analysis of the pretest results helped to reword specific items to ensure clarity for respondents. A total of 123 questionnaires were finally received, and that formed the basis for the analysis of the study. The information was first keyed into the Excel worksheet to clean the data, after which it was imported into the Warp PLS software for structural equation analysis. The results of the analysis are presented in the next section of the study.

III. RESULTS

3.1 Descriptive Statistics

Table 1 Correlation, Mean and Standard Deviation

Variable	Mean	SD	1	2	3	4	5	6	7
(1) Environmental Responsible Management	3.2	0.78	_						
(2) Socially Responsible Management	3.8	0.37	.45**	_					
(3) Supplier Monitoring and Assessment	4.6	0.35	.34**	. 44*	_				
(4) Supplier Collaboration	3.1	0.19	.47**	.47**	.54**	_			
(5) Supply Chain Integration	4.2	0.63	.36**	.39**	.42**	.26**	_		
(6) Process Innovation	3.8	0.31	.46**	.29**	.48**	.39**	.46**	_	
(7) Environmental Performance	3.7	0.85	0.86*	0.69*	0.81*	0.75*	0.64*	0.87 *	_

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

* Correlation is significant at the 0.05 level (2-tailed)

Table 1 presents the outcome of the descriptive statistics and the test of multicollinearity based on the correlation matrix. In terms of descriptive statistics, environmentally responsible management, which is the first attribute of a responsible supply chain management, obtained a mean response value of 3.2 with a standard deviation of 0.78. The kurtosis and the skewness for this variable were within an appropriate range. The second variable in the responsible supply chain construct is socially responsible management. It returned a means response value of 3.8 with a standard deviation of 0.37. Again, the skewness and kurtosis values recorded for this attribute were within an acceptable range.

Regarding the descriptive information about supplier monitoring and assessment, a mean response value of 4.6 and a standard deviation of 0.35 was recorded. The skewness and kurtosis values recorded for this attribute did not deviate from acceptable values. The last indicator in the responsible supply chain construct is supplier collaboration. In this case, the mean response value is 3.1, with a standard deviation of 0.19. The mean response value for supply chain integration is 4.2, with a standard deviation of 0.63, whereas the mean response value for process innovation is 3.2, with a standard deviation of 0.31. Finally, the mean response value of environmental performance is 3.7, with a standard deviation of 0.85. In all the instances, the recorded kurtosis and skewness values were within appropriate ranges.

The second section of the table shows the degree of multicolinearity among the variables. The test of multicolinearity is necessary in order to demonstrate the extent of independence of each of the independent variables. There are two main methods used in demonstrating independence. The first model is the correlation matrix, which has been used in this study. In this model, the significance of the relationship value of 0.5 as benchmarked by Saunders et al. (2009) is used to determine the significance of the relationship among each of the variables. The results of the analysis show that none of the independent variables have a strong relationship with each other. The highest is 0.48, and the lowest is 0.29, which means that all the Pearson product-moment r values fall lower than the recommended threshold. This implies that each of the independent variables can be analyzed in relation to the dependent variables.

3.2 Reliability and Validity Test

The study used an exploratory factor analysis based on Maximum Likelihood with Promax rotation to determine the degree to which the observed variables loaded together. The results showed a positive outcome as the variables loaded, correlated together, and met the criteria of reliability and validity. Some scholars have argued that factor loadings from .50 should be an acceptable loading. For this reason, the constructs that reported standardized factor loadings above the .50 criteria were accepted as recommended by Hair et al. (2010) who posited that each item is considered a satisfactory item when item loadings are greater than 0.50 in all, the measures of the study were considered as showing satisfactory reliability. Table 2 shows the factor loadings

Table 2 Factor Loadings and Goodness of Fit

VARIABLE	α	CR	AVE	FACTOR LOADING
RESPONSIBLE SUPPLY CHAIN	**.911**	**.687**	**.929**	
Environmental Responsible	.786	.920	.746	.934

Management				
ERM1				.892
ERM2				.923
ERM3				.781
Socially Responsible Management	.916	.942	.729	.942
SRM1				.763
SRM2				.861
SRM3				.882
Supplier Monitoring and Assessment	.907	.939	.720	.963
SMA1				.852
SMA2				.844
SMA3				.871
SMA4				.802
SMA5				.743
Supplier Collaboration	.923	.984	.751	.987
SC1				.811
SC2				.863
SC3				.854
SC4				.842
SC5				.833
Supply Chain Integration	**.787**	**.904**	**.759**	
SCI1				.784
SCI2				.901
SCI3				.923
Process Innovation	**.911**	**.929**	**.687**	
PI1				.763
PI2				.882
PI3				.851
Environmental Performance	**795**	**.848**	**.582**	
EP1				.764
EP2				.781
EP3				.854
EP4				.842
EP5				.734
EP6				.773

3.3 Sampling Adequacy

Next, a sampling adequacy test was conducted using the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity. The KMO test results were significantly high whiles the minimum value of the communalities was above 0.300 (most of them were above 0.600). This indicates that the chosen variables are adequately correlated for factor analysis. Also, the reproduced matrix had only 2% non-redundant residuals greater than 0.05, further confirming the adequacy of the variables and the 6-factor model.

3.4 Internal Consistency

The test of internal consistency was examined using the Cronbach's alpha correlation coefficient, as recommended by (Kamakura, 2010; Hair et al., 2014). The values for each of the extracted variables are presented in Table 5.3, along with their specifications, support highly internally consistent variables. Each of the alphas above is more than 0.07, which exceeds the recommended threshold of 0.06. The factors are all reflective because their indicators are highly correlated and are mostly interchangeable(Jarvis, MacKenzie, & Podsakoff, 2003).

The factors demonstrate sufficient convergent validity, as their loadings were all above the recommended minimum threshold of 0.350 for a sample size of 300(Hair et al., 2011). The factors also demonstrate sufficient discriminant validity, as the correlation matrix shows no correlations above 0.700, and there are no problematic cross-loadings. This six-factor model had a total variance explained of 60%, with all extracted factors having eigenvalues above 1.0 except one, which was close at 0.989.

Table 3 : Construct Reliability measures

Latent variables	Cronbach's alpha coefficients	Specification
(1) Environmental Responsible Management	0.823	Reflective
(2) Socially Responsible Management	0.910	Reflective
(3) Supplier Monitoring and Assessment	0.808	Reflective
(4) Supplier Collaboration	0.910	Reflective
(5) Supply Chain Integration	0.711	Reflective
(6) Process Innovation	0.845	Reflective

3.5 Confirmatory Factor Analysis (CFA)

The influential nature of Confirmatory factor analysis (CFA) as a statistical tool for probing the nature of and relationships among latent constructs is highly regarded among researchers. This is because, according to (Kaplan, 2000; Schumacker and Lomax, 2010), it helps to measure the construct validity, identify method effects, and helps in evaluating the factor invariance through time and groups. The use of Confirmatory Factor Analysis (CFA) continues to gain ground in the psychological literature as a result of the belief researchers have in the Structural Equation Model as a robust model specifically. Given the critical impact CFA makes in the measure development and due to the understanding that having a tool that manages the measurement of variables effectively, it can be presumed to be paramount quantitatively only because its role is crucial to the results a researcher reports. We sought to find out the relationship between the latent variables using Warp PLS. We removed one composite attribute of environmentally responsible management, zero attribute of socially responsible

management, four attributes of supplier monitoring and assessment, three attributes of supplier collaboration, zero attributes of supply chain integration, and none of the attributes of process innovation due to poor loading. The researcher consulted modification indices to determine if there was an opportunity to improve the model. Accordingly, the error terms were we co-varied between some of the attributes. Figure 1 shows the second-order confirmatory analysis of the factors.

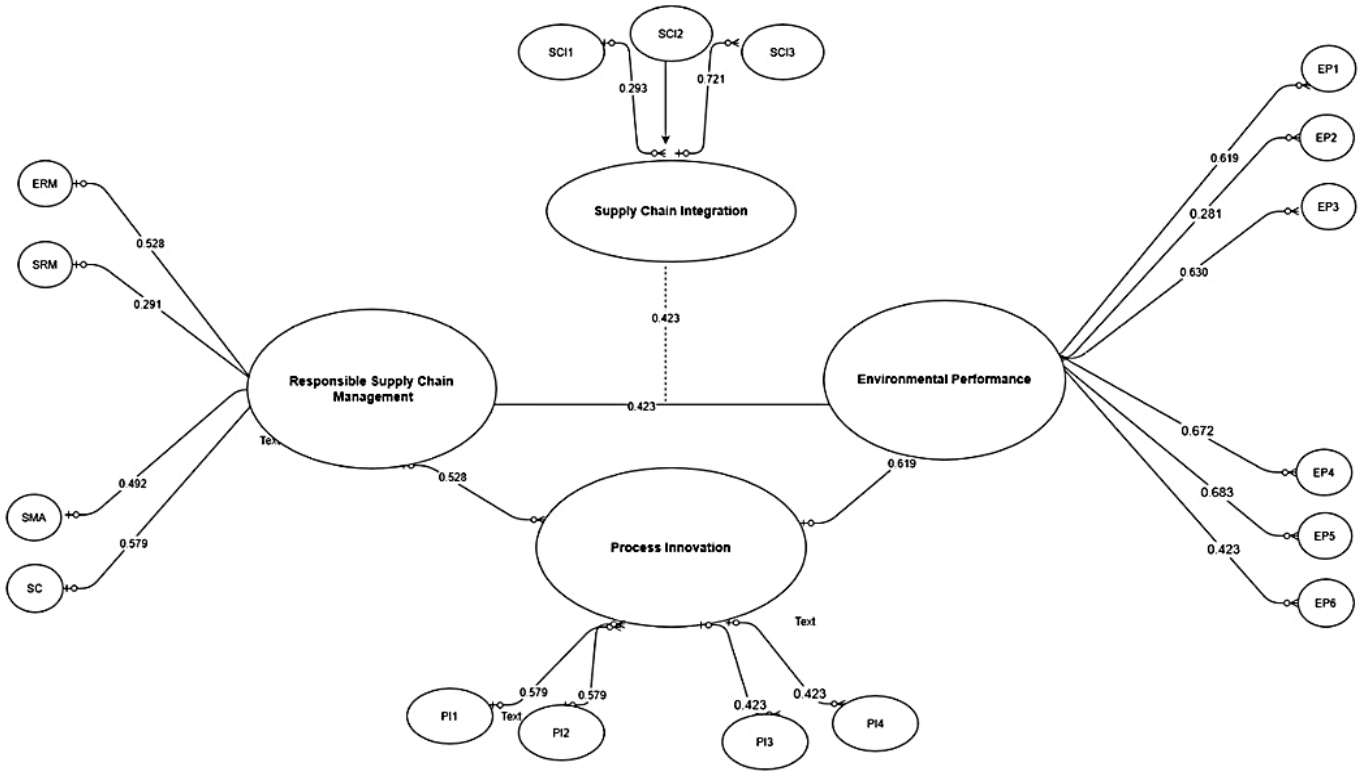

Table 4 provides the results of the goodness of fit for our measurement model is sufficient. The results also show that the various parameters are within acceptable range for inferential analysis

Table 4 : Goodness of fit indexes

Measure	Estimate	Threshold	Interpretation
CMIN	413.13	--	--
DF	302	--	--
CMIN/DF	1.403	Between 1 and 3	Excellent
CFI	0.582	>0.05	Excellent
SRMR	0.081	<0.08	Excellent
RMSEA	0.026	<0.06	Excellent
PClose	0.763	>0.05	Excellent
Cutoff Criteria*			
Measure	Terrible	Acceptable	Excellent
CMIN/DF	> 5	> 3	> 1
CFI	<0.90	<0.55	>0.92
SRMR	>0.10	>0.07	<0.06
RMSEA	>0.08	>0.06	<0.04
PClose	<0.01	<0.05	>0.03

Model Fit Indexes in Covariance Structure Analysis

Table 5 : Model Fit measures

	CR	**AVE**	**MSV**	**1**	**2**	**3**	**4**	**5**	**6**
Environmental Responsible Management	0.838	0.655	0.002	0.801					
Socially Responsible Management	0.872	0.496	0.493	0.043	0.697				
Supplier Monitoring and Assessment	0.892	0.703	0.171	0.042	-0.052	0.830			
Supplier Collaboration	0.853	0.621	0.171	-0.035	0.004	0.409	0.780		
Supply Chain Integration	0.808	0.475	0.183	0.023	0.423	-0.037	0.017	0.682	
Process Innovation	0.744	0.506	0.493	-0.001	0.695	-0.079	0.041	0.397	0.744

The results show that the composite reliability of all the concepts was in excess of 0.7 thresholds for all the constructs. This further confirms the high level of internal consistency among the reflective latent variables. For this reason, a lower indicator reliability of CR is acceptable. Similarly, the convergent reliability is also accepted since the factor loading exceeds the threshold of 0.60. The AVE for all the factors was in excess of 0.50 except in the case of supply chain integration (0.475) and socially responsible management (0.496). This notwithstanding as the factor has minimal correlation with other factors in the model and also because the reliability value (0.823) is in excess of 0.700, it was deemed admissible (i.e., while it is not especially strong internally, it is, at least, a reliable and distinct construct within our model). According to Fornell and Larcker (1981) suggest that if this value is higher than other related values in the potential variable, the AVE square root in each potential variable can be used to establish differentiated validity. The square root of the extracted average variance (A0) is shown diagonally and in **bold** in Table 5.5. The table shows that discriminatory validity has been well established.

Indirect Effect of the Moderator

We did a bootstrap of 2000 sample to find out the indirect effect of the interaction, and details are presented in Table 6.

Table 6 : Path Effect of the Moderator

Parameter			Coefficient	Lower	Upper	P
RSCM	<---	ERM	0.974	5.385	38.256	0.057
RSCM	<---	SRM	0.437	4.549	33.453	0.037
RSCM	<---	SMA	0.713	5.149	36.856	0.019
RSCM	<---	SC	0.970	0.970	0.970	0.008
EP	<---	RSCM	0.053	0.050	0.073	0.014
PI	<---	RSCM	0.037	0.086	0.047	0.036
EP <---	PI <---	RSCM	0.037	0.086	0.047	0.025
EP <---	SCI <---	PSYJI	0.061	0.166	0.026	0.072

Table 6 shows the coefficient of the relationship established through the structural equation analysis conducted. The table shows a positive and statistically significant effect of environmentally responsible management, socially responsible management, supplier's monitoring and assessment, and supplier collaboration on responsible supply chain management. This coefficient of regression values to support these are 0.974, 0.437, 0.713, and 0.970, respectively, and these are statistically significant at a 95% confidence interval. The influence of a responsible supply chain management on environmental performance is explored in the next analysis. The study found out that the coefficient of regression of 0.014 supports the hypothesis that there is a direct relationship between RSCM behaviors and firms' environmental performance. This is statistically significant at a 95% confidence interval as the p-value is 0.053, which is less than 0.05. To determine the mediating effect of process innovation on the relationship between responsible supply chain management and environmental performance, there was the need first to determine the effect of responsible supply chain management on process innovation and the corresponding effect of process innovation on environmental performance. The study shows that a responsible supply chain management behavior significantly causes a change in process innovation. A unit change in a responsible supply chain management behavior causes a 0.037 unit change in process innovation, and this is statistically significant ($p = 0.036$). Correspondingly, process innovation is determined to play a partial mediating role in the relationship between responsible supply chain and environmental performance. This is supported by the fact that process innovation reduces the direct effect from 0.053 to 0.037, as shown by the coefficient of regression. Statistically, this mediating influence is significant as significant value of 0.025 is lower than the 0.05 threshold at a 95% confidence interval. This information implies that while a responsible supply chain management behaviors have a direct relationship with environmental performance, the relationship can be supplemented by activities relating to process innovation. Similarly, the moderating effect of supply chain integration on the relationship between responsible supply chain behaviors and environmental performance is the last hypothesis that was tested in this research. The influential role of the moderator variable is evident in the 0.61 coefficient of regression when the moderator, which is statistically significant at a 95% confidence interval. This finding implies that in the context of responsible supply chain management and its interplay with environmental performance, supply chain integration plays a significant role in improving the relationship. It serves as a strong intermediary that strengthens the relationship to the extent that a higher level of organizational commitment to supply chain integration potentially speeds up the rate at which organizations can achieve far-reaching environmental performance targets.

IV.CONCLUSION

The objective of this chapter was to evaluate the relationship between the responsible supply chain management and the intervening role of process innovation and supply chain integration. The results support the three hypotheses that were formulated. Organizations that want to achieve strong environmental performance must focus on strengthening a responsible supply chain culture. Also, there is a need to ensure a strong process innovation. In the same way, the results confirm previous studies that organizations that want to improve performance through the implementation of responsible supply chain management must ensure supply chain integration. There is the need to ensure close alignment and coordination within a supply chain system to promote linkages among components in the chain and better facilitate decision making to get every part to interact (Seuring and Gold 2013;Gelhard and von Delft, 2016) effectively.

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