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## ADAPTATION LEVEL OF GREEN SUPPLY CHAIN PRACTICES: AN EMPIRICAL STUDY OF INDIAN AUTOMOBILE SECTOR

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### ABSTRACT

*Green initiatives in supply chain operations of manufacturing organizations have emerged as indispensable approach, which not only reduces the environmental issues but also yields economic benefits to manufacturers. This paper aims to present, current state of Green Supply Chain Management (GSCM) practices' adaptation level in Indian automobile industry. Primary data was collected through questionnaire survey from Pithampur (Madhya Pradesh) and descriptive statistics is being used to analyze data. The research findings show that, in general, Indian Automobile manufacturers have initiated adaptation of environmental friendly practices into their supply chain operations.*

### KEYWORDS

Indian automobile sector, green supply chain management (GSCM), GSCM practices.

### INTRODUCTION

The environmental management has now become a vital issue across the world. Tremendous growth in the production, consumption and transportation has caused the environmental issues such as global warming, climate change and air and water pollution. Besides, manufacturing supply chain is one of the major sources of environmental pollution by release of unnecessary waste and emissions throughout the operations. As a result, environmental issues have become a threat for supply chain activities of manufacturing organizations. Hence, an attempt has been made through this research to investigate adaptation level of GSCM practices in Indian Automobile Sector.

According to the Council of Logistics Management, Supply Chain Management (SCM) is defined as the process of planning, implementing controlling efficient and cost effective flow of material, and related information from point of order to point of consumption for fulfilling customers' requirements as efficiently as possible. Karchu (2009) defined SCM as conscious effort to maximize customer value and sustainable competitive advantage. In addition, SCM involves extraction and exploitation of the natural resources (Srivastava, 2007).

Consequently, it causes environmental degradation. Besides, conflict between natural environment and manufacturing supply chain has become more complex and need of environmental friendly initiatives has raised across full SCM activities; from extraction of resources to disposal of end life of product. GSCM has emerged as add-on to traditional SCM concept. It is the process of incorporating environmental consciousness in the SCM activities. Jung (2011) defined GSCM as fast moving, multidisciplinary field and an effort of organization to integrate environmental requirements with SCM systems.

Green et al. (2012) defined green supply as referred to the way in which innovations in SCM and industrial purchasing may be considered in the context of the environment. Godfrey (1998) addressed GSCM as the practice of monitoring and improving environmental performance in the supply chain.

### LITERATURE REVIEW

The choice of GSCM practices depends up on some external and internal factors of organization like type of operations, nature of product, management policies and support and stage of organization in the supply chain of industry (i.e., supplier, OEMs, distributor). There are numerous studies conducted on GSCM practices. Zhu & Sarkis (2007a) found significant positive relationship between organizational leaning and management support and the adoption of GSCM practices in Chinese manufacturing firms.

In another study Zhu et al. (2008b) performed cross-sectional analysis with four Chinese manufacturing industries: power generating, chemical/petroleum, electrical/ electronic and automobile, to evaluate their GSCM and closing the supply chain loop (reverse logistics). They found the insights capabilities of manufacturers in implementation of GSCM practices and concluded that these practices are not considered equally across the four industries. Hence, GSCM practices implementation level and choice of practice varies as per the industry operations and requirements.

Hsu et al. (2008) developed a model to prioritize practices while implementing GSCM practices in electronic industry. Their findings indicate that supplier management and organizational involvement are the two most important decisions for implementing GSCM practices followed by product life cycle management and product recycling. Zhu et al. (2008a) applied confirmatory factor analysis to construct both first and second order GSCM practices model. They developed standard constructs and scale to implement GSCM practices in manufacturing organizations.

Few studies addressed common practices among manufacturing organizations. Eitayeb & Zailani (2009) empirically investigated the adoption of green supply chain initiatives namely, green purchasing, eco- design, and reverse logistics among ISO 14001 certified manufacturing firms in Malaysia. Eco- design was found to be the most adopted practice followed by green purchasing whereas reverse logistics adoption level found very low. Moreover, they found that manufactures with more number of suppliers are practicing more green purchasing initiatives than lower. They also found that green adoption level is no significantly varied between firm age and type of product.

Zhu et al. (2010) compared implementation of internal environment management, eco - design, customer cooperation, green purchasing and investment recovery in Japanese and China large manufacturing firms. They found that internal environmental management practices as most adopted practice in Japanese manufacturers than Chinese manufacturers. Luthra et al. (2013) identified and ranked strategies for the successful implementation of GSCM practices in Indian manufacturing sector with the help of experts view and Analytic Hierarchy Process (AHP). They divide strategies into four categories namely, non members of supply chain, downstream supply chain members, organizational members and upward stream supply chain members. Lo (2014) investigated the relationship in supply chain position of an organization in the industry and type of GSCM practices adoption. According to literature review, GSCM Practices mainly includes the followings:

- a. Green Design,
- b. Green Procurement,
- c. Green Manufacturing,
- d. Green Packaging,

- e. Green Warehousing & Building,
- f. Green Distribution & Transportation, and
- g. Green Reverse Logistics.

### NEED AND OBJECTIVE OF STUDY

Automobile sector is one of the major contributors in critical environmental issues. Meanwhile, Indian Automobile Sector is also tackling a range of environmental issues in their supply chain. Thus, greening the supply chain has become essential for Indian automobile manufacturers to take global competitive edge. Therefore, this research paper is aimed towards to describe adaptation level of green supply chain practices in Indian Automobile Sector.

### RESEARCH METHODOLOGY

This research is descriptive in nature. Based on available literature, a questionnaire was developed of fifty two identified parameters of GSCM practices and grouped into main seven GSCM practices, which include; green design, green purchasing, green manufacturing, green packaging, green warehousing and building, green distribution and transportation and green reverse logistics.

Data was collected through survey questionnaire on 5 - point Likert scale of 1= not considering it, 2 = planning consider it, 3 = considering it currently, 4 = initiating implementation, 5 = implementing successfully (scale adopted from Zhu et al. 2007b).

The non-probability, convenient sampling, was used to opt for the data from original equipment manufacturers (OEMs) and auto component manufactures situated in Pithampur (Indore) Mandhya Pradesh, India. Pithampur is one of the big auto clusters of India. The questionnaires were emailed to Automobile organizational managers according to their area of expertise in Supply Chain Management/ Production/Logistics. Out of 50 questionnaires, 31 complete questionnaires were received.

### RESULTS AND DISCUSSION

This research aimed to find out the adaptation level of GSCM practices in Indian Automobile Sector. The reliability (Refer Table 1) and descriptive test (Mean and Standard Deviation) of GSCM practices was computed. Out of fifty two practices, only two GSCM practices mean scores were found less than the threshold of 3, which are; use of alternative fuels in transportation (2.71) and collect back used packaging from customers for reuse or recycle (2.94) (Refer Table 2). Therefore, these two GSCM practices are not practicing by selected sample of Indian automobile manufacturers. Table 1 shows that research data is reliable and scored value of more than .70.

TABLE 1: RELIABILITY TEST OF GSCM PRACTICES

Factor	Reliability Test Value ( $\alpha$ )
Green Design	.807
Green Procurement	.878
Green Manufacturing	.872
Green Packaging	.754
Green Warehousing and Building	.818
Green Distribution and Transportation	.826
Green Reverse Logistics	.851
Overall	.954

TABLE 2: MEAN AND STANDARD DEVIATION OF GSCM PRACTICES

S. No.	GSCM Practices	Mean	SD
<b>Green Design</b>		<b>4.05</b>	<b>0.59</b>
1	Design of products for optimum consumption of material/energy	3.84	0.77
2	Design of product for reuse, recycle, recovery of material, components parts & remanufacturing	3.9	0.87
3	Design of products to avoid or reduce use of hazardous of products	4.1	0.94
4	Design of products to reduce waste & costs	4.19	0.74
5	Design of product to meet environmental regulation and safety standards	4.48	0.72
6	Co-operation & feedback with customer in developing eco-design	3.65	1.17
7	Design of product for easy to repair	4.06	1.12
8	Design of product to be energy efficient for users	4.19	0.79
<b>Green Procurement</b>		<b>3.59</b>	<b>0.69</b>
1	Holding awareness seminars for suppliers	3.87	0.76
2	Guiding suppliers to set up their own environmental programs	3.74	0.99
3	Informing suppliers about the benefits of cleaner production and technologies;	4.03	0.83
4	Pressuring suppliers to take environmental actions	3.35	1.25
5	Choice of supplier by environmental criteria	3.71	1.00
6	Environmental audit for suppliers' internal management	3.45	1.15
7	Provide design specifications to supplier that include environmental requirements for purchased items	3.42	1.25
8	Second-tier supplier's environmentally friendly practice evaluation	3.06	0.92
9	Developing a mutual understanding of responsibilities regarding environmental performance	3.29	0.97
10	Require Supplier's ISO 14001 Certification	4.03	0.79
<b>Green Manufacturing</b>		<b>4</b>	<b>0.61</b>
1	Optimization of process to reduce noise	3.71	1.29
2	Optimization of processes to reduce solid waste	3.58	1.17
3	Optimization of processes to reduce air emissions	3.77	1.20
4	Taking environmental criteria into consideration in selection of manufacturing process	3.81	1.13
5	Use of environmental friendly raw materials	4.23	0.76
6	Substitution of environmentally questionable raw materials	4.45	0.50
7	Minimize toxic/hazardous waste during manufacturing	4.42	0.72
8	Production planning and control focused on reducing waste and optimizing materials exploitation	4.29	0.58
9	Process Design focused on reducing energy and natural resources consumption in operations	3.97	0.91
10	Use of cleaner technology process to make savings (energy, water, and wastes)	4.1	0.7
11	Measures taken to reduce material, water & energy used in manufacturing	4.29	0.64
12	Internal recycling of materials within the production phase	3.42	1.20
<b>Green Packaging</b>		<b>3.91</b>	<b>0.77</b>
1	Selection of recyclable packaging material	3.87	1.08
2	Selection of multi-purpose, reusable and cleaner technology in packaging	3.87	0.99
3	Redesigning containers/packaging to minimize materials	3.84	1.15
4	Reduction in packaging materials	4.06	0.77
<b>Green Warehousing &amp; Building</b>		<b>3.81</b>	<b>0.76</b>
1	Reducing energy consumption through solar panels and green roofing options	3.23	1.33
2	Reducing inventory and handling of product	4.1	0.7
3	Standard water systems (e.g. plants and landscaping materials that minimize water waste, use of "grey water" systems)	3.81	1.13
4	Standard Day Lighting system (Installing skylight, use natural light as a interior illumination)	4.03	1.08
5	Use of Energy - efficient material handling equipment	3.71	1.03
6	Use of Energy - efficient lighting system	3.97	0.94
<b>Green Distribution &amp; Transportation</b>		<b>3.68</b>	<b>0.74</b>
1	Redesigning distribution networks to accommodate greater returns	3.39	1.23
2	Use of environment-friendly technology in transportation	3.39	1.23
3	Use of reusable containers /storage equipment	4.13	0.80
4	Use of alternative fuels in transportation	2.71	1.32
5	Effective shipment considering consolidation and full vehicles loading.	3.97	0.98
6	Optimizing location of distribution hubs	3.94	1.09
7	Minimizing frequent shipments	4.19	0.74
8	Periodically Services of the vehicles at service stations	3.74	1.23
<b>Green Reverse Logistics</b>		<b>3.13</b>	<b>1.02</b>
1	Collects back used products from customers for recycling, reclamation of materials, or reuse.	3.23	1.20
2	Collects back used packaging from customers for reuse or recycling	2.94	1.15
3	Requires suppliers to collect back their packaging materials.	3.26	1.29
4	Returns back its products to suppliers for recycling, retaining of materials, or remanufacturing.	3.1	1.24

The descriptive data shows that, in general, Indian Automobile Sector is considering implementation of GSCM Practices into their supply chain. Table 2 shows that, the Indian Automobile Sector (selected sample) has initiated implementation of Green Design (*Mean* = 4.05) and Green Manufacturing (*Mean* = 4) practices in their supply chain management activities. On the other hand, Green Purchasing (*Mean* = 3.60), Green Packaging (*Mean* = 3.91), Green Warehousing & Building (*Mean* = 3.81), Green Distribution & Transportation (*Mean* = 3.68), and Green Reverse Logistics (*Mean* = 3.13) are at the initial level of consideration. Whereas, green reverse logistic is found to be the lowest considered practice in sampled organizations. In addition, the research findings are in similar direction of past research as discussed in literature review.

## CONCLUSION

This research was achieved through extraction of fifty two parameters under seven dimensions of GSCM Practices from the literature available on GSCM and afterwards, pilot study questionnaire was framed to collect empirical data from automobile experts, to find out the implementation level of GSCM practices in Indian Automobile Sector. Out of fifty two parameters, two were found to be less than threshold mean score.

The study found that green design and manufacturing practices has adopted by selected sample and remaining practices are at the initial stage of consideration. Therefore, it can be concluded that Indian Automobile Sector is at the initial stage of implementing GSCM Practices in majority of supply chain functions.

## RECOMMENDATIONS

The results show that Indian Automobile Sector is considering implementation of GSCM practices in their supply chain activities. The Indian Automobile Sector may increase the implementation of green procurement practices like ISO14001 certification and environment audit of suppliers to improve the upward supply chain. Additionally, customer cooperation should be increase to make green design of products. Measurement of carbon footprints during manufacturing should also be increased to improve the environmental and operational performance. It is also suggested that recycling and reuse of used vehicles or components should be also increased to minimize wastage in the environment.

## LIMITATIONS AND SCOPE FOR FUTURE RESEARCH

Research sample is the limitation of this study. Future research can be conducted with large sample. Some other methods, like, case study will be also useful for this area of research.

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