

Green Supply Chain Management - Barriers & Drivers: A Review

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Abstract:- Green Supply Chain Management (GSCM) has emerged as an important organizational philosophy to reduce environmental risks, but there are many Barriers as well as Drivers which affects directly and indirectly to the implementation of GSCM in an organization (different at different levels and with respect to organization's level of development). In this paper a total number of 20 Barriers and a total number of 16 Drivers are identified through extensive literature review and expert opinion to academics. These Barriers and Drivers are almost common for various organizations for the adoption and implementation of GSCM in them.

Keywords: - Green Supply Chain Management, Barriers and Drivers.

I. INTRODUCTION

Today, environmental pollution is the main problem which has the potential to lead to the extinction of mankind on earth if not addressed at this moment. Of the various kinds of pollution, air pollution is the one which needs immediate attention. Global warming, an effect due to the increase in amounts of the green house gases present in air is the most severe problem mankind is facing at the moment. The amount of carbon dioxide which was found to be roughly around 280 parts per million before industrial revolution has reached to a proportion of 380 parts per million, and its rise has accelerated. At present we have been adding 2 parts per million annually. It was found that a rise in carbon dioxide proportions to more than 450 parts per million would lead to an increase in temperature up to 2 degrees centigrade which would result in faster and irrevocable melting of Greenland and Antarctic ice. The increased 2 degree centigrade in atmospheric temperature will lead in increase of energy consumption to achieve and maintain the temperature of human comforts. Melting of Greenland ice itself is expected to increase the sea level by 23 feet, which means that the face of earth will be changed beyond recognition. Without proper action, it will be merely impossible to stop at 450 ppm. For that to happen, large scale technological and social changes instigated by financial and political inputs are necessary (Johnny C. Ho et. al. 2009; McKibben 2007).

Automobile sector exhaust accounts for more than 75% of total air pollution. Automobiles are responsible for 80% of total CO emission, 36% of the HC's, 44% of the NOx, 4% of SOx and 18% of the particulate matter. Environmental management system refers to the protection of our surrounding environment and utilizing our natural resources in most efficient way. Automobiles are responsible for over 75% of total pollution in India. If we look for different options for protecting the environment then GSCM is the most suitable and efficient one.

GSCM is one of the best strategies for meeting the challenge to reduce carbon emission and enhance sustainability because of its potential to improve the environmental performance of any organization (S. Balasubramaniam 2012). Along with the rapid change in global manufacturing scenario, environment and social issues are becoming more important and compulsory in managing any business (Sunil Luthra et al. 2010).

GSCM is an approach to improve performance of the products and processes keeping in mind to the requirements of the environmental regulations predefined by government and aims at confining the wastes within the industrial system so that energy resources are conserved and prevent the dissipation of harmful materials into the environment, including all phases of product's life cycle which includes the design phase, production phase and the distribution phase to the end users of the product and also its disposal at the end of product's life cycle.

Patrick Penfield of the Whiteman School of Management defines Green Supply Chain Management (GSCM) as *"the process of using environmentally friendly inputs and transforming these inputs into outputs that can be reclaimed and reuse at the end of their life cycles thus, creating a sustainable supply chain"*²⁹.

GSCM as a process includes all the processes and operations of a manufacturer starting from emergence of a product's concept, its design, raw material selection and extraction from the suppliers, transport facilities from suppliers to manufacturing plant, manufacturing processes/methods/operations/machines, finished product to retailers/distributors through transport facilities, then transport

to customers and also after the end of life cycle of the product – customer to disposal of the product.

The environmental impacts at each stage of the supply chain are minimized and focus on the utilization of energy and resource (of an organization) for making environmentally sound supply chain.

It is important to integrate environmental management practices into the entire SC in order to achieve a greener SC and maintain competitive advantage. Accordingly, Srivastava (2007) defines GSCM as, “integrating environmental thinking into SCM, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the

consumers as well as end-of-life management of the product after its useful life”.

According to Rao and Holt (2005), GSCM practices should cover all SC activities, from green purchasing to the integration of life cycle management, through the manufacturer and customer, to closing the loop with reverse logistics. Several green practices at the product level are described in the literature, including eco-design (Linton et al., 2007, Zhu et al., 2008b) and design for product recyclability (Chen and Sheu (2009). Another practice which is commonly referred to is reverse logistics (Srivastava, 2007).

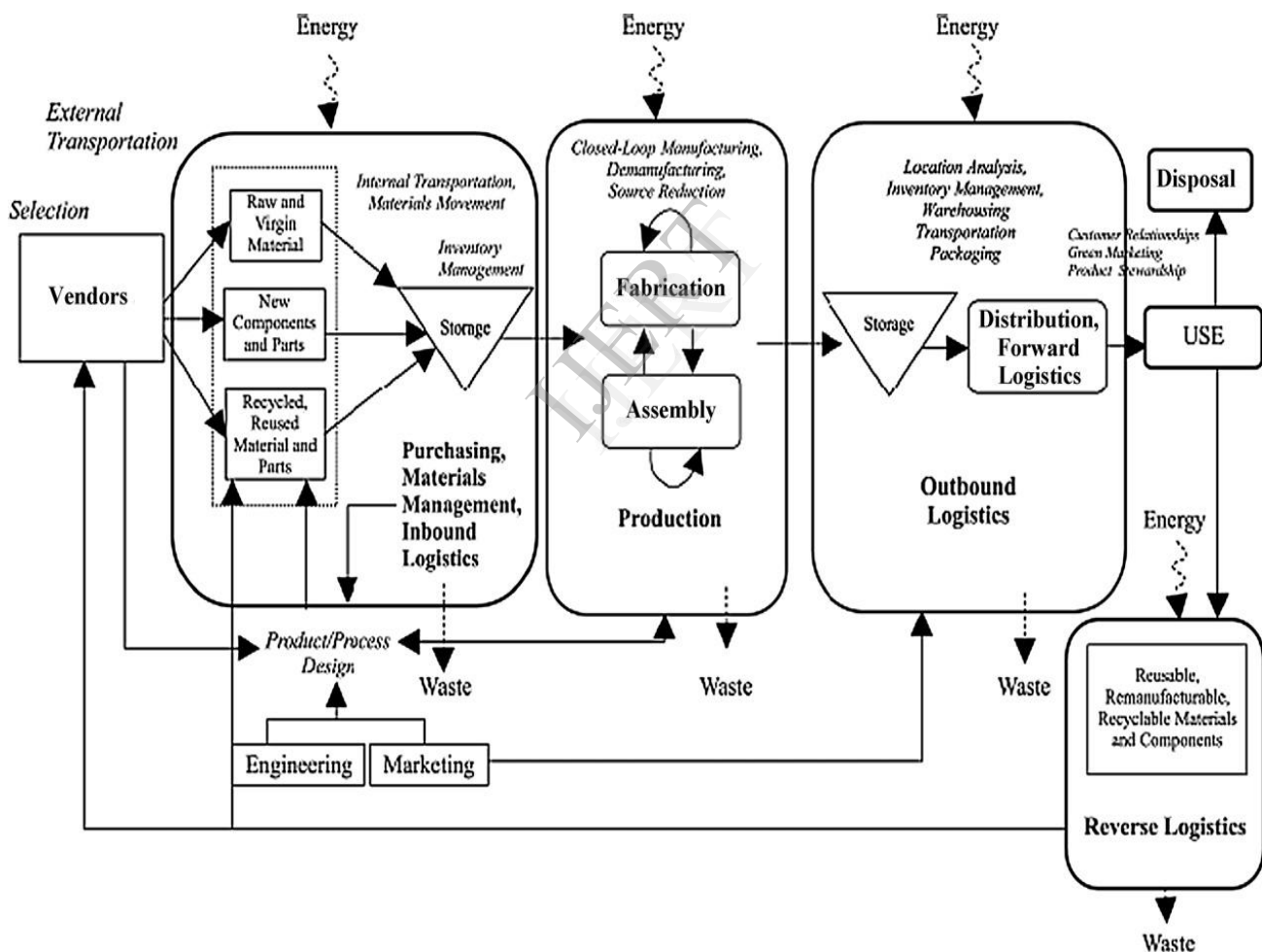


Figure 1: Process involved in green supply chain management (Source: Ali Daibat et. al. 2011)

II. LITERATURE REVIEW

A number of authors have referred to the green supply chain over the past decade as a result of emerging environmental management topics. Approaches towards Green Supply Chain

Management (GSCM) practice have been identified by various researches; they are briefly outlined in the below Table I and the different journals which were reviewed are enlisted with their respective year of publishing is outlined in the Table II.

TABLE I: Concepts and models related to environmental issues have been suggested by different researchers is summarized in the following table:

Year	Title	Author	Description
2012	An Overview of Green Supply Chain Management in India	Nimawat Dheeraj & Namdev Vishal	The paper seeks out environmental performance index (EPI) of India and four activities of the green supply chain management; namely green purchasing, green manufacturing, green marketing and reverse logistics.
2012	Examining Green Production and its Role within the Competitive Strategy of Manufacturing	Tim Banies, Steve Brown, Ornella Benedettini, Peter Ball	It relates and summarizes the core knowledge on green production, aligns to production and operations management prospective.
2012	A Hierarchical Framework of Barriers to Green Supply Chain Management in the Construction Sector	Sreejith Balasubramanian	In this paper barriers are identified and then they are classified as external and internal barriers to the organization which help policy makers to focus on specific barriers important to the adoption of GSCM in the UAE construction sector.
2012	Modeling the Knowledge Sharing Barriers using an ISM Approach	B. P. Sharma, M. D. Singh and Neha	Variables which resists knowledge sharing (KS) in the organizations are known as Knowledge Sharing barriers (KSBs) were identified and ISM model is proposed showing solutions.
2011	Barriers to implement Green Supply Chain Management in automobile industry using Interpretive Structural Modeling (ISM) Technique – An Indian Perspective	Sunil Luthra, Vinod Kumar & Abid Haleem	An industry based approach was used to develop a structural model of the barriers to implement green supply chain management.
2011	An Analysis of the Drivers Affecting the Implementation of Green Supply Chain Management	Ali Diabat & Kannan Govindan	A case study approach is used to identify various drivers of green supply chain management for a manufacturing firm.
2011	Drivers of Green Supply Chain Management Performance: Evidence from Germany	Large, R.O. & Thomsen, C.G.	The paper seeks to evaluate two practices – green supplier assessment and green collaboration which impacts purchasing department and environmental commitment of the firm. Out of this commitment influences green assessment directly and environmental performance impact purchasing performance directly.
2011	The Influence of Greening the Suppliers and Green Innovation on Environmental Performance and Competitive Advantage in Taiwan	Chiou, T.Y., Chan, H.K., Lettice, F., & Chung S.H.	The paper aims at providing empirical proofs to encourage companies to implement GSC and green innovation in order to improve their environmental performance, and to enhance their competitive advantage in the global market and uses Structural Equation Modeling that verifies the significance of the proposed relationships among the selected variables.
2011	Sustainable Production: Practices and Determinant Factors of Green Supply	Xianbiag Liu, Jie Yang, Sixiao Qu,	A special emphasis is laid on companies' overall green supply chain practices, which is measured by

	Chain Management of Chinese Companies	Leina Wang, Tomohiro Shishime and Cunkuan Bao	using data from various respondents in a questionnaire survey.
2011	Research on the Performance Measurement of Green Supply Chain Management in China	Yan Li	The paper tries to improve the environmental performance by implementing a variety of GSCM practices in additionally top level manager's commitment is necessary for development of any GSCM program.
2010	Evaluating Green Supply Chain Management among Chinese Manufacturers from the Ecological Modernization Perspective	Zhu, Q., Geng, Y., Sarkis, J., & Lai, K.H.	The study includes a comparison between Chinese manufacturers and Japanese manufacturers which implies more significant improvements made in environmental and financial performance and additionally four other GSCM practices were implemented.
2009	Opportunities in Green Supply Chain Management	Jonny C. Ho, Maurice K. Shalishali, Tzu-Liang Tseng and David S. Ang	A comparison is performed between traditional and green supply chain. It includes several important opportunities in green supply chain management, including those in manufacturing, bio-waste, construction, and packaging.
2009	An Empirical Study of Green Supply Chain Management Practices Amongst UK Manufacturers	Daine Holt and Abby Ghobadian	The paper identifies various operational activities within a supply chain and also suggests the factors which are driving these operational changes.
2008	Environmental Management System and Green Supply Chain Management: Complements for Sustainability?	Nicole Darnall, G. Jason Jolley and Robert Handfield	The paper evaluates a relationship between environmental management system (EMS) and green supply chain management (GSCM) practices.
2008	Influences, Practices & Opportunities for Environmental Supply Chain Management in Nova Scotia SMEs	Raymond P.C., Lopez J., Marche S., Perron G.M. & Wright R.	This paper demonstrates that opportunities exist to reduce greenhouse gas emissions and solid waste within supply chains using environmental performance and environmental issues as working variables.
2008	Drivers for the Participation of Small and Medium-Sized Suppliers in Green Supply Chain Initiatives	Su-Yol Lee	The paper shows that buyer's GSC practices, readiness and participation, also government support plays a vital role in motivating small and medium-sized suppliers towards GSCM practices.
2008	Knowledge management barriers: An interpretive structural modeling approach	M. D. Singh and R. Kant	The paper identified KM barriers to the organization and a relationship among them is made, further giving solutions by using ISM methodology.

TABLE II: Journals Reviewed for literature

Sr. No.	Year of Published	Journals Reviewed
1.	2012	Research Journal of Recent Sciences (Vol. 1)
2.	2012	International Conference on Information & Knowledge Management (Vol. 45)
3.	2012, 2011	Journal of Industrial Engineering and Management
4.	2012	Journal of Sustainable Development (Vol. 5)
4.	2011, 2008	Business Strategy and the Environment
5.	2011	Resources, Conservation and Recycling
6.	2011	Journal of Purchasing and Supply Management (Vol. 17)
7.	2010	Transportation Research Part E, 47
8.	2011	Journal of Sustainable Development (Vol. 4)
9.	2008	Business Strategy and the Environment
10.	2009	The Coastal Business Journal (Vol. 8)
11.	2009	Journal of Manufacturing Technology Management (Vol. 20)
12.	2008	Journal of Cleaner Production (Vol. 16)

13.	2008	International Journal of Management Science & Engineering Management (Vol. 3)
14.	2008	Supply Chain Management: An International Journal (Vol. 13)

III. DISCUSSION OF FINDINGS

Concepts and models related to environmental issues have been suggested by different researchers. Literature was reviewed to identify barriers and drivers to implement GSCM in an industry. We have identified more than 42 various barriers and 30 drivers to implement GSCM in various industry sectors from the literature reviews, but the paper contains a total of 20 barriers and 16 drivers which were commonly stated by different authors in their respected papers.

The common barriers to implementation of GSCM in various industry sectors are: Lack of integration of IT system, Lack of acceptance of advancement in new technology, Poor organizational culture in GSCM, Lack of skilled human resource professionals in sustainability and GSCM, Uncertainty and competition in market, Lack of government initiatives system for GSCM practitioners, Poor implementation of green practices within a supply chain, Lack of top level management commitment, Cost of implementation for GSCM, Supplier's flexibility to change towards GSCM, Customer's unawareness towards GSCM products and services, Lack of knowledge and experience, Lack of green architects, consultants, green developers, contractors in the region, Lack of training in GSCM, Lack of internal sustainability audits within the organization, Lack of external sustainability audits for suppliers and contactors, Lack of sustainability certification like ISO 14001, Lack of professional treatment and long term contracts for adopting GSCM from government, Lack of professional

treatment and long term contracts for adopting GSCM from government, Lack of management initiatives for transport and logistics, Lack of energy management and waste management of the organization.

The common drivers to implementation of GSCM in various industry sectors are: Certification of suppliers' environmental management system, Company's environmental collaboration with their suppliers, Reduction and elimination of product's harmful environmental impacts by collaborating between product designer and suppliers, Government regulation and legislation, like making transparent reward system for green practitioners, Green product design, Standard quality certifications like ISO 14001, Integrating total quality environmental management into planning and operation processes, Reducing energy consumption and confining wastes, Reusing and recycling materials and packaging, Environmental collaboration with customers and making them environmentally aware, Reverse logistics and feedback system, Establishing company's green image locally and globally, Cost of environmentally friendly goods, Cost of environmentally friendly packages, Supplier's awareness and advances in providing environmentally friendly packages, Sharing best green practices.

Following are the tables which conclude the Barriers (Table III) and Drivers (Table IV) for the GSCM with their respective references.

TABLE III: Barriers for GSCM

Sr. No.	Barrier to Implement GSCM	Description	Resource
1.	Lack of integration of IT system	It uses various computer based applications programs and various IT enabled procedures and software which may be of utility during the various data and information exchange process.	Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Daine Holt (2009); Abby Ghobadian (2009); Wu et al. (2009); AlKhidir et al. (2009); Ravi et al. (2005); McLaren et al. (2004); Rogers et al. (1998).
2.	Lack of acceptance of advancement in new technology	It emphasizes on adoption of various advancements in technology to the older established technology in existing organization.	Shreejith B. (2012); Christian B. (2011); Jie Yang (2011); AlKhidir et al. (2009); Daine Holt (2009); Hsu et al. (2008); Hosseini (2007); Digalwar et al. (2004); TSai et al. (1999); Gant (1996); Cooper (1994).
3.	Poor organizational culture in GSCM	It directs towards the participation of top level management in motivating the employee.	Brooks W. (2011); Cunkuan Bao (2011); Abby Ghobadian (2009); Yu Lin et al. (2008); Yu Lin (2007); Hsu et al. (2008); Chien et al. (2007); Ravi et al. (2005).
4.	Lack of skilled human resource professionals in sustainability and	It reflects the lack of skills in human resource department of the organization	Shreejith B. (2012); Xianbing Lui (2011); Gioconda Q. (2011); Yu Lin et

	GSCM	with special context to their recruitment policies and trainings in GSCM.	al. (2008); Hsu et al. (2008); Chien et al. (2007); Yu Lin (2007).
5.	Uncertainty and competition in market	Market competition and uncertainty is high due to global competitiveness and varying customer's requirements.	Jie Yang (2011); Mudgal et al. (2010); Daine Holt (2009); Hosseini (2007); Yu Lin (2007).
6.	Lack of government initiatives system for GSCM practitioners	It means government not making industry friendly policies toward GSCM and not giving special benefits to those organizations implementing GSCM.	Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Sunil L. (2010); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2010); Mudgal et al. (2009); Yu Lin et al. (2008); Hsu et al. (2008); Srivastva (2007); Hosseini (2007); Scupola (2003).
7.	Poor implementation of green practices within a supply chain	Lack of consideration of green practices like hazardous solid waste disposal, energy conservation, reusing and recycling materials etc.	Christian B. (2011); Jie Yang (2011); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2009); Yu Lin et al. (2008); Hsu et al. (2008); Ravi et al. (2005).
8.	Lack of top level management commitment	It means top level management resisting towards implementation of green practices.	M.D. singh (2012); Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Sunil L. (2010); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2010); Sarkis (2009); Mudgal et al. (2009); Zhu (2007); Ravi V. et al. (2005); Digalwar et al. (2004).
9.	Cost of implementation for GSCM	It reflects to the high initial cost investment required to implement various green methodologies such as green design, green manufacturing, green labeling of packing etc	Shreejith B. (2012); Gioconda Q. (2011); Xianbing Lui (2011); Sunil L. (2010); Daine Holt (2009); Abby Ghobadian (2009); Mudgal et al. (2009); AlKhidir et al. (2009); Hosseini (2007); Ravi et al. (2005).
10.	Supplier's flexibility to change towards GSCM	This means suppliers unwillingness to be involved in design process and technology, which affects overall performance of whole chain.	B.P. Sharma (2012); Shreejith B. (2012); Tomohiro Shishime (2011); Sanjay K. (2010); Lettice et al. (2010); Hsu et al. (2008); Kannan et al. (2008); Srivastva (2007); Sarkar et al. (2006); Ravi et al. (2005).
11.	Customer's unawareness towards GSCM products and services	This reflects customers do not know about green products and their benefits.	B.P. Sharma (2012); Shreejith B. (2012); Tomohiro Shishime (2011); Sanjay K. (2010); Mudgal et al. (2009); Zhu et al. (2008); Zhu et al. (2007); Ravi et al. (2005).
12.	Lack of knowledge and experience	Lack of knowledge and experience among the supply chain stakeholders in executing GSCM.	Sixiao Qu. (2011); Daine H. (2009); Yu and Hui (2008); Tsai and Ghosal (1999).
13.	Lack of green architects, consultants, green developers, contractors in the region	Lack of green practitioners available in the region for an organization.	Sixiao Qu. (2011); Daine H. (2009); Yu and Hui (2008); Tsai and Ghosal (1999).
14.	Lack of training in GSCM	This reflects lack of training given to the employee of the organization, thus resisting enhancement of overall performance of supply chain and green practices in it.	B.P. Sharma (2012); Daine H. (2009); Yu and Hui (2008); Bowen et al. (2001); Cooper et al. (2000).
15.	Lack of internal sustainability audits within the organization	It reflects integration of all internal departmental issues related to the coordination for the supply chain.	Walker and Preuss (2008); Min and Galle (2001); Wycherley (1999).
16.	Lack of external sustainability	It reflects integration of all external	Walker and Preuss (2008); Sharfma et

	audits for suppliers and contactors	departmental issues related to the coordination for the supply chain.	al. (2007); Min and Galle (2001); Wycherley (1999).
17.	Lack of sustainability certification like ISO 14001	It refers to authenticity of quality of products and services as per pre-established norms.	B.P. Sharma (2012); Shreejith B. (2012); Tomohiro Shishime (2011); Sanjay K. (2010); Yu (2007); Linton et al. (2007).
18.	Lack of professional treatment and long term contracts for adopting GSCM from government	It shows poor government regulations and support to the GSCM practitioners.	B.P. Sharma (2012); Shreejith B. (2012); Cunkuan Bao (2011); Sanjay K. (2010); Yu (2007); Linton et al. (2007); Carter and Ellram (1998).
19.	Lack of management initiatives for transport and logistics	It shows poor managerial management of logistics in the organization.	M.D. Singh (2012); Daine Holt (2009).
20.	Lack of energy management and waste management of the organization	It shows poor management of organization towards its resources.	M.D. Singh (2012); Daine Holt (2009); Alemayche (2008); Roger and R.S. (1998).

TABLE IV: Drivers for GSCM

Sr. No.	Drivers of GSCM	Description	Resource
1.	Certification of suppliers' environmental management system	Certification of suppliers for EMS ensures organization to have environmental friendly services from its supplier, thus beneficial for its supply chain.	Gioconda Q et. al. (2011); Ali Daibat et. al. (2010); Paulraj (2009); Zhu et al. (2008); Vachon (2007); Zhu et al. (2007).
2.	Company's environmental collaboration with their suppliers	Company can make collaboration with the certified EMS suppliers to have better relationship between them and quality assurance with no harm to the environment.	Ali Daibat et. al. (2010); Abby Ghobadian (2009); Vachon (2007); Zhu and Sarkis (2006); Zhu et al. (2005, 2007a,b, 2008a,b,c); Hu and Hsu (2006); Yuang and Kielkiewicz-Yuang (2001); Klassen and Vachon (2003); Lippman (2001); Lippmann (1999); US-AEP (1999).
3.	Reduction and elimination of product's harmful environmental impacts by collaborating between product designer and suppliers	Mutual understanding and awareness for environment between product designer and suppliers can help a lot to reduce and eliminate product's harmful impacts over the environment.	Kannan Govindan et. al. (2010); Holt and Ghobadian (2009); Zhu et al. (2005); Lippman (2001).
4.	Government regulation and legislation, like making transparent reward system for green practitioners	Making green practitioners friendly laws and rewards can stimulate more and more organizations to practice GSCM.	Kannan Govindan (2010); Walker et al. (2008); Hall (2001); Min and Galle (2001); Beamon (1999); Walton et al. (1998); Green et al. (1996).
5.	Green product design	Environmental friendly products are more genuinely accepted.	Kannan Govindan et. al. (2010); Routroy (2009); Hu and Hsu (2006); Zhu et al. (2005, 2007a,b, 2008a,b,c); Zhu and Sarkis (2006).
6.	Standard quality certifications like ISO 14001	Certification encourage organizations towards continue quality enhancement, thus improving organization's culture.	Ali Daibat (2010); Abby Ghobadian (2009); Zhu et al. (2005, 2007a,b, 2008a,b,c); Vachon (2007); Zhu and Sarkis (2006); Hu and Hsu (2006); Rao and Holt (2005).
7.	Integrating total quality environmental management into planning and operation processes	It enables new innovations in production and operation methodologies, confining wastes and reduces energy usages.	Ali Daibat (2010); Zhu and Sarkis (2006); Zhu et al. (2005, 2007a,b, 2008a,b,c); Rao and Holt (2005).
8.	Reducing energy consumption and confining wastes	It results in better usage of financial resources of the organization.	Ali Daibat (2010); Paulraj (2009); Abby Ghobadian (2009); Gonzalez et al. (2008); Rao and Holt (2005).
9.	Reusing and recycling materials and packaging	It prevents waste of raw material resources.	Kannan Govindan (2010); Daine Holt (2009); Paulraj (2009); Vachon (2007);

			Rao and Holt (2005).
10.	Environmental collaboration with customers and making them environmentally aware	Making customers aware towards green products and acknowledging benefits.	Ali Daibat (2010); Paulraj (2009); Abby Ghobadian (2009); Zhu et al. (2008); Vachon (2007); Klassen and Vachon (2003).
11.	Reverse logistics and feedback system	Reverse logistics and feedback system assures customer satisfaction towards product and brand.	Ali Daibat (2010); Routroy (2009); Vachon (2007); Rao and Holt (2005); Zhu et al. (2005); Hu and Hsu (2006); Lippman (2001).
12.	Establishing company's green image locally and globally	Making customers satisfied with all the environmental and performance aspects of product, thus making them brand loyal.	Gioconda Quesada et. al. (2011); Daine Holt (2009).
13.	Cost of environmentally friendly goods	Encourage to the customers to buy the products.	Gioconda Quesada et. al. (2011); Daine Holt (2009).
14.	Cost of environmentally friendly packages	Encourage to the suppliers.	Christian Bailey et. al. (2011); Daine Holt (2009).
15.	Supplier's awareness and advances in providing environmentally friendly packages	Cost of environment friendly packages encourages suppliers to provide less costly packaging.	Brooks Woodfin et. al. (2011); Daine Holt (2009).
16.	Sharing best green practices	Sharing best green practices in supply chain can make organization IT network strong and beneficial too.	Gioconda Quesada et. al. (2011); Daine Holt (2009).

IV. CONCLUSION

In this research paper various barriers and drivers of Green Supply Chain Management (GSCM) were identified based upon the GSM literature and on consultations with experts in the academics. For the better implementation of GSCM in any organization these barriers and drivers occur in most of the cases. Hence to overcome the difficulties and for proper implementation of GSCM in the organization proper attention must be paid to these barriers and drivers.

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