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A survey analysis of factors while implementing Green Supply Chain Management (GSCM) practices in manufacturing companies

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ABSTRACT

The present research paper has examined the factors which a company must consider while implementing Green Supply Chain Management (GSCM) practices. Manufacturing companies nearby Bhopal will be examined in their approach to be more sustainable. The research method employed is a case study analysis through Semi-structured interviews held with relevant managers. This research correspond with the Strategic and operational planning, Structure, systems, and decision making Management of people and company culture; Relationships with supply chain members. Top-management support is crucial for effectively working GSCM practices. A flat hierarchical structure might be helpful for successful GSCM, but therefore the inherent advantages of a flat hierarchy have to be exploited. Employee involvement is recognized as another crucial element of GSCM. An environmentally friendly company culture is beneficial and should be derived from the companies' environmental vision and/or mission. Collaborations with suppliers are perceived to be productive and essential to develop innovative products. Other tools, like supplier questionnaires, can help to improve the environmental impact of the whole supply chain.

Introduction

Supply chain management is the fundamental coordination and management of a complex network of activities involved in delivering a finished product to the end-user or customer. All stages of a product's life cycle have influence of supply chain's environment burden, from resource extraction, to manufacturing, use and reuse, final recycling, or disposal .Many businesses around the world have exploited the environment with impunity, without any thought of sustainability. In absence of regulations, companies tend to create products and services based in part on the cost of the public goods, namely the environment. Air and water are polluted and forests are degraded. So far, there are no effective tools to include these additional real costs of a product into its end-price. More and more entrepreneurs and managers are motivated to behave in accordance with their personal or social codes of ethics and want to protect the environment for coming generations. Another driver is the higher awareness of environmental problems from the consumer perspective, which leads to more demand for companies to balance business performance with environmental issue. Still other companies see an opportunity in these developments and want to build a business that generates a competitive business advantage. By responding to consumer demand and adhering to their own moral codes, they can force governments to enact better environmental regulations and can compel competitors to improve their efficiency.

Green Supply Chain Management: an Innovative Approach

Green Supply Chain Management (GSCM) is the term that refers to the way in which organizational innovations and policies in supply chain management respond to the need for a more sustainable environment.

Under the backdrop of globalization, green supply chain management is recognized as a direct and effective mechanism to address environmental problems along the global value chain. Using the purchasing power and consumption behaviors of governments, large enterprises and the public, green supply chain management is a market mechanism for reducing pollution and improving energy and resource efficiency. When combined with effective enforcement of national and regional environmental laws and policies, it can result in the green transformation of entire industry sectors. Green supply chain management can be an innovative tool for environmental management.

Green supply chain management can serve as a significant tool to realize India "green transformation". In the long run, green supply chain management – which takes environmental protection and energy conservation into account during the life cycle of production from design, to resource extraction to manufacturing, marketing and recycling or end-of-life management will not only reduce environmental impact but also optimize resource allocation, making it an innovative system to foster the country's green transformation. As the global financial crisis goes deeper, a growing number of international trade disputes are arising, with trade barriers based on environmental issues being more frequently applied. In general, Indian environmental standards are lower than those of developed countries due to the differences of development stage, but the international community tends to mistake the products of "Made in India" as high-carbon and heavy-polluting products. Today, significant changes have taken place in the international market, and India, as a major exporter, is directly or indirectly forced to address environmental issues that could become barriers to international trade.

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Indian image in manufacturing industry to service industry is globally changing and world market is eagerly accepting the Indian products. A fully realized green supply chain management program would be beneficial not only for India to reduce environmental impacts and energy consumption domestically, but also to avoid the economic risks arising from green barriers to international trade.

Background of Study

Many researchers (Zhu et al., 2005, 2007; Ninlawan et al., 2010) have studied Green supply chain management: pressures, practices and performance within the Chinese automobile industry and Thailand electronics industry. They observed that increasing pressures from a variety of directions improve both their economic and environmental performance. Zhu et al., (2005, 2007) also focused on different dimensions of practices including green procurement, internal environmental management, eco design, customer cooperation, and investment recovery. Hsu, and Hu (2008) studied the green supply chain management in the electronic industry in which they mentioned various approaches for implementing green supply chain management practices, nevertheless no investigation on reliability and validity of such approaches. Shang et al. (2010) and Walton et al. (1998) conducted a GSCM study based eco design, green manufacturing and packaging, environmental participation, green marketing, stock and suppliers.

In another study Ninlawan & Tossapol in 2010 works on the Implementation of Green Supply Chain Management Practices in Electronics Industry in which they aims to survey current green activities in computer parts' manufacturers in Thailand to evaluate green supply chain management and they survey current green activities in computer parts' manufacturers in Thailand, 11 manufacturers are case studies who provide in depth interview about green procurement, green manufacturing, green distribution, and/or reverse logistics. To evaluate green supply chain management, the questionnaire related to investigate GSCM practices, measure GSCM performance, and explore GSCM pressure/ driver within Thai electronics industry is used to obtain survey results. Then suggestions to develop GSCM in electronics industry are presented in the end.

Aim of the Study

To introduce and provide an overview of the various issues related to environmental (green) supply chain management performance measurement. It is important to carry out the research on the relationship between GSCM practices and supply chain performance among Indian Manufacturing firms. In this research, this relationship among Indian enterprises especially in Madhya Pradesh will be empirically investigated. The basic purposes of GSCM practice and performance measure are: external, internal, and eco design analysis (understanding the business better and continuous improvement). These are the fundamental issues that drive the development of frameworks for business performance measurement. It is important to consider both purpose, as well as the interrelationships of these various measurements. Further the three basic performance factors such as resource, output and flexibility is taken under the consideration of research.

Methodology

This study has two measurement models that include GSCM practices, supply chain performance measure, and a structural model. In addition, hypotheses are developed for the research.

A survey is conducted to collect the measuring data for the research. This study uses principle component analysis (PCA) and multiple linear regressions to test and measure posited hypotheses using survey data using SPSS (16.0).

To conduct a Factor Analysis, start from the "Analyze" menu. This procedure is intended to reduce the complexity in a set of data, so we choose "Data Reduction" from the menu. And the choice in this category is "Factor," for factor analysis. The goal of principal component analysis is to reduce an original set of variables into a smaller set of uncorrelated component that represent most of the information found in the original variables. The technique is most useful when a large number of variables prohibit effective interpretation of the relationships between objects. By reducing the dimensionality, you interpret a few components rather than a large number of variables. Standard principal component analysis assumes linear relationships between numeric variables. On the other hand, the optimal-scaling approach allows variables to be scaled at different levels. Categorical variables are optimally quantified in the specified dimensionality. As a result, nonlinear relationships between variables can be modeled.

Reliability of Survey Data

Cronbach's alpha for validity and the reliability analysis confirm alpha values equal to 0.88, 0.73, and 0.88 for the standard practices, and for the performance 0.88, 0.94, and 0.78, which is above 0.70. This ensures the reliability of obtained data. Therefore, it can be concluded that the items listed in the questionnaires contribute to the validity and relevance of the questions and the study.

Correlations Analysis Between Gscm Practices and Supply Chain Performance

The bivariate correlation results, using Pearson correlation coefficients, are shown in Table 1. Results show a significant relationship among internal management, external management, and eco design with each of three supply chain performance types including output, resource, and flexibility. The correlations between GSCM practices and supply chain performance types are in the expected direction.

Table 1. Correlations between GSCM practices and supply chain performance.

GSCM/Practices	1	2	3	4	5	6
GSIN	1.0					
GSEX	0.645**	1.0				
GSED Performance	0.451**	0.428**	1.0			
PEOP	0.506**	0.468**	0.280**	1.0		
PERE	0.378**	0.348**	0.383**	0.292**	1.0	
PEFL	0.561**	0.536**	0.428**	0.524**	0.180*	1.0
*p ≤ .05, ** p ≤ .01						

4.4 Results of Regression of Supply Chain Output on Gscm Practices

To test research question 1, research question 2, and research question 3, the author regressed supply chain output performance parameter on GSCM practices including internal management, external management, and eco design.

As shown in Table 2, R Square value is 0.270. This means that the research model explains 27 per cent of the variance in supply chain output performance. Through the ANOVA table, the model reaches statistical significance (Significant value. =.005, and p ≤ .0

Table 2. Model summary of regression of supply chain output.

Model	R	R square	Adjusted R Square	Std. Error of the Estimate
1	.537a	.289	.270	2.325

a. Predictors: (Constant), GSED, GSEX, GSIN

ANOVA is a general technique that can be used to test the hypothesis that the means among two or more groups are equal, under the assumption that the sampled populations are normally distributed (Swift and Piff, 2010). It was not introduced in the analysis plan section as it was only employed to test whether local manufacturing SMEs from different industrial sectors in the focal area have experienced different GSCM pressures in terms of the three factors. With regard to different items of GSCM practices, differences exist among the SMEs from the other sectors. Taking GSCM practices for example, the mean for internal arising from important performance measurement as output is 5.4 for the SMEs while the mean for flexibility is only 4.2. The corresponding SD values are 2.32 for output and 1.69 for, which suggests that SMEs from GSCM Practices feel a similar intensity with respect to performance measurement, while the intensity of output felt among SMEs from flexibility and resources varies. A similar situation occurs between internal practices in terms of output from national laws and regulations on environmental protection, with the means of 5.4 and 15.7, respectively; this indicates that local industries are under clear regulatory practices regarding employing GSCM strategy, but this kind of practice for industry is not supported, as the mean is below 6. Though differences exist as shown by the different means, ANOVA can help to test whether the differences are significant or not among these different industrial GSCM performance measurement.

Table 3. ANOVA table of regression of supply chain output.

Model	Sum of Square	df	Mean Square	F	Sig.
Regression	254.678	3	84.89	15.7	0.000a
Residual	626.968	116	5.4		
Total	881	119			

a. Predictors: (Constant), GSED, GSEX, GSIN

b. Dependent Variable: O

The test of research question 1 assessed whether GSIN practices were positively related to supply chain output performance. This research question was tested by regressing supply chain output on the GSIN. Results suggest that the higher the level of GSIN practices leads the higher the supply chain output ($\beta = 0.348$, $t = 3.281$, $p \leq .01$), thus research question 1 was supported. Also, Table 4 shows results of significance test for the relationship between GSEX practices and supply chain output performance. The relationship is positive and significant ($\beta = 0.234$, $t = 2.244$, $p \leq .05$). Therefore, research question 2 is strongly supported. Research question 3 proposed that GSED practices are positively associated with supply chain output. The results shows that the relationship between GSED and supply chain output is insignificant ($\beta = 0.015$, $t = 1.172$, $p \geq .05$).

a. Dependent Variable: O

Results of Regression of Supply Chain Resource on Gscm Practices

Supply chain resource performance was regressed on the GSCM practices to test empirically research question 4, research question 5, and research question 6. According to Table 5, R Square value accounts for 0.176., and the model explains 18 per cent of the variance in supply chain resource performance. As shown in Table 5, the regression model has statistical significance (Sig.=.000, and $p \leq .01$).

Table 5. Model summary of regression of supply chain resource.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.444a	.197	.176	1.020

Predictors: (Constant), GSED, GSEX, GSIN

Table 6. ANOVA table of regression of supply chain resource.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	29.582	3	9.861	9.485	.000a
Residual	120.595	116	1.040		
Total	150.177	119			

a. Predictors: (Constant), GSED, GSEX, GSIN

b. Dependent Variable: R

Table 7, shows that the main effects of GSIN ($\beta = 0.203$, $t = 1.803$, $p \geq .05$) and

GSEX ($\beta = 0.116$, $t = 1.048$, $p \geq .05$) were insignificant. Therefore, research question 4 and research question 5 were rejected. However, the main effect of GSED is significant ($\beta = 0.222$, $t = 2.337$, $p \leq .05$), thus, research question 6 was supported.

The negative standardised beta coefficient of ECO (-0.432) theoretically indicates a negative correlation between eco-design practices and flexibility performance. In other words, a higher level of eco-design implementation within an SME will cause a financial decrease for the SME. However, the p-value of 0.52 suggested that the relationship between ECO and flexibility performance is not significant and IEM is the only significant variable with $p = 0.000$.

Table 7. Coefficients of regression of supply chain resource.

Constant	Unstandardized Coefficient (Beta)	standardized Coefficient (Beta)	T	Significant	Lower Bound	Upper Bound
GSIN	0.214	0.119	0.203	1.8	-.021	0.448
GSEX	0.119	0.114	0.1156	1.0	-.106	0.344
GSED	0.245	0.105	0.222	2.3	-0.037	0.452

Results of Regression of Supply Chain Flexibility on Gscm Practices

Regression of supply chain flexibility for GSCM practices is being conducted to prove Research question 7, Research question 8, and Research question 9.

Table 8. Model summary of regression of supply chain flexibility.

Model	R	R Square	Adjusted Value of R	Std. Error of the estimate
1	0.634	0.402	0.386	0.775
Predictors: GSED, GSEX, GSIN				

Table 4. Coefficients of regression of supply chain output.

Constant	Coefficient (Beta)	T	Significant	Lower Bound	Upper Bound
GSIN	0.348	3.281	0.824	0.351	1.422
GSEX	0.234	2.244	0.001	0.068	1.094
GSED	0.015	0.172	0.027	-0.432	0.514

a. Dependent Variable: O

Table 9. Coefficients of regression of supply chain flexibility.

Model	Unstandardized Coefficient (Beta)	standardized Coefficient (Beta)	T	Significant	Lower Bound (95%)	Upper Bound (95%)
GSIN	0.276	0.298	3.06	0.015	.201	.454
GSEX	.240	.267	2.78	0.003	.098	.425
GSED	.19	.20	2.44	0.006	.070	.352

As shown in Table 8, R Square value is 0.402. This value indicated that the research model explains 40 per cent of the variance in supply chain output performance. ANOVA table shows that the regression is statistically significant (Sig.=.000, and $p \leq .01$).

Research question 7 proposed that GSIN practices are positively related to supply chain flexibility. Table 9, indicated that the relationship is significant ($\beta = 0.298$, $t = 3.056$, $p \geq .01$). In addition, GSEX practices are significantly associated with supply chain flexibility ($\beta = 0.267$, $t = 2.787$, $p \geq .01$).Therefore, research question 8 was supported. The test of research question 9 assessed whether GSED practices were positively related to supply chain output flexibility. Research question 9 was supported by the regression results ($\beta = 0.200$, $t = 2.443$, $p \leq .05$).

Conclusions

Using descriptive statistics, the research supported the hypotheses, which address the question of what the current GSCM practices for SMEs in the fixed geographical circumstances are. The results show that Madhya Pradesh manufacturing SMEs in Bhopal region are motivated by internal drivers of GSCM. The ANOVA demonstrated that some differences exist in the extent to which these GSCM Practices are experienced among SMEs from the different industrial sectors investigated in this research work. Similarly, other hypotheses addressed the GSCM initiatives used by SMEs in this area. SME manufacturers have implemented the GSCM initiatives in practices of Internal, external and eco-design. In addition, the discussion on the results explained that SMEs have had different experiences in employing these GSCM practices. Output, resources used and flexibility are positively related to internal, external and eco-design practice performance.

This research makes three major managerial contributions to the existing body of knowledge. First, acceptance for eco design, GSCM practices improves supply chain output performance. Through the multiple regression analysis, this study found that implementing GSCM practices enable organizations to strengthen output such as sales, profit, on-time delivery, and the customer service level. Further, all GSCM practices positively affects supply chain flexibility. Supply chain flexibility stands for ability to respond to uncertainty. In this regard, implementing GSCM practices improves organizations' capacity to handle the supply chain disruption.

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