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# FACTOR ANALYSIS OF GSCM PRACTICES IN INDIAN INDUSTRIES

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***ABSTRACT***

***Supply Chain Management (SCM) has become a critical factor to sustain organization's competitive advantages. In this regard, many firms and researchers have attempted to find out factors that affect either positively or negatively on SCM. Recently, Green Supply Chain Management (GSCM) has been receiving the spotlight in many studies. Social and political concerns about the environment in India emerged in the early 1990s when Indian government established new environmental regulations in order to implement environmental management throughout the entire supply chain. It is critical to conduct the research on the relationship between GSCM practices and supply chain performance among Indian firms. In this research, the relationship among Indian enterprises will be empirically tested.***

***Keywords: GSCM, SCM, Resources, Indian Firms***

## INTRODUCTION

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. GSCM aims to find ways to improve some of the impacts that a company has on the environment. As important as these changes may be for the environment, they are often accompanied by cost savings, improved efficiency, and/or profitable customer awareness. Some companies show commitment to GSCM practices on their websites and might even change their mission statements or something similar, but often this means nothing more than "green washing" (misinformation that presents an environmentally responsible public image) and not a real commitment. The objectives of GSCM are aimed at finding a win-win strategy to benefit the environment as well as the performance of the company. These companies want both to exceed the expectation of the regulators and to satisfy the increasing demands of the customer. These companies strive to go further from compliance to competitiveness.

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## GREEN SUPPLY CHAIN MANAGEMENT

Scott and Westbrook (1991) and New and Payne (1995) pointed out that SCM stands for the chain connecting each element of the manufacturing and supply process from raw materials through to the end users, and handling integration of all participating firms contributions in the supply chain. Over the past decade, SCM has played an important role for organizations' success and subsequently the green supply chain (GSC) has emerged as an important component of the environmental and supply chain strategies of a large number of companies. Although the term "environment" or "greening" has an ambiguous meaning in various fields, the term indicates not only harmonizing corporate environmental performance with stockholders' expectations but also developing a critical new source of competitive advantage in terms of management perspective (Gupta, 1994). According to Gupta (1995), environmental management relieves environmental destruction and improves environmental performance by institutionalizing various greening practices and initiating new measures and developing technologies, processes and products.

In recent years, numerous studies have attempted to find and explore GSCM. Green supply refers to the way in which innovations in supply chain management and industrial purchasing may be considered in the context of the environment. Narasimhan and Carter (1998) define GSCM as the purchasing function including reduction, recycling, reuse, and the substitution of materials. The GSC covers wide areas of GSCM practices and SCM's participants and practices from green purchasing to integrated supply chains flowing from suppliers, to manufacturers, to customers, and to the reverse supply chain (Zhu and Sarkis, 2006; Raoand Holt, 2005).

Brown et al. (2001) suggests two main types of green supply management process: greening the supply process and product-based green supply. Greening the supply process stands for accommodations made to the firm's supplier management activities for considering environmental perspectives. In addition, product-based green supply focuses on changes to the product supplied and attempts to manage the by-products of supplied inputs. According to Pagell et al. (2004), leaders of the logistics and supply chain department should balance low cost and innovation process while maintaining good environmental performance. Through supply chain analysis, organizations are able to check whether environmental issues can be incorporated into industrial transformation processes (Green et al., 1996).

## GSCM PRACTICES

To implement GSCM, organizations should follow GSCM practices which consist of environmental supply chain management guidelines. Numerous studies have tried to identify GSCM practices in organization which are referred to such internal systems as environmental

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and quality management systems. Internal environmental management is critical to improving the organization's environmental performance (Zhu et al., 2008). Zhu and Sarkis (2004) indicate that quality management lubricates implementation of GSCM. They suggest that under rigorous quality control, organizations can improve their environmental practice by learning from experiences of their quality management programs.

Some studies focused on external environmental factors such as customers and suppliers. To improve their own environmental supply chain performance, organizations need the interactions with the government, suppliers, customers, and even competitors (Carter and Ellram, 1998). Cooperation with suppliers and customers has become extremely critical for the organizations' to close the supply chain loop (Zhu et al., 2008).

Importance of the design process in environmental management is well demonstrated by the existing literature. Reuse stands for both the use of a product without-manufacturing and is a form of source reduction. Recycling is the process which makes disposal material reusable by collecting, processing, and remanufacturing into new products (Kopicki et al., 1993). As an environmental practice, resource reduction enables firms to minimize waste which results in more efficient forward and reverse distribution processes (Carter and Ellram, 1998). Eco-design, design for environmental management, enables organizations to improve their environmental performance and close the supply chain loop by handling product functionality while minimizing life-cycle environmental impacts (Zhu et al., 2008).

**THE PROBLEM**

Supply Chain Management (SCM) has become a critical factor for the organization's success. In this regard, many firms and researchers have attempted to find out variables that affect either positively or negatively on SCM. Recently, Green Supply Chain Management (GSCM) has been receiving the spotlight in many studies. According to Green et al. (1997), in the context of the deteriorating environment, GSCM stands for innovations in supply chain management and industrial purchasing. Zhu and Sarkis (2004) suggest that GSCM practices consist of four major dimensions: internal environmental management, external environmental management, investment recovery, and eco design.

**PURPOSE OF THE STUDY**

It is important to carry out the research on the relationship between GSCM practices and supply chain performance among Indian firms. In this research, this relationship among Indian enterprises will be empirically investigated.

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## METHODOLOGY

This study includes GSCM practices, and factors considered while the adoption of GSCM. Supply chain performance measure and the relation among the factors are examined with the descriptive and correlation analysis. In addition, assumptions are developed for the research. A survey is conducted to collect the measuring data for the research. This study uses SPSS (16.0) for the data analysis collected from the survey. The target respondent companies are interviewed with a developed semi structured questionnaire. The respective position of the companies representatives are managers at different level.

## SAMPLE DESCRIPTION

The author received 157 responses on GSCM practices but 36 of them were incomplete and deleted (n=121). The sample statistics are analyzed. Supply chain manager (39%) and logistics manager (25%) mainly consist of job title of respondents since the most of respondents are member of the national Logistics and Distribution Association. In sum, the majority of respondents were supply chain manager from manufacturing firms with more than 900 employees.

## FACTOR ANALYSIS

### GSCM Practices

In this research, 10 items on a seven-point scale (1 = very bad, 7 = very good) was used for measuring GSCM practices including internal environmental management, external environmental management, and eco design.

Table 1: Items for GSCM practices

| | Item no. | Item |
|---|---|---|
| Internal | IN1 | Commitment for GSCM from senior managers |
| | IN2 | Support for GSCM from mid-level managers |
| | IN3 | Cross-functional cooperation for environmental improvements |
| | IN4 | Environmental compliance and auditing programs ISO |
| External | EX1 | Providing design specification to suppliers that include environmental requirements for purchased item |
| | EX2 | Environmental audit for suppliers' internal management |
| | EX3 | Suppliers' ISO14000 certification |
| Eco Design | ED1 | Design of products for reduced consumption of material/energy |

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| | | |
|---|---|---|
| | ED2 | Design of products for reuse, recycle, recovery of material, component parts |
| | ED3 | Design of products to avoid or reduce use of hazardous products and/or their manufacturing process |

The scale items are based on existing literature on GSCM (Zhu and Sarkis, 2004). To measure overall GSCM practices, PCA was used. The items for factor analysis are shown in Table 1.
A factor analysis was conducted to further confirm grouping of GSCM practice and supply chain performance from the survey data. Factors were extracted using the maximum likelihood method, followed by a varimax rotation.

Table 2: Total variance of factor analysis

| | % of Cumulative | | | % of Cumulative | | | % of | | Cumulative |
|---|---|---|---|---|---|---|---|---|---|
| Component | Total | Variance | % | Total | Variance | % | Total | Variance | % |
| 1 | 5.112 | 51.116 | 51.116 | 5.112 | 51.116 | 51.116 | 2.866 | 28.658 | 28.658 |
| 2 | 1.513 | 15.133 | 66.249 | 1.513 | 15.133 | 66.249 | 2.498 | 24.985 | 53.643 |
| 3 | 1.009 | 10.092 | 76.341 | 1.009 | 10.092 | 76.341 | 2.270 | 22.698 | 76.341 |

As shown in Table 2, the Kaiser criterion (Eigen values>1) was employed in conjunction with an evaluation of scree plots. According to initial Eigen value test suggested the presence of three meaningful factors for GSCM practice. This factor analysis divided GSCM practices into three factors: GSCM internal practices (GSIN), GSCM external practices (GSEX), and GSCM eco design practices (GSED).

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**Supply Chain Performance**

Eleven items about GSCM performance were developed by the author based on Beamon's supply chain performance measurement system reflecting supply chain resource, flexibility, and output. Questions about supply chain performance results from implementing GSCM practices were answers using a seven- point scale (1 = strong disagreement, 7 = strong agreement). Items for the supply chain performance model are listed in Table 3.

| Construct | Item no. | Item |
|---|---|---|
| Resource | R1 | Total cost |
| | R2 | Distribution cost |
| | R3 | Manufacturing cost |
| Output | O1 | Sales |
| | O2 | Profit |
| | O3 | On-time deliveries |
| | O4 | Customer response time |
| Flexibility | F1 | The ability to change the output level of products produced |
| | F2 | The ability to change planned delivery dates |
| | F3 | The ability to change the variety of products produced |
| | F4 | The ability to introduce and produce new products |

Table 3: Items for supply chain performance

A factor analysis was used to verify grouping of supply chain performance from the survey data. Like the method to conduct factor analysis for GSCM practices, the maximum likelihood method was used with a varimax rotation.

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Table 4: Total variance of factor analysis

| | | | | Extraction Sums of Squared | | | Rotation Sums of Squared | | |
|---|---|---|---|---|---|---|---|---|---|
| | Initial Eigenvalues | | | | Loadings | | | Loadings | |
| | | % of | Cumulative | | % of | Cumulative | | % of | Cumulative |
| Component | Total | Variance | % | Total | Variance | % | Total | Variance | % |
| 1 | 4.670 | 42.453 | 42.453 | 4.670 | 42.453 | 42.453 | 2.882 | 26.203 | 26.203 |
| 2 | 2.127 | 19.334 | 61.787 | 2.127 | 19.334 | 61.787 | 2.682 | 24.378 | 50.581 |
| 3 | 1.197 | 10.884 | 72.671 | 1.197 | 10.884 | 72.671 | 2.430 | 22.090 | 72.671 |

Total variance of factor analysis table suggested the presence three meaningful factors for supply chain performance in terms of the Kaiser criterion (eigenvalues>1). This factor analysis empirically categorized supply chain performance types into three factors: resource (R), output (O), and flexibility (F).

**Correlations between GSCM Practices and Supply Chain Performance**

The bivariate correlation results, using Pearson correlation coefficients, are shown in Table 5. 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.

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Table 5: Correlations between GSCM practices and supply chain performance

| Scale | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| GSCM Practices | | | | | | |
| (1)GSIN | 1.0 | | | | | |
| (2)GSEX | 0.645** | 1.0 | | | | |
| (3)GSED | | | | | | |
| Performance | 0.451** | 0.428** | 1.0 | | | |
| (4)PEOP | 0.506** | 0.468** | 0.280** | 1.0 | | |
| (5)PERE | 0.378** | 0.348** | 0.383** | 0.292** | 1.0 | |
| (6)PEFL | 0.561** | 0.536** | 0.428** | 0.524** | 0.180* | 1.0 |

*p ≤ .05, ** p ≤ .01

**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 6, 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 (Sig.=.000, and p ≤ .01).

Table 6: 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

**CONCLUSION**

This present research makes three major managerial contributions to the existing literature. First, except for eco design, GSCM practices improve supply chain output performance. Although some studies investigated the relationship between GSCM practices and economic or environmental performance, measuring green supply chain performance with supply chain

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performance measurement systems has received minimal attention. Through the factor analysis, correlation analysis and multiple regression analysis, this study found that implementing GSCM practices enable organizations to strengthen sales, profit, on-time delivery, and the customer service level. Second, because of the cost problem, internal management and external management for GSC do not improve supply chain resource performance. Since organizations usually need more budgets to implement GSCM practices, supply chain resource performance was not enhanced in the research. Lastly, all GSCM practices positively affect 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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