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Sustainable Logistics in Automobile Passenger Vehicle Manufacturing Organizations

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Abstract: Pollution is a big threat to the environment, and logistics is one of the major causes of pollution. Organizations are adopting sustainable practices to overcome this situation. This paper aims to study the various sustainable practices related to transportation, warehousing, packaging, and reverse logistics being followed by organizations, their impact on the organization's performance, and the barriers they face in implementing these practices. The related journals were reviewed, and a study was done in 200 organizations of manufacturing passenger vehicles, including their supplier base. The questionnaires were prepared and tested for reliability & validation before circulation. The data collected were tested for normality, and accordingly, ANOVA and multiple regression tests were carried out using SPSS software. The results indicate that sustainable practices have a positive impact on organizational environmental, economic and operational performance. It also concludes that the organization's size has no impact on sustainable logistics practices, whereas the internal & external barriers vary with the size of the organization. The study can be taken further by researchers for taking a larger number of industries covering other commercial vehicles also. Sustainable logistics practices are very important for organizations to manage environmental issues.

Keywords: *Sustainable logistics, environment, transportation, warehousing, packaging and reverse logistics*

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INTRODUCTION

In the present chapter, an overview of the automobile industries, impact of climate change, logistics and its significance, definitions of logistics and sustainable practices and green supply chain management are discussed. This chapter ends with the statements of the problem, purpose of the study, the contribution of the study, the significance of research work and organization of the remainder of the study.

The economy is emerging globally and changing very fast. The expectations are also changing with the time frame. With this increased demand, there is more dependency on logistics requirements. Logistics has four major essentials, i.e., transportation, warehousing, packaging & reverse logistics. Out of this, transportation is directly related to the creation of pollution through exhaust gases, which results in more greenhouse gases in the environment. This is resulting in thinning of the ozone layer, which is one of the major reasons for global warming. Evangelista, Santoro, and Thomas (2018); Lan, Tseng, Yang, and Huisingh (2020) describe that logistics segment is more prominent due to increase in demand & is the second largest creator of greenhouse gases after power generation; demand is growing. As per Min and Kim (2012), this growing interest sparked a series of new lines of research dealing with various supply chain activities that have important environmental implications, ranging from manufacturing to logistics and

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transportation. Government of India has made strict regulations to upgrade the designs of vehicles which produce less pollution, i.e., upgradation of vehicles pollution norms from BS IV to BS-VI being implemented from April-2020, as per BSES, Bharat Stage Emission Standard.

Problem Statement

There is a big threat to the environment with the increase in production and consumption of products, which causes the raw material sources to diminish, increasing the pollution level and uncontrollable waste generation which is a burden on environment.

Purpose of the Study

In the present scenario, pollution is the major intimidation to the environment. The pollution is being generated largely from transportation after the power sector. The requirement of transportation is growing with the growth in demand. The automobile companies are responsible for pollution generation directly or indirectly, which produces transport vehicles. Therefore, it is important to be studied to visualize how transportation is contributing to vehicular emission and what kind of green practices are being followed by organizations to support in reducing pollution level.

Rationale

Following are the main reasons for choosing the automobile field for the study:

Automobile is one of the major areas which drive the Gross Domestic Product (GDP) in India. As per skill India, the automobile sector of India is one of the largest in the world and accounts for over 7.1% of India's GDP. It also contributes to nearly 22% of the country's manufacturing GDP.

Logistics and transporters are one of the major contributors to exhaust greenhouse gases. As per a study made, India is the third-largest emitter of CO_2in the world; it produces about 2.5 billion metric tons of CO_2per annum. This is the reason to choose the study in automobile.

Objectives of the Study

- To study the logistics and its need in today's scenario
- To study sustainable logistics practices being followed by automobile companies
- To study the barriers affecting the implementation of sustainable practices.
- To study the impact of sustainable logistics on an organization's performance

Contributions of the Study

The study gives a knowledgebase for academia and practitioners to know the sustainable practices being followed by the passenger vehicle manufacturer and its associates, the impact of size of the organization on sustainable practices being followed, the impact of internal & external barriers varying with the size of the organization and the impact of sustainable practices on organizational performance related to environment, economy and operations.

Organization of the Study

This paper includes the literature review done from various journals and related research papers, the methodology adopted, sample question paper and data collected accordingly. It also includes the data analysis and conclusion of the future of the study.

LITERATURE REVIEW

This section contains the review of secondary literature from various journals, books, official reports. The study is done on the related topics majorly on logistics, the impact of logistics on the environment, sustainable logistics practices, green supply chain management, motivations and barriers, the impact of logistics performance on organizational performance. Following are the key points of the literature review:

Govindan, Kaliyan, Kannan, and Haq (2014) focus on finding obstacles to introducing a green supply chain management focused on the quality of procurement. They identified forty-seven types of barriers and put them in racking based on the priority.

Deckert (2014) describes that the logistics business is also growing and becoming more complex as the world

economy expands. Companies can no longer focus solely on economic factors that influence the results of their business. Their business, consumers and other stakeholders need logistics to pay attention to environmental sustainability.

Julka, Subodh, and Lamba (2014) focused on exports and entrance of international companies with higher demand and prices has a beneficial effect on the logistics industry. Third-Party Logistics (3PL) has made its entrance into the Indian logistics industry in India, which is still at a rather preliminary level.

Perotti, Micheli, and Cagno (2015) analyzed that the implementation of Green Supply Chain Practices (GSCP) does not seem to be motivated by a strategic benefit focused purely on sustainability, likely due to a lack of interest/low green knowledge that keeps businesses from perceiving green 3PLs as better than other 'non-green' rivals.

Sanghavi, Rana, Shenoy, and Yadav (2015) describe that to address challenges in today's globalized world, companies have been striving to green their supply chains to tackle challenges like energy efficiency and emissions reduction.

Chauhan, Prakash, Soni, and Badhotiya (2016) describes that "logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory and the related information flows through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment of orders."

Dube and Gawande (2016) studied that implementation of GSCM is a difficult challenge owing to the complexities of GSCM procedures, consumer recognition and products and regulatory cost changes. Badhotiya describe that internal barriers include cost concerns, lack of training, lack of buyer awareness, lack of commitment to management, accounting methods that limit green reporting and cost reductions at the expense of green practices, lack of green incorporation into buying, and lack of legitimacy that resists internal drivers. Similarly, external barriers include regulations, poor supplier commitment and industry-specific barriers.

Evangelista et al. (2018) provide the insight into the essential aspects of green issues in transport and logistics service companies using an empirical framework based on the following five topic areas: effect factors, green actions and effects on results, Information and Communication Technology (ICT) tools supporting green actions, energy efficiency in road freight transport and shipper insight.

INTRODUCTION OF LOGISTICS & ITS SIGNIFICANCE

Logistics is one of the main elements of supply chain management responsible for material handling and storage of materials. As per Stank, Davis, and Fugate (2005), logistics is an integral and significant element of supply chain management. Srivastava (2006) explored the Indian scenario of logistics and its integration with supply chain and supply chain partners. The Council of SCM Professionals describes logistics management as part of SCM that prepares, implements and tracks the safe, successful forward movement and storage of products, services and related information between the point of origin and point of consumption to meet customer requirements.

The Impact of Logistics on Environment

With an increase in logistics demand, there is more impact on the environment as it is resulting in pollution. The logistics have a larger impact on the environment because transport vehicles emit greenhouse gases which contain CO^2, CO, NOx, hydrocarbon & smoke which are dangerous and resulting air pollution as well as thinning the ozone layer which is resulting in global warming (Abukhader & Jönson, 2004; San, 2016). As per Sheu, Chou, and Hu (2005), vehicles moving on the road for material handling emit CO2, which creates pollution, having road accidents and noise pollution as well.

Sustainable Logistics Practices & its Significance

Logistics has basically 4 elements, i.e., transportation, warehousing, packaging & reverse logistics. The sustainable practices are being followed by organizations to minimize the adverse impact on the environment with the increase in demand.

Transportation: Transportation is the main element of logistics as it is creating air pollution and emits greenhouse gases which are resulting in global warming. The initiatives taken to reduce the transportation need and usage of multiple transportation options than only depending upon road transport. 2PL is one of the initiatives to optimize transportation needs. Hertz and Alfredsson (2003) define this that "2PL is an external provider who manages, controls, and delivers logistics activities on behalf of a shipper". As observed by Pagell, Yang, Krumwiede, and Sheu (2004), the

Supply Chain has pressure to ensure cost-effectiveness as well as environmental balancing. To reduce the workload pressure on road transport, it is important to use mix transport arrangement, i.e., use of railways and waterways along with roadways, which will reduce the road overcrowding as well as it will be cost-effective.

Warehousing: The initiatives were taken to use vertical height stackers for material storage to reduce more space or congestion on floor and usage of battery-operated MHE (materials handling equipments) to minimize pollution. Richards (2017) has mentioned in his paper the responsibility of warehouse management and its role in environment balancing by energy reduction, hazardous waste handling & disposal, equipment disposal and use of forklift trucks running with low pollution exhaust.

Packaging: The initiatives were taken to use non-bio-graded material in packaging and recyclable materials to minimize the wastages, which impacts environment, i.e., avoid usage of single-use plastics which is very difficult to recycle or reuse, i.e., transport of material in bins & trolleys which can be recycled. Min and Kim (2012) mentioned in their study that green logistics were important to take care of environmental issues related to hazardous material movement & storage, packaging design to suit the environment, inventory management and warehousing & to have a sustainable transportation system so that pollution generation is reduced to a bare minimum.

Reverse logistics: Reverse logistics take care of the process of reuse of products and materials. The initiatives were taken for products for recycling and reconditioning when products are not in use by remanufacturing and refurbishing activities. The products are used can be recovered to original shape and position after repair. Fleischmann, Beullens, Ruward, and Wassenhove (2009) focused on reverse logistics in their study. They compared the modified logistics system w.r.t. traditional method which is generally being used. They suggested holistic methods for reshaping logistics system. Reverse logistics are also used for moving goods from manufacturing the main plant to suppliers for taking back packaging materials or goods not in use.

Hypothesis

H 1a (Null Hypothesis) *There is no significant relationship among the different size of the organization and sustainable practices (Transportation, Packaging, Warehousing and Reverse Logistics).*

H 1b (Alternative Hypothesis) *There is a significant relationship among the different size of the organization and sustainable practices (Transportation, Packaging, Warehousing and Reverse Logistics)*

H 2a (Null Hypothesis) *There is no significant relationship among the different size of the organization with respect to External and Internal Barriers.*

H 2b (Alternative Hypothesis) *There is no significant relationship among the different size of the organization with respect to External and Internal Barriers.*

RESEARCH METHODOLOGY

The present study is descriptive in nature, supported by empirical evidence from industries. For the purpose, various research articles have been reviewed from journals. The hypothesis made before finalization of questionnaires. The reliability and validation was done before the start of survey. The study made from logistics heads, plant heads of passenger vehicle manufacturers and their tier one Supply Chain Partners (SCP's) and logistics partners. The questionnaires consist of the green logistics practices being followed, challenges and barriers faced by them for implementing the initiative. The study also includes the impact of sustainable practices on the environmental, economic and operational performance of the organization. The data were tested for normality test and based on that hypothesis, tests were conducted using one-way ANOVA and Multiple Regression through SPSS software.

Sampling Design

For sample selection, Automobile passenger vehicles manufacturers i.e., Original Equipment Manufacturer (OEMs) and their tier-one SCPs were selected at pan India level, and these were distributed in 4 major zones of east, west, north & south. As per ET Auto, total 2727 industries exist pan India, including OEMs & tier-1 SCPs, out of which, 2039 industries belong to North & West and balance from South & East. For the study, we have selected 10% sample of North and West zone, which is approx. 200 industries (Figure 1).

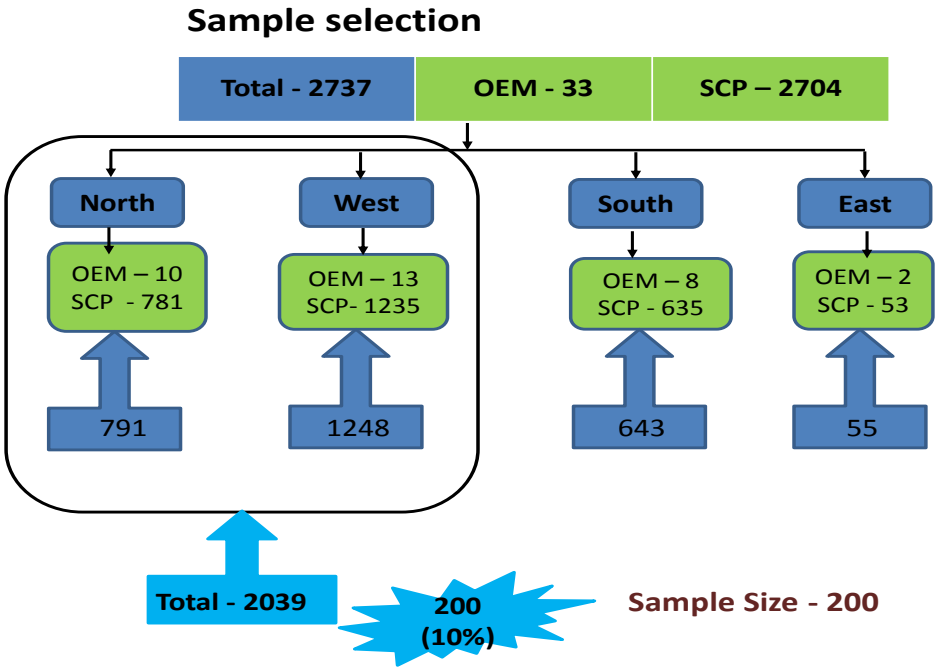

Figure 1 *Sample selection criteria*

Validation and Reliability of Questionnaire

The questionnaire were validated by industries experts and senior professionals. These were modified as per their advice and value addition. The reliability test was done for 55 question items through SPSS and found data was reliable.

Table 1 *Reliability Test*

Cronbach's Alpha	No. of Items
0.891	55

Cronbach's Alpha value requires minimum 0.7 to test the reliability of the data, as the above table results observed 0.891, which means data received are reliable.

Data Collection

The question paper was circulated and collected 200 industries managing directors, plant heads and logistics head. The analysis was done in SPSS software using ANOVA tool for checking relationship of sustainable practices in industries of transportation, warehousing, packaging and reverse logistics as well as internal and external barriers w.r.t. size of a company in the organization. The regression tool was applied for impact relationship on organizational performance of environment; economical and operational w.r.t. sustainable practices followed in industries related to transportation, warehousing, packaging and reverse logistics.

RESULTS AND DISCUSSION

The data were tested by ANOVA and Regression methods through SPSS software; the results are mentioned below:
ANOVA: The analysis was done to determine whether there are any statistically significant differences between the means of two or more independents to understand whether sustainable practices differed based on Size of Organization. Further, in order to use one-way ANOVA, one of the assumptions, i.e., homogenfeity of variances, needs to be tested. Therefore, for testing this assumption in SPSS Statistics, Levene's test for homogeneity of variances was carried out.

Table 2 *Test of Homogeneity of Variances*

	Levene Statistic	df1	df2	Sig.
Sustain- Transport	0.11	2	207	0.90
Sustain- Packing	0.85	2	207	0.43
Sustain- Warehouse	1.01	2	207	0.37
Sustain- Reverse logistics	2.75	2	207	0.07
Barrier-External	1.18	2	207	0.31
Barrier-Internal	1.28	2	207	0.28

Levene's test analysis: $p > 0.05$, i.e., variances among all different groups were found to be insignificant, so the ANOVA test has been performed.

Table 3 *ANOVA Test Results*

		Sum of Squares	df	Mean Square	*F*	Sig.
Sustain- Transport	Between Groups	1.62	2	0.81	1.70	0.19
	Within Groups	129.15	271	0.48		
	Total	130.77	273			
Sustain- Packing	Between Groups	3.35	2	1.68	2.13	0.12
	Within Groups	213.41	271	0.79		
	Total	216.76	273			
Sustain- Ware-house	Between Groups	0.10	2	0.05	0.16	0.86
	Within Groups	84.04	271	0.31		
	Total	84.14	273			
Sustain- Reverse Logistics	Between Groups	0.84	2	0.42	0.86	0.43
	Within Groups	132.20	271	0.49		
	Total	133.04	273			

ANOVA analysis: As *p*-value is > 0.05, i.e., Null Hypothesis is accepted, i.e., there is no significant relationship among the different size of the organization and sustainable practices (Transportation, Packaging, Warehousing and Reverse Logistics).

Table 4 *ANOVA Test Results*

		Sum of Squares	df	Mean Square	*F*	Sig.
Barrier-External	Between Groups	5.16	2	2.58	3.56	0.03
	Within Groups	196.41	271	0.73		
	Total	201.57	273			
Barrier-Internal	Between Groups	7.07	2	3.54	3.88	0.02
	Within Groups	246.65	271	0.91		
	Total	253.72	273			

ANOVA analysis: As *p*-value is < 0.05, i.e., Null Hypothesis is rejected, i.e., There is a significant relationship among the different size of the organization with respect to External and Internal Barriers.

Multiple Regressions

Multiple Regressions was done to determine whether there are any statistically significant differences between the dependent variables with multiple independent variables. Here, multiple regressions are used to understand whether Sustainable Practices differed based on the organizational performance of (i) Environmental (ii) Economical and (iii) Operational. Here, analysis is shown of Environmental performance only due to space limitations.

Sustainable logistics practices relationship with overall environment performance: The table shows that 54.5% variation in the dependent variable (The Overall Environment performance) is being explained by independent variables (Sustainable Reverse logistics, Sustainable Warehouse, Sustainable Packaging and Sustainable Transportation).

Table 5 *Regression Analysis for Sustainable Logistics Practices Relationship With Overall Environment Performance*

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.746a	0.556	0.545	0.301

Table 6 *Regression Results*

Model	Sum of Squares	df	Mean Square	*F*	Sig.
Regression	23.155	5	4.631	51.08	.000b
Residual	18.495	204	0.091		
Total	41.65	209			

As per the above ANOVA table, $p < .05$ and F (5, 204) = 51.081, i.e., the independent variable significantly predicts the dependent variable and the regression model is a good fit of the data.

Table 7 *Impact of SustainablE Practices on Overall Environment Performance*

	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
	B	Std. Error	Beta		
(Constant)	2.567	0.194		13.3	0
Sustainable Transport	0.137	0.056	0.225	2.47	0.015
Sustainable Packing	-0.02	0.037	-0.04	-0.45	0.651
Sustainable Warehouse	0.851	0.059	0.893	14.5	0
Sustainable Reverse logistics	-0.67	0.067	-1	-9.96	0

As $p > 0.05$, i.e., the impact of Sustainable Packing practices on Overall Environment performance is insignificant whereas $p < 0.05$ in all other independent variables (Sustainable Transportation, Sustainable Warehouse and Sustainable Reverse logistics) have a significant impact on Overall Environment performance.

Estimated Model Coefficients

Table data shows that Predicted Overall Environment performance = 2.567+ (0.137x Sustainable Transport) (0.017x Sustainable Packing) + (0.851x Sustainable Warehouse) - (0.671 x Sustainable Reverse logistics) Unstandardized coefficients indicate how much the dependent variable (Overall Environment performance) varies with an independent variable when all other independent variables (Sustainable Reverse logistics, Sustainable Warehouse, Sustainable Packaging and Sustainable Transportation) are held constant.

CONCLUSION

Following is the outcome of the research paper:

- There is no significant relationship of Size of the organization with sustainable practices of transportation, packaging, warehousing and reverse logistics.
- There is a significant relationship between internal and external barriers, which varies with respect to the size of the organization in implementing sustainable practices.
- There is an impact on the overall organizational performance of the environment, economic and operational the implementation of sustainable practices of transportation, packaging, warehousing and reverse logistics.

Research Implications

It can be concluded from the study that size of the organization has no impact on sustainable logistics practices whereas the internal and external barriers vary with the size of the organization and the sustainable logistics practices have positive impact on organizational environmental, economic and operational performance.

Research Limitations

The research paper has limitations to cover a sample size of 10% of industries manufacturing passenger's vehicles and their supply chain partners.

Future Research Directions and Recommendations

The study can be taken further by researchers for taking a larger number of industries covering other commercial vehicles also. Sustainable logistics practices are very important for organizations for managing environmental issues. It should be taken in the main stream because it not only improves the environment but also impacts economic and operational performance as well.

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