

AN EMPIRICAL STUDY ON THE BARRIERS AND APPLICATION OF BEST GREEN SUPPLY LOGISTIC PRACTICES IN MANUFACTURING SECTOR

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Abstract

In recent years, concept of green supply chain management has started gaining importance in India inspite of unclear regulations from the government. Logistics involve not only transportation but also warehousing, packaging, inventory management and material handling. All these activities in logistic make a substantial adverse impact on the environment. Green logistic practices are the need of the hour to reduce the impact on the environment and gain competitive advantage. The major objective of this paper is to empirically analyze the major barriers to implementation of green logistics and to statistically rank the best green logistics practices with respect to Manufacturing Sector in Tamil Nadu. Quantitative approach was carried out to find out the barriers to green logistics and filter out the best green practices with the help of survey conducted among the middle level managers in the operations department of different organizations in Manufacturing Sector in Tamil Nadu. The major barriers emerged from the study are cost of implementation of green logistics, lack of training in green logistics practices, lack of top level management commitment, lack of acceptance in advancement of new technology and practices and lack of skilled human resource. This research study will help the policy makers in understanding the significance of the green supply chain management and the overall sustainability by focusing on green supply chain logistics resulting in positive mindset towards enforcement of environment protection rules and regulations.

Keywords : Logistics, Green Supply Chain Management, Best Green Logistic Practices, Barriers of Green Logistics, Manufacturing Sector.

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Introduction

Traditionally, supply chain management is the coordination and management of complex network of activities which starts from the procurement of raw material till the final product reaches the customer, also involving the reverse flow of products (Reverse Logistics). Each stage in the supply chain leaves a negative mark on the environment by depleting the natural resources, improper waste disposal and carbon emissions (Zhu *et al*, 2014). 49% of the world's carbon dioxide emission is from the transport and industry emission(iea.org, 2015). Green management acts as a panacea for industrial pollution. The concept of Green Supply Chain Management is gradually emerging in order to reduce the risks faced by the environment (Mathiyazhagan *et al*, 2013). The barriers and drivers of green practices need to be researched and understood by the corporates, as otherwise it will lead to mismanagement of resources in the organization (Balajiet *al*, 2014).

Need of the Study

Environmental pollution has been the major problem in the 21st century across all countries. The logistics in business acts as a link connecting the producer and the real customers. Logistics is strategically the most important part of every business. At the same time, logistics has been the forerunner in creating adverse impact on the environment. Carbon and greenhouse gases emissions have been increasing at an alarming rate resulting in climate change. These serious implications bring in the concept of green logistics. Green logistics involves the practices and strategies to reduce the environmental impact and the carbon footprint. The green practices must be understood and implemented by the organizations in order to minimize pollution. Manufacturing sector is said to produce more amount of pollution and so there arises a need to study the implementation of best green practices in manufacturing sector as a part of corporate social responsibility.

Statement of the Problem

With the implementation of government regulations and as part of the corporate social responsibility, it is the need of the hour for the organizations to adapt green practices. The major problem in the implementation of best green practices is lack of comprehensive studies on barriers and recognition of best green logistic practices. The

organizations must be made aware of the options for green logistics to implement it to sustain themselves and the environment. Hence the following objectives of this study.

Objectives of the Study

- To identify the Barriers to green logistics practices in Manufacturing Sector.
- To find the Importance of best green logistics practices with respect to Manufacturing.

Green Supply Chain Management (GSCM)

Green supply chain originated from the idea of supply chain management and sustainable development theory. Traditionally supply chain management has been considered as a process in which the raw material is converted into the final products (Beamon, 1999). A considerable amount of natural resources has been extracted and exploited by the companies in the supply chain process. This exploitation of the environment led to the need of the concept of green supply chain management. Green supply chain management is integrating the environmental aspects, considerations and practices into the traditional supply chain of design, procurement, manufacturing, logistics and waste management thereby reducing the environmental risk and impact (Srivastava, 2007). Indian practitioners and researchers have started examining green supply chain management practices due to the performance pressure from consumers, environmental regulations and drivers (Afroz *et al*, 2019). Long term benefits can be reaped when all the components of GSCM work hand in hand in order to reduce the risk faced by the environment (Wibowo *et al*, 2018).

Facets of GSCM

Green design, Green Procurement, Green manufacturing and Green logistics are the different facets and aspects of green supply chain practices (Srivastava, 2007). Green design denotes the design of products with environmental considerations. Green procurement is selection of suppliers following environmental practices and purchasing the environmental friendly products. Green manufacturing encompasses the usage of green technology in the organization which necessitates environmental development (Paul *et al*, 2014).

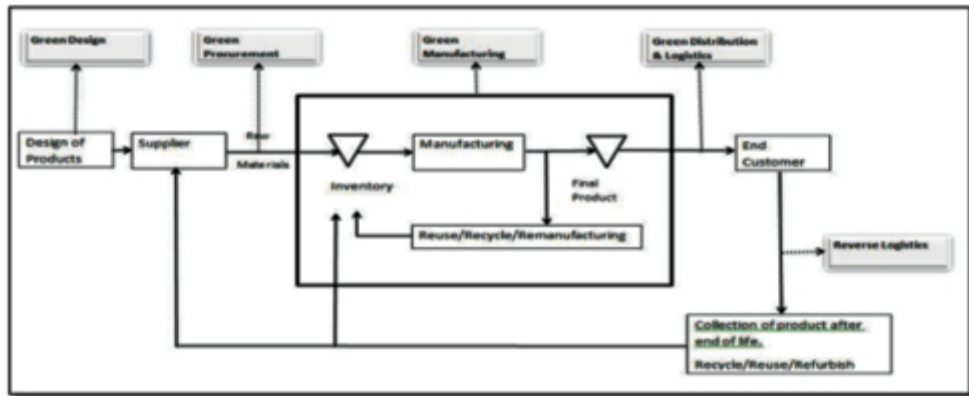


Figure I: Green Practices integrated traditional supply chain (Modified:Ninlawan *et al*,2010)

Green Logistics

Green logistics comprises all the attempts and actions to minimize the environmental impact of the logistics activities. According to Thiellet *al*, (2011), Green logistics, as a concept emerged in the mid 1980's. It originated as a concept to characterize logistics practices and approaches which leverage the advancement in the technology and usage of equipment to minimize the environmental damage during the logistics operations.

Green Distribution

Green distribution involves efficient management of warehouses with less environmental impact, green packaging and green logistics. Various warehouse operations such as storage, material handling and packaging need the extensive use of environmental resources. It also leads to emission of waste. Green warehousing concentrates on reducing the use of resources by following practices such as natural lightings, using renewable energy, heat resistant roofs, recycling the pallets, waste and water management. DHL a leading global forwarding company changed to electric forklifts from diesel forklifts in their new facility at Chicago. The change resulted in cleaner, safer environment along with economic benefit of cost savings for DHL (Supplychain247.com,2016).

Green Packaging

Green packaging uses recyclable materials for packaging. Size and shape of the packaging also plays an important role as better packaging can reduce the material usage, increase the utilization of space, thereby resulting in savings in storage and transportation resulting in reduced use of resources and emissions.(Toke *et al*,2010).

Green Transportation

Transportation is another major contributor for deterioration of the environment. Transportation by air emits 600-1260 g CO₂/tonne km, truck emits 80-340 g CO₂/tonne km, rail emits 20-40 g CO₂/tonne km(iea.org, 2015). Measuring the CO₂ emissions from transportation, consolidation of goods for shipping, clean fuel vehicles, switching from single modal transport to multi modal transport and also placing distribution hubs in a way to support intermodal transport are the common green logistics practices. Mahindra logistics as part of its sustainability initiatives launched a program called FALCON-Freight and Logistics Control which has activities like network and capacity optimization, driver engagement program with training for efficient use of vehicles, asset quality maintenance database for timely maintenance of vehicles and CO₂Emission baseline to capture the carbon foot print from trucks (Mahindra logistics, 2017).

Reverse logistics is the process of moving the product from the consumer, back to the manufacturer for refurbishing, reuse, reduce, remanufacturing, repair or recycling (Srivastava,2007). Reverse logistics practice has been in practice in India from the olden days in the form of paper and aluminum recycling. Now many companies have started getting involving in reverse logistics. Green dust, an Indian Reverse logistics company procures the damaged or defective product from the OEM (Original equipment manufacturer), refurbish/repair them and sell them online at a discounted price with warranty (Economic times, 2014).

Drivers of Green Logistics

Extensive Literature review reveals that the drivers for the implementation of green logistics canbe divided into two categories such as Internal and External drivers.

Government Regulations:

One of the major external drivers for the companies to move towards green practices is the government regulations and legislations (M. A. A. Rhman and R. L. Shrivastava, 2011). Government regulations pushes the industry towards sustainability and creating a healthy competition which in turn benefits the environment as well as the customers.

Market/Consumer:

Consumer's behavior patterns play a major role in the integration of green logistics. According to Paçoet *al*, 2009, customers are moving towards environmental friendly products. In the automobile logistics industry, OEM's are the major customers for the logistics companies. The sustainability strategy of the OEM's drives the logistics companies to go for practices which support sustainability.

Top Management Commitment:

Internally top management has been the major driver for the green logistics practices. But lack of top management commitment has been the major barrier for many of the companies in the logistics industry for the implementation of green logistics.

Cost Reduction:

The ultimate aim of any business is to reduce costs and generate profits. Previous researches have supported that adopting green practices can reduce the cost (Y. Aganet *al*, 2013). This advantage makes cost reduction as one of the major internal drivers for the green logistics.

Barriers for the Implementation of Green Logistics Practices

The following barriers were identified from the extensive literature review.

- Cost of implementation for Green logistics – Companies needs high amount of capital to implement green practices such as green packaging, labeling, manufacturing, etc. **(Balasubramanian, S. 2012)**.
- Customers' unawareness towards GSCM products and services **(Sharma, 2012)**.
- Lack of acceptance of advancement in new technology - Emphasises the importance of accepting the evolution of technology, and adapting to change by replacing the old systems used in an established organization **(Balasubramanian, S. 2012)**.
- Lack of government initiative systems **(Balasubramanian, S. 2012)**.
- Lack of integration of IT systems **(Balasubramanian, S. 2012)**.
- Lack of knowledge and experience – this barrier denotes the lack of knowledge in green logistics among the customers and stakeholders **(Holt *et al*, 2009)**.
- Lack of top management commitment – refers to the resistance from the top management for the green practices **(Min & Galle, 2001)**.

- Lack of training in GSCM – refers to the Lack of training that employees of an organization receive, therefore hampering the implementation of green practices in the supply chain (Carter & Dresner, 2001).
- Uncertainty and competition in market – refers to the global competitiveness and unpredictable customers' requirements (Mudgal, R.K *et al*, 2010).

Research Methodology

Quantitative approach was carried out to find out the barriers to green logistics, filter out the best green practices with the help of survey conducted among the middle level managers in the operations department of different organizations in Manufacturing Sector in Tamil Nadu. 53 questionnaires were received in which only 50 was considered to be valid and used for the study.

Research Instrument and Data Collection

The study involves quantitative approach of research. Survey method was used by using questionnaire as the data collection tool. Questionnaire had been developed with Section A comprising of the demographic details, Section B concentrating on the barriers to green practices in different organizations in Manufacturing Sector, Section C on the importance of best green practices with respect to different organizations in Manufacturing Sector. Likert scale options ranging from 1 to 5 had been used for measuring the importance of items with 1 being very important and 5 being least important and for measuring the barriers option 1 meant strongly agree and option 5 meant strongly disagree.

Data Analysis and Interpretation

The Statistical package tool (SPSS) version 20 was used to analyze the data.

Reliability Analysis

Below table present the results of reliability test.

TABLE 1: Reliability Scores for Final Test:

Variables	Number of Items	Cronbach's Alpha Score
Barriers to green logistics practices	10	0.782
Importance of green logistics practices	10	0.797

Cronbach's alpha score for the variables was above 0.75 which indicates that all the items are positively correlated to one another and internally consistent.

Barriers of Green Practices

The Mean values of the barriers are shown in Table 5.4. The 10 barriers in the questionnaire were evaluated on a five point scale (1 being Strongly Agree and 5 being Strongly Disagree).

TABLE 2: Descriptive Statistics of Barriers of Green Practices:

	Lack of training in Green logistics practices	Lack of Integration technology systems	Lack of acceptance in advancement of new technology and practices (like RFID, cross docking etc)	Lack of skilled human resource professionals in sustainability and Green logistics	Uncertainty and competition in market
Mean	1.80	2.60	1.88	2.00	2.20
Std. Deviation	.881	1.414	.824	.926	1.161
Variance	.776	2.000	.679	.857	1.347
	Lack of knowledge in green logistics	Lack of top level management commitment	Lack of government Regulations and policies for Green logistics	Cost of Implementation of green logistics	Customer's unawareness towards green logistics practices
Mean	2.86	1.82	2.32	1.64	2.60
Std. Deviation	1.325	.748	.794	.693	1.340
Variance	1.756	.559	.630	.480	1.796

Inference:

The above result shows that **cost of implementing green logistics** is the most major barrier whereas lack of knowledge in green logistics barrier ranks last.

Importance Level of Best Green Practices in Manufacturing Sector

The mean values of the importance of green practices are shown in the table. All the variables were evaluated on a five point scale (1 being Very Important and 5 being Least Important).

TABLE 3: Descriptive Statistics of Importance of Green Practices:

	Paper reduction in logistics processes	Implementation of Automatic Warehousing Systems(AWS)	Carbon Footprint assessment	Usage of different packaging technologies and materials to reduce contamination	Solar roof top in warehouses
N Valid	50	50	50	50	50
Mean	1.42	3.00	1.96	1.78	2.22
Std. Deviation	.575	.948	.638	.887	.864
Variance	.330	.898	.407	.787	.747

	Training for drivers	Monitoring fuel consumption of vehicles	Electric Forklifts instead of diesel Forklifts	Reconditioning and reuse of pallets and containers	Onsite recycling
N Valid	50	50	50	50	50
Mean	2.28	2.10	1.70	1.44	3.12
Std. Deviation	.809	.763	.735	.705	1.023
Variance	.655	.582	.541	.496	1.047

Inference: The results from the above table show that Paper reduction is considered most important and onsite recycling being the least important of the above practices with respect to Manufacturing Sector. Onsite recycling is said to be a function of reverse logistics and is found to be the least important best green practices because it is not feasible for implementation in the manufacturing sector.

Difference in Perspectives among the Experienced Groups on the Barriers to Green Logistics in Manufacturing Sector

One way ANOVA analysis was performed to find out any difference in perspectives about the barriers to green logistics among the experience groups.

The results indicate that there is a significant difference in perspectives among the experience groups for the following barriers

- Cost of Implementation of green logistics (sig = 0.044)
- Customer's unawareness towards green logistics practices (sig = 0.045)
- Lack of knowledge and experience (sig = 0.001).

Mean values indicate that employees in the experience group of 5-10 years(mean = 3.30) and more than 10 years(mean = 3.9) don't think lack of knowledge and experience

as a barrier whereas employees with experience less than 1 year (mean = 1.6) perceive it as a barrier. Employees with less than 1 year experience (mean = 1.6) consider customer's unawareness towards green logistics practices as a barrier whereas employees from experience group more than 10 years(mean = 3.4) feel the opposite, while the results show that experience group having experience more than 10 years(mean = 1.2) consider cost of implementation as a barrier .

Difference in Perspectives among the Experience Groups on the Importance of Best Practices

The ANOVA results indicate that there is no significant difference among the experience group on the best green practices.

Findings

All the employees surveyed gave yes in response to the question about their awareness about the green practices. This shows that the major concern in the manufacturing sector is not about awareness but rather the barriers in the implementation of green logistics. Table 1 summarizes the ranking based on mean values of barriers and importance analyzed from responses in Section B and C of the questionnaire.

TABLE 4: Summary and Ranking of Top Five Barriers and Importance of Green Practices:

BARRIERS OF GREEN PRACTICES		
BARRIERS	MEAN VALUE	RANK
Cost of Implementation of Green Logistics	1.64	1
Lack of Training in Green Logistics Practices	1.80	2
Lack of Top level Management Commitment	1.82	3
Lack of Acceptance in Advancement of New Technology and Practices	1.88	4
Lack of Skilled Human Resource	2.00	5

IMPORTANT GREEN PRACTICES		
IMPORTANT	MEAN VALUE	RANK
Paper Reduction in logistics processes	1.42	1
Reconditioning and Reuse of pallets and containers	1.44	2
Usage of different packaging technologies and materials to reduce contamination	1.78	3
Carbon Footprint Assessment	1.96	4
Monitoring Fuel Consumption of Vehicles	2.10	5

Inference

The mean value result shows that cost of implementing green logistics is the major barrier, which is followed by lack of training in green logistics practices, lack of top level management commitment, lack of acceptance in advancement of new technology and practices (like RFID, cross docking, etc), lack of skilled human resource professionals in sustainability and green logistics, uncertainty and competition in market, lack of government regulations and policies for green logistics, lack of integration technology systems and customer's unawareness towards green logistics practices, whereas lack of knowledge in green logistics ranks last.

The results show that Paper reduction is considered most important, which is followed by reconditioning and reuse of pallets and containers, electric forklifts instead of diesel forklifts, usage of different packaging technologies and materials to reduce contamination, carbon footprint assessment, monitoring fuel consumption of vehicles, solar roof top in warehouses, training for drivers, implementation of Automatic Warehousing System (WAS) and onsite recycling is the least important of the above practices with respect to Manufacturing Sector. Onsite recycling is said to be a function of reverse logistics and is found to be the least important best green practices because it is not feasible for implementation in the manufacturing sector.

Suggestions

Based on the past literature and the analysis, the author of this paper proposes certain suggestions for overcoming the barriers of green supply chain practices. Since cost emerged as a major barrier in the implementation of green supply chain management the companies can treat it as part of their CSR activities which is mandatory under the companies act 2015 as the implementation of green supply chain management leads to not only reduction in air pollution but also reduces the waste as a whole impacting the society in a positive way. Though initially the cost of production is high it will bring benefits in the future through various practices like paper reduction i.e. minimal usage of resources, providing training to drivers will help in lowering the transportation costs. Eg: Changing Truck Fleets – Older vehicles with lower efficiency and higher emission can be changed to newer fleets. This exercise needs the collaboration of the vehicles vendors since the company does not own any of the fleets.(Mahindra logistics, 2017). This collaboration of vehicle vendors aids in minimizing the cost. The next major barrier is lack of training drivers in green logistics practices. It is the responsibility of the organizations to clear this lacuna by providing appropriate training programs for implementing green logistics practices. Proper training should be given to drivers so that they use minimum fuel and this will lead to reduction in the transportation cost. The following are the best green practices which can be implemented in order to eliminate the second most important barrier. Asset Quality Maintenance – Daily checks and scheduled maintenance of vehicles with the help of database (Mahindra logistics, 2017), Alternate Fuels – Environmentally friendly fuels can be used for the vehicles for short transportation. (Mahindra logistics, 2017), Reducing engine idling – Trucks can be preset to switch off if it idles for too long. This reduces the fuel wastage and carbon emission.(Toke *et al*, 2010), Multimodal Transport – The transport network can be optimized in a way to use multimodal transport for the logistics operations (Supplychain247.com, 2016), Load Optimization – Space in the trucks should be optimized for maximum usage (Toke *et al*, 2010) and Safety Manuals – Safety manuals can be given for the truck drivers. The third major barrier is found to be lack of top level management commitment. The implementation of green supply chain management practices involves change and for any change process to be successful the top level management commitment is must. Decision making should help in implementing change. Thus for successful implementation of green logistics, top level managers must

take decisions to implement the required change. The fourth most important barrier is lack of acceptance in advancement of new technology and practices. Organization's resistance to technology advancements and lack of management commitment has been the major deterrent to the green practices in the company. Participation & involvement of employees in the process of change management in terms of bringing new technology for green logistics will result in unsuccessful implementation of change. Green Innovation is defined as "hardware or software innovation that is related to green products or processes, including the innovation in technologies that are involved in energy-saving, pollution-prevention, waste recycling, green product designs, or corporate environmental management" (Chen *et al*, 2006). Green Innovation broadly covers the effect and emissions of green-house gases, resource shortage and alternative energy (Reuvers, 2015). Knowledge is enunciated as one among the key variables of innovation; without which there is absence of innovation. Despite the sound technical knowledge in the process of green innovation, the application of this knowledge in the organization is yet to gain momentum. Thus the process of green innovation involves not only acquiring new green knowledge but also implementing the acquired green knowledge (OECD, 2000). Eg: Tracking and Tracing systems – Tracking and tracing technologies such as RFID can be used to increase the efficiency of the logistics and warehousing operations (Supplychain247.com, 2016). Carbon capture and storage (CCS) is an essential group of technologies to combat climate change. As part of a portfolio of technologies, it can help mitigate CO₂ emissions from industrial sectors such as steel, cement, chemicals and refining, as well as from electricity production from fossil fuels (<https://webstore.iea.org/carbon-capture-and-storage-2015>). The fifth barrier is found to be lack of skilled human resource. Unskilled human resource creates more wastage in organization. For example for packing and unpacking, machines can be used which requires technical operation skills but if the employees are not trained in these skills then it will lead to unsuccessful change in the organization. In order to implement green practices in the organization the employees must possess required skill which can be improvised by attending workshops, courses, etc. Various other barriers emerged are uncertainty & competition in market, lack of government regulations and policies for green logistics, customer's unawareness towards green logistics practices, lack of integration technology systems and lack of knowledge in green logistics. Few companies like Nestle and Heineken have already incorporated green supply chain

management initiatives. Eg: Nestle employed a worldwide company based sustainability program which incorporated services related to re-using, energy recovery and recycling, and reaped significant amount of financial as well as environmental profits (www.nestle.com, 2013). Heineken formulated “Drop the C” program in order to reduce the fuel consumption as a part of a green supply chain management initiative (www.theheinekencompany.com, 2018). A separate research and development center can be established to identify and implement various activities that will promote sustainable green chain development.

Conclusion

This study is a first step in manufacturing Sector for its transformation into a sustainable industry. Sustainability cannot be achieved in single day and it can be achieved only by continuous improvement. This paper identifies some of the important green practices which is the need of the hour for gaining a competitive advantage and logistics cost reduction. This study empirically ranks the green practices which should feature in the future of the company's operations. Cost implication is the major barrier for the integration of green practices in the company. By working on the barriers enumerated in the study and application of best green logistic practices, the organizations can move towards the path of green supply chain practices. Strong management commitment and training in the green technologies will surely help organizations towards a cleaner and sustainable environment. Further research and study can be undertaken to find out more areas of improvement and planning of green practices framework involving employees for implementation.

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