

Barriers of Green Supply Chain Management: A Literature Review

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Abstract— In last few decades, there is a growing importance of Green supply chain management(GSCM) due to continuous degradation of environment e.g.- increasing pollution, wastage of natural resources, extinction of animals and harmful effects on human. A growing awareness among industries to implement GSCM is observed. There are many barriers which hinders successful implementation of GSCM. The objective of this paper is to trace research on GSCM in past 10 years and focus on research on barriers of GSCM. A list of barriers identified from extensive literature available, is presented in this paper. Finally, sorting of barriers is done according to its type, which can assist decision makers in an effective implementation of GSCM and utilize the same to expand understanding and knowledge of this research field.

Keywords—Green Supply Chain Management(GSCM),Barriers

Introduction

Historically the study and management of industrial pollution has been a critical issue since early days of industrial revolution. Managing supply chains gained focus in the early 20th century but environment movement begun in the US in the 1960s and 1970s due to Rachel Carson's book, "Silent Spring". This book criticized on DDT and its influence on birds and humans. Thus role of industries in terms of economics and environmentalism started to mature [22]. There is a growing awareness among customers in India and the world to produce environmental safe products and to use concepts that help to reduce pollution [2]. Green management is a best concept for industries to achieve a hazard- free environment [2]. There is many definitions of Green supply chain management (GSCM) as given by researchers. According to scholars, GSCM is a modern management approach where supply chain is a combination of economy and ecology. The term Supply chain management (SCM) describes all activities right from procurement of raw materials to delivery of product/service to customer and disposal. GSCM philosophy is to integrate environmental concept in to SCM [2]. GSCM aims at confining waste and harmful impacts on environment within industrial system, hence helps to conserve the energy and prevents pollution. GSCM is one of the systematic ways to sustain our resources and surrounding environments to prevent our lives from deteriorating [65].

The accelerating environmental consciousness among customers, multinational companies and government entities acts as drivers for manufacturers to focus on greening the business [7]. Following this, interest of academia on sustainability has also begun to increase resulting in large number of researches in this area. Sustainability was first defined in 1987 in Brutland report and was then adopted by the United Nations' World Commission on Environment and Development (WCED): "sustainability means being able to satisfy current needs without compromising the possibility for future generations to satisfy their own needs" [19].

I. LITERATURE REVIEW

In spite of the increasing importance of GSCM, there are organizations which fail to adopt green practices. Hence factors hindering the same needs to be known which are called barriers. Barrier means something which does not helps to achieve or comes in way of successful implementation. In Springer.com, there are around 2000 results for green supply chain or sustainability including 1508 preview- only content. There are many researches done on analysis of barriers of GSCM. Our target population is primarily articles published in referred scholarly journals. Table 1 shows extensive literature review of papers relate to GSCM.

TABLE I. LITERATURE REVIEW

Sr. No	Author/s	Title of paper
1.	Shaikha et al.[1]	Analysis of interaction between barriers for sustainable supply chain management
2.	Mathiyazhagan & Nooral [2]	Analysis of influential pressures for GSCM –An Indian perspective using ISM
3.	Tsai Chi Kuo et al.[3]	Barriers analysis for product service system using ISM
4.	Kannan et al.[4]	An ANP based model for reverse supply chain
5.	Arni et al.[5]	SCM on crossroad to sustainability- a blessing or curse?
6.	Ali Diabat et al.[6]	An exploration of green supply chain practices and performances in automotive

<i>Sr. No</i>	<i>Author/s</i>	<i>Title of paper</i>
		industries
7.	Zhigang et al.[7]	Development of environmental performance assessment method for manufacturing process plans
8.	Samuel et al.[8]	Additive manufacturing and its societal impact
9.	Eoin et al.[9]	Development of energy performance indicators within a complex manufacturing facility
10.	Florent et al.[10]	Sustainable manufacturing, evaluation and modeling of environmental impacts of additives
11.	Merie et al.[11]	Proposition of a tool to evaluate customers performance in collaborative product development with suppliers
12.	Ming Lang Tseng et al.[12]	Closed loop structures in GSCM under uncertainty
13.	Sachin Patil & Ravi Kant[13]	A fuzzy AHP-TOPSIS framework for ranking solutions of knowledge management adoption in supply chain to overcome its barriers
14.	Stefan et al.[14]	GSCM- Role of trust and top management in B2B & B2C markets
15.	Tarek et al.[15]	Investigating option for installing small scale PVs on facility rooftops in a GSC
16.	Yahaya et al.[16]	The UK oil and gas supply chains-adoption of sustainable measures
17.	Jorg et al.[17]	Critical factors for sub supplier management-sustainable food supply chains perspective
18.	Philip et al.[18]	GSCM and dynamic capabilities in food industries, literature analysis
19.	Federico et al.[19]	Environmental sustainability in fashion supply chains
20.	Balan et al.[20]	Modeling carbon footprints across supply chain
21.	Zhu & Sarkis[21]	Relation between operational practices & performance among early adopters of GSCM in China
22.	Zhu et al.[22]	An organizational theoretic review of GSCM
23.	Michael et al.[23]	Firm size and sustainable performance in food supply chains in Greek SMEs
24.	Ezutah & Kuan[24]	An expert fuzzy rule based system for closed loop supply chain in automotive industry
25.	Indranil & Raktim[25]	Do GSCM impact stock prices of firms?
26.	Gulcin & Gizem[26]	An integrated QFD framework with multiple formatted and incomplete preferences, GSCM application
27.	Shams & Nachiappan[27]	Factors for implementing end of life computer recycling operations in reverse supply chains
28.	James et al.[28]	Responsive supply chain strategy in global complexity in manufacturing firms

<i>Sr. No</i>	<i>Author/s</i>	<i>Title of paper</i>
29.	Muhammad et al.[29]	Critical barriers in implementing reverse logistics in Chinese manufacturing sectors
30.	Glover et al.[30]	An institutional theory perspective on sustainable practices across dairy supply chain
31.	Blandine et al.[31]	Sustainable supply management-an empirical study
32.	Kavitha et al.[32]	Sustainable supply chain management- British Aerospace systems
33.	Sebastian & Stefan [33]	Manufacture supplier partnership- An ANP model for collaborative carbon dioxide reduction management
34.	Daniel & Jan[34]	Supply chain integration and performance
35.	Andrea et al.[35]	Energy efficiency retrofitting services supply chains
36.	Gulcin & Gizem[36]	A novel hybrid MCDM approach to evaluate green suppliers
37.	Zhu et al.[37]	Evaluating green supplier development programs with ANP method
38.	Grekova et al.[38]	Extending environmental management beyond firm boundaries-Dutch food & beverages firms
39.	Kannan et al.[39]	Selecting green suppliers based on GSCM practices-using TOPSIS, Brazilian electronics company
40.	H.Winkler[40]	Closed loop production system- A sustainable supply chain approach
41.	Riccardo et al.[41]	Economic and environmental assessment of reusable plastic containers, a food catering supply chain
42.	Fleming et al.[42]	Climate change risk and adaptation options across Australian seafood supply chains
43.	Naoum et al.[43]	Agrifood supply chain management, a hierarchical decision making framework
44.	Yang & Zou[44]	Stakeholder associated risks and their interactions in green building projects, a social network model
45.	Soysal et al.[45]	Modeling food logistics networks with emission considerations
46.	Guo Ciang Wu et al.[46]	The effect of GSCM drivers and institutional pressures on GSCM practices in Taiwan's textile industry
47.	Chialin Chen et al.[47]	Quality control in food SCM, case study of adulterated milk incident in China
48.	Stefan et al.[48]	Turning sustainability into action, firms efforts and its impact on its performance
49.	Tsai Chi Kuo et al.[49]	A collaborative model for controlling green supply network in the motorcycle industry
50.	Richard Hoggett[50]	Technology scale and supply chains in a secure affordable

Sr. No	Author/s	Title of paper
		and low carbon energy transition
51.	Ming Lang & Anthony[51]	Grey entropy ANP process for innovative green practices
52.	Marisa et al.[52]	Towards a sustainable fashion retail supply chain in Europe
53.	Anja et al.[53]	A novel concept for a renewable network within municipal energy systems
54.	Kamalakanta et al.[54]	Barriers to GSCM in Indian mining industries, a graph theoretic approach
55.	Kshitij et al.[55]	GSCM , a hierarchical framework for barriers
56.	Sue Tinnish[56]	Barriers and enablers to adoption of ISO 20121 standard for event sustainability management
57.	Kumar et al.[57]	Customer involvement in greening the supply chain, an ISM model
58.	Sharma et al.[58]	Analysis of barriers for reverse logistics, an Indian perspective
59.	Dileep More et al.[59]	Identification of stimuli, enablers and inhibitors of GSCM
60.	Toke et al.[60]	An empirical study of GSCM in Indian perspective
61.	Helen & Neil Jones[61]	Sustainable SCM across UK private sectors
62.	Kannan et al[62]	Barriers analysis for green supply chain management implementation in Indian industries using analytic hierarchy process
63.	Vinodh & Joy[63]	Structural equation modeling on sustainable manufacturing practices
64.	Vinodh et al.[64]	Compromising ranking approach for sustainable concept selection in Indian modular switches manufacturing organization
65.	Hokey & IIsuk[65]	GSCM research, past present and future

II. OUTCOME OF LITERATURE REVIEW-BARRIERS OF GSCM

There are many barriers faced by industries during implementation of GSCM. All barriers could not be prevented but a dominant barrier, if known, could be taken care of. Analysis of barriers of GSCM is carried out in fastener industries in India and 13 barriers are identified [1]. Lack of top management commitment is identified as dominant barrier [1] [21]. Pressures faced by automotive industries in India, to follow green practices, are analyzed [2]. Without strong pressures and regulations, industries will not adopt GSCM; hence absence of the same is also a barrier. Lack of strategic planning is a major barrier as it hinders establishing long term relationship with customers and suppliers [3]. Evaluation of the effects of manufacturing on the environment also helps to decide on the major factors involved in implementing continuous efforts of sustainability [7]. There are two methods for doing this evaluation - environmental impact assessment [EIA] and life cycle analysis [LCA] [8]. Manufacturing and delivering products to customers includes various companies

like raw material suppliers, component suppliers, original equipment manufacturers, wholesalers and distributors, logistics service providers and retailers [8]. There are different barriers faced by each stage of a supply chain. The quality and quantity of energy metering devices installed at manufacturing site places the organization at forefront of sustainable engineering [9]. This type of installation is costly and if it does not match with company's financial status, it is a type of financial barrier. Due to global competition, firms enhance their competitive advantage by utilizing supplier's technologies to integrate environmental concerns [12][14][17]. There are many researches on role of suppliers in adopting GSCM [22][58][59]. In broader sense, GSCM closed loop hierarchical structure can be used as analytical tool to evaluate suppliers under uncertainty [12]. Barriers of knowledge management, which flows in a reverse direction in supply chain, are categorized in to - strategic, organizational, technological, individual, and cultural barriers [13]. Knowledge sharing is considered as a dynamic capability in the supply chain of a sustainability-oriented industry [18]. Lack of information sharing is one of the informational barriers of GSCM [28][55][58][59]. A constant flow of updated information about market dynamics and demand patterns is necessary for successful implementation of sustainability[28] In B2B markets, firms GSCM activities are not constrained by strategic imperatives and hence top management support is more important, while in B2C markets customer demands and risk of negative media attention forces the implementation of GSCM activities [14]. Hence lack of top management support and customer demands [26][27] acts as barriers of GSCM [19][58][59]. Firms nowadays are opting to change facilities from net energy users to net energy producers in order to follow green business [15]. One example is use of photovoltaic arrays in building structure, which is a costly project [15]. A change made in a facility should be in accordance with the economic policies of the company. Absence of the drivers like environmental regulations, market incentives, international agreements like Kyoto protocol [15][16], are considered as barriers. Research and Development (R&D) plays an important role in implementation of new technology or system. Firms having high R&D intensity tend to convince investors in implementing GSCM activities [25][27][58][59]. Hence lack of R&D incentives is a barrier of green practices. Table 2 shows list of barriers as identified from the literature survey.

TABLE II. BARRIERS OF GSCM AS FOUND IN RESPECTIVE RESEARCH PAPER

Sr. No	Year	Author	Barriers
1.	2014	Kannan et al.[62]	<ul style="list-style-type: none"> • Lack of government support to adopt Environmental friendly policies , • Complexity of measuring/monitoring environmental practices of suppliers , • Problems in maintaining environmental suppliers , • Lack of new technology, • Complexity to design, reuse/recycle products, • Lack of technical expertise , • Lack of Human resource , • Lack of effective environmental measures , • Fear of failure ,

Sr. No	Year	Author	Barriers
			<ul style="list-style-type: none"> Lack of professionals exposed to green systems, Lack of Environmental Knowledge , Perception of “out-of-responsibility” zone , Disbelief about environmental benefits , Lack of awareness about reverse logistics, High cost for hazardous waste disposal , Non-availability of bank loans to encourage green products/ processes, High investments and less Return-on-Investments , Lack of training courses/consultancy/institutions to train, monitor and mentor progress specific to each industry , Lack of customer awareness and pressure about GSCM, Lack of Corporate Social Responsibility , Lack of top management involvement, Restrictive company policies, Poor supplier commitment and unwilling to exchange information, Lack of Inter-departments co-operation,
2.	2013	Dashore et al.[56]	<ul style="list-style-type: none"> lack of top level management commitment , Lack of integration of information technology system, Lack of acceptance of advancement in new technology, Poor organizational culture in GSCM , Lack of skilled human resource professionals in sustainability and GSCM , Lack of energy management and waste management system, Uncertainty and competition in market, Lack of government initiatives system for GSCM practitioners, Lack of knowledge, experience and training to personals in GSCM, Lack of green architects, consultants, green developers, contractors in the region, Cost of implementation for GSCM , Supplier’s flexibility to change towards GSCM, Lack of management initiatives for transport and logistics , Lack of customer’s awareness towards GSCM and green products,
3.	2012	Duran et al.[72]	<ul style="list-style-type: none"> hesitation to collaborative distribution, Insufficient route overlaps, IT technology needed, focus shift on larger shipper community, disclosing strategies
4.	2012	Toke et al.[60]	<ul style="list-style-type: none"> Prioritization, cost/budget constraints, security risks,

Sr. No	Year	Author	Barriers
5.	2012	Muduli et al.[54]	<ul style="list-style-type: none"> Information gap, Insufficient society pressure (isp), Poor legislation (pl), Capacity constraints
6.	2012	Dileep More et al.[59]	<ul style="list-style-type: none"> Lack of govt subsidy, company’s policy, lack of resources, performance matrices, lack of knowledge of green initiatives, lack of training , lack of management commitment, lack of green supplier network, lack of reverse flow, society requirements, organizational structural, less awareness, low expertise, lack of technology,
7.	2011	Paul Hoslin[75]	<ul style="list-style-type: none"> absence of customer support
8.	2011	Muduli et al.[66]	<ul style="list-style-type: none"> Resistance to change and adoption, Insufficient pressure from societies, Ignorance towards sustainability issues, Poor legislation, Lack of direct incentives, Financial constraints, Technical barriers, Lack of top management commitment, Lack of employee commitment, Lack of awareness, inappropriate approach to implementation,
9.	2011	Sharma et al.[58]	<ul style="list-style-type: none"> Lack of systems management, Financial resources, Personal resources, Company’s policies, Inferior quality of input resources, Lack of stakeholder commitment, Regulation and customer preference, Lack of awareness about reverse logistics, Management inattention, Financial constraints, Lack of Personnel resources, lack of training and education, problems with product quality, lack of appropriate performance management system, inadequate information and technological systems, legal issues, administrative and financial burden of tax, limited forecasting and planning, co-operative behavior of chain members, reluctance of the support of the dealers, distributors, and retailers towards the reverse logistics activities
10.	2010	Joseph et al.[22]	<ul style="list-style-type: none"> Physical and cultural barriers, organizational boundaries, Proximal boundaries, Political boundaries, Informational boundaries, Temporal boundaries,

Sr. No	Year	Author	Barriers
			<ul style="list-style-type: none"> Legal boundaries, Cultural boundaries, Economic boundaries, technological boundaries,
11.	2009	[87]	<ul style="list-style-type: none"> Lack of clean and shared understanding of what to solve and how to solve
12.	2008	[86]	<ul style="list-style-type: none"> Need of knowledge distribution, Need of problem solving perspective, Low financial support, Differing priorities, Lack of interdisciplinary cooperation, Lack of publicity, Differing understanding of term sustainability
13.	2007	Stephen et al.[67]	<ul style="list-style-type: none"> Financial barrier Informational barrier, Legal barrier, Managerial barrier, Political barrier
14.	2007	Mariëtte et al.[85]	<ul style="list-style-type: none"> Lack of knowledge among customers about eco labels, No confidence among customers in green information
15.	2007	Ottar Michelsen [84]	<ul style="list-style-type: none"> Low ability of one channel member to control decision of another, Lack of information about performance of suppliers, Lack of horizontal cooperation between independent organization
16.	2006	Rochon et al.[83]	<ul style="list-style-type: none"> Lack of robust educational programs on sustainability, Strong interdisciplinary linkages
17.	2005	Jamie R. Hendry & Aarne Vesilind [82]	<ul style="list-style-type: none"> Lack of ethical concern, Lack of strict laws, Lack of financial advantage, Short term profit oriented goals
18.	2004	Sheffield et al.[79]	<ul style="list-style-type: none"> Lack of energy options for future
19.	2003	Heriberto Cabezas [81]	<ul style="list-style-type: none"> Lack of energy goals and target, Need of better education of policy makers, Education on sustainability and related environmental issues, Lack of better dissemination of information
20.	2003	Janne Hukkine n [80]	<ul style="list-style-type: none"> Lack of human environment interaction, Lack of functional linkages between indicators – ecological, economic, & socio cultural
21.	2003	Morioka et al.[78]	<ul style="list-style-type: none"> Absence of “tack- back” legislation
22.	2003	Roland Clift [77]	<ul style="list-style-type: none"> Lack of public participation or commitment, Lack of high value added technology, Lack of strong government regulations, Lack of government subsidy

III. TYPES OF BARRIERS

Literature review resulted in sorting out of the barriers according to its type as listed in Table 3.

Types of barriers are-

1. Organizational barriers
2. Informational barriers
3. Customer barriers
4. Technology barriers
5. Government barriers
6. Financial barriers
7. Cultural barriers
8. Others

TABLE III. BARRIERS OF GSCM AS FOUND IN RESPECTIVE RESEARCH PAPER

Organizational /management	Informational	Customers	Technology
<ul style="list-style-type: none"> 1.organization al boundaries 2. Existing infrastructure/ bureaucracy 3 poor alliance management 4.lack of managerial commitment 5.Integration into management systems 6. lack of top level management commitment 7.Existing infrastructure 8.Poor organizational culture in GSCM 9.Managemen t inattention 10.lack of appropriate performance management system, 11.organizational structure 12.Lack of stakeholder commitment, 13.Company policies 14.Lack of systems management 15. Poor legislation 	<ul style="list-style-type: none"> 1.Informational boundaries 2. inadequate information sharing 3.Misinformed advocacy groups 4.Educating marketing and sales professionals 5.Insufficient and incomparable environmental information 6.Lack of knowledge, experience and training to personals in GSCM 7.Lack of integration of information 8.Information gap 9.lack of training and education 10.inadequate information and technological systems, 11.lack knowledge of green initiatives 12.lack of training 13.Lack of awareness about reverse logistics 14.Lack of competencies and knowledge in companies and public authorities. 15. Need of better education of policy makers 16.Education on sustainability and related 	<ul style="list-style-type: none"> 1.absence of customer support 2. Lack of public awareness/training 3. Lack of customer’s awareness towards scum and green products 4. insufficient society pressure and customer’s demand 5. Lack of public participation or commitment 6. Lack of knowledge among customers about eco labels 7.No confidence among customers in green information 	<ul style="list-style-type: none"> 1.Tech data (td) rights; 2.IT technology needed 3.Lack of acceptance or advancement in new technology 4.technologica l boundaries 5. Lack of energy options for future 6. Lack of high value added technology

	environmental issues 17.Lack of better dissemination of information 18. Lack of information about performance of suppliers 19. Lack of clean and shared understanding of what to solve and how to solve		
Government	Financial	Cultural/human	Others
1.statutory/regulatory requirements 2. Lack of government initiatives system for GSCM 3.Pressures from laws and regulations 4.restrictions of govt 5. Legal boundaries 6.govt subsidy 7.legal issues 8.Political boundaries 9.absence of “take-back” legislation	1. Economic boundaries 2. Funding restrictions/infl exibility 3. Inability to incentivize organic providers cost/budget constraints 4. Estimating hidden costs and potential savings 5.Changing the first cost mindset 6.Cost of implementation for GSCM 7.Capacity constraints (cc) 10.administrative and financial tax burden 11.Lack of direct incentives 12.Financial constraints 13.large investments in machinery and infrastructure systems	.cultural barriers 2.resistance to change-lack of trust 3.Lack of skilled human resource professionals in sustainability 4. Old paradigms/culture 5. Lack of personnel resources. 6.Resistance to change and adoption 7.unwillingness among partnering companies and suppliers 8.Lack of employee commitment 9. Lack of green architects, consultants, green developers, contractors in the region 10. Lack of ethical concern 11. Lack of human environment interaction 12. Low ability of one channel member to control decision of another 13. Lack of horizontal cooperation between independent organization 14. hesitation to collaborative distribution	1.multiple complexities and uncertainties 2. Potential barriers to trade 3.hesitation to collaborative distribution 4. Uncertainty and competition in market. 5.Insufficient route overlaps 6.focus shift on larger shipper community 7.disclosing strategies 8. Lack of clear definitions 9.Pressures from sales 10.poor conflicting measurement 11.inconsistent operating goals 12.security risks 13.Lack of energy management and waste management system 14.Ignorance towards sustainability issues 15.limited forecasting and planning, 16.co-operative behavior of chain members- 17.reluctance of the support

			of the dealers, distributors, a retailers towards the reverse logistics 18.R&d of new materials and chemicals 19.problems with product quality 20.inappropriate approach to implementation
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IV. CONCLUSION

In this paper, we review the literature on GSCM with a focus on identifying barriers of GSCM in different sectors that have been utilized to expand understanding and knowledge of this research field. In order to overcome a barrier of GSCM, a decision maker must know that the barrier belong to which sector. Listing of barriers according to its type would help for the same. We find that researchers in GSCM have started to apply methodologies to prioritize barriers to prevent the barriers during implementation of GSCM. We can make a number of observations of this initial review and integration of the literature. First, the survey of barriers helps the decision makers to take care of the critical barriers first along with sincere efforts to make use of the enablers of GSCM. This will ensure a more effective implementation of GSCM. Second, there are ample opportunities for future research and investigation in analyzing barriers using methods like ISM, AHP, and ANP etc. Third, much of the literature on GSCM research has been relatively recent. This observation means that we are at the growth stages of GSCM. Fourth, additional and emergent barriers may exist that can help address unforeseen and nascent GSCM issues. Methodological developments and application for supply chain and GSCM research are also promising areas for future studies. We believe that significant growth and opportunities to understand our world exist at the nexus of these important environmental-based researches.

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