Exploring correlations in components of green supply chain practices and green supply chain performance

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Abstract

Purpose – The purpose of this paper is to explore the peer-reviewed literature, as well as literature written by practitioners having authority on green supply chains and allied areas with a view to identify future research directions with the help of an extensive literature review.

Design/methodology/approach – In line with this objective, the constructs "Green Supply Chain Practices" and "Green Supply Chain Performance" were the two terms that were identified for a co-relational study.

Findings – As indicated by the literature review, there is a need to do a more detailed study that can pinpoint particular components of green supply chain practices that have a strong association with particular components of green supply chain performance. This paper attempts to achieve the aim by using a different connotation of these two constructs.

Originality/value – Such a study with the connotation and components of green supply chain (GSC) practices and GSC performance as identified and used in this paper might not have been conducted before in the way it is proposed to be used in this paper, thus making this an appropriate contribution. Accordingly, a framework for the research has been depicted, and research questions have been framed.

Keywords Supply chain management, Green supply chain management, Green supply chain practices

Paper type Literature review

Introduction

The Rio Declaration on Environment and Development, which is an updated version of the Stockholm Declaration of 1972, published general principles for future international action on environment and development. Agenda 21 of the Earth Summit, 1992 lays down an action plan for the next hundred years along with a framework for dealing with the environment and development issues (Barrow, 2006). Accordingly, global warming has raised alarming concerns all over the world because of the adverse effect it is having on the environment. Nations all over the world are posed with an immediate issue of reducing this adverse impact on the environment which is predominantly because of the anthropogenic activities (Asian Productivity Organization's Greenhouse Gas Emissions: Estimation and Reduction, 2009). Supply chains are also not free from these anthropogenic activities. Hence, activities of supply chains need to be managed, so that

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they do not adversely affect the environment. Activities aimed at achieving this goal are termed as green supply chain practices. The research problem here is to identify how these green supply chain practices are associated with green supply chain performance.

There is a growing body of literature that has studied green supply chain management (GSCM) practices, GSC practices and GSC performance. Studies that have addressed green supply chain (management) practices are: Klassen and Johnson (2004), Zhu and Sarkis (2004), Rao and Diane Holt (2005), Chien and Shih (2007), Zhu *et al.* (2008), Darnall *et al.* (2008), Eltayeb and Zailani (2009), Rha (2010), Zhu *et al.* (2010), Ninlawan *et al.* (2010), Nunes and Bennett (2010), Kirchoff (2011), Li (2011), Wu *et al.* (2012), Toke *et al.* (2012), Pandya and Mavani (2012), Perotti *et al.* (2012), Green *et al.* (2012), Zhu *et al.* (2012), Chin-Chun *et al.* (2013), Lee *et al.* (2013a, 2013b), Lo (2014), Luthra *et al.* (2014). Studies that have addressed green supply chain performance are: Beamon (1999a, 1999b); Stuart and Emmett (2012), Kurien and Qureshi (2012), Diab *et al.* (2015). Studies that have addressed both green supply chain (management) practices and green supply chain performance are: Zhu and Sarkis (2004); Rha (2010); Zhu *et al.* (2010), Ninlawan *et al.* (2010), Li (2011), Green *et al.* (2012), Zhu *et al.* (2012), Perotti *et al.* (2012), and Laosirihongthong *et al.* (2013).

Studies have shown that broad measures of GSC (management) practices have an association with broad measures of GSC performance (Zhu *et al.*, 2012). Very few empirical studies have focused on identifying the particular components of GSC practices that have a strong correlation with particular components of GSC performance in the way it is done in this paper (Zhu and Sarkis, 2004; Rha, 2010; Zhu *et al.*, 2010; Ninlawan *et al.*, 2010; Li, 2011; Green *et al.*, 2012; Zhu *et al.*, 2012; Perotti *et al.*, 2012). Even though few studies have considered the correlation between GSC practices and GSC performance, they have not focused on the true definition of the term GSC practices consistently. Few studies have addressed the term "Green Supply Chain Management Practices" but titled the paper containing the term "Green Supply Chain Practices". This calls for a much detailed clarity in the definition of the term "Green Supply Chain Practices", as these two terms have been used interchangeably in the past. This calls for a further study which could investigate into the difference, if any, which might be existing between the constructs "Green Supply Chain Practices" and "Green Supply Chain Management Practices". What remains to be explored is which factors or components of GSC practices are predominantly associated with which factors or components of GSC performance (Zhu *et al.*, 2012).

This study adds a different shade to the existing research on association between "Green Supply Chain Practices" and "Green Supply Chain Performance" by using a different connotation superimposed on the existing studies. It is felt that this study could add to the existing knowledge base of academia in the areas of GSC practices and GSC performance. Also, this study will be of great utility to managers in various spheres of work in identifying individual components of GSC practices which may be predominantly associated with particular components of GSC performance. It is also likely to translate into better environmental, economic, social, legislative and technological performance of firms that incorporate these GSC practices (Emmett and Sood, 2010) The society, the suppliers, the manufacturing focal firms and the customers are expected to be benefited in a different manner. Ultimately, this is expected to reduce the adverse impact on the environment and aid in making the planet earth toward

becoming a greener plant earth, if all countries in the world adopt similar green supply chain management practices.

This study attempts to contribute to the existing body of knowledge by exploring the individual components of GSC management practices predominantly associated with particular components of GSC performance. This will help supply chain practitioners to invest their resources in appropriate GSC practices to affect a particular component of GSC performance.

Background of the research

Global warming has been universally accepted as posing the greatest environmental threat to mankind in the current century. The impacts of global warming are staggering, for example, the thinning of the Antarctic ice at increasingly rapid rates has caused a massive influx of fresh water into the oceans of the world. Siberia has warmed by more than 3°C as compared to 1960 (Asian Productivity Organization's Greenhouse Gas Emissions: Estimation and Reduction, 2009).

Human activities are mostly responsible for all these changes which have been translating into raising levels of CO_2, which is a major greenhouse gas (GHG). Atmospheric concentrations of CO_2 have risen by more than 35 per cent since the Industrial Revolution. Anthropogenic activities such as the burning of fossil fuels and deforestation are the primary causes for such an increase. Accordingly, reducing the rate of emission of GHGs has been an enormous challenge throughout the world. This challenge has to be faced and fought on many fronts. Global warming also reflects in the list of top ten environmental issues.

Supply chains are also not free from these anthropogenic activities. Hence, activities of supply chains need to be managed, so that they do not adversely affect the environment. Activities aimed at achieving this goal are termed as GSC management practices. The research problem here is to identify how these GSC management practices can affect GSC performance.

Review of literature

On the basis of a key word search on "Green Supply Chain (Management) Practices" from research library databases, namely, Science Direct, ProQuest and EBSCO, as well as from google.com search engine, the papers published in scholarly peer-reviewed international journals, as well as conferences, were obtained. Also obtained were list of authored and edited books by the authors of repute. The statistics of the literature obtained from various journals, books, dissertations and conference papers is shown in Table I.

The chronological distribution of all the publications obtained for doing the literature review pertaining to GSC practices and GSC performance is illustrated in Figure 1 and Table II. Figure 1 and Table II also clearly indicate that there was an emergence of published literature on GSC practices and GSC performance from the 1980s, and since then, there has been a sharp rise in the number of publications pertaining to the GSC practices and GSC performance till date. This rise can be attributed to the fact that environmental issues have been on the top priority list of nations all over the world.

To have an understanding of the various connotations of the terms supply chain management; GSC (management) practices; and allied terms a listing of all these definitions as appearing in the existing literature till date was made as shown in

Source: Reviewed journal/dissertation/book/conference proceeding	No. of papers	% of total
Advanced Engineering Informatics	1	0.44
Bio Resource Technology	1	0.44
Book–Environmental Management for Sustainable Development	1	0.44
Book–Green Supply Chains: An Action Manifesto	1	0.44
Book–Greening the Supply Chain: A Guide for Asian Managers	1	0.44
Book–Introduction to Supply Chain Management	1	0.44
Book–Logistics and Supply Chain Management Strategies for Reducing Costs and Improving Services	1	0.44
Book–Strategic Purchasing and Supply Chain Management	1	0.44
Book–Supply Chain Management: Strategy. Planning and Operation	1	0.44
Book–Understanding Supply Chains: Concepts, Crituques & Futures	1	0.44
Business Strategy and the Environment	1	0.44
CIRP Annals – Manufacturing Technology	1	0.44
Computer Aided Chemical Engineering	1	0.44
Computers & Industrial Engineering	1	0.44
Conservation and Recycling	1	0.44
Department of Management Science and Information Systems, Penn State University	1	0.44
Dictionary–APICS dictionary	1	0.44
Dissertation–Dissertations and Theses from the College of Business Administration	1	0.44
Dissertation–Doctoral Dissertation, University of Wales. Cardiff	1	0.44
Dissertation–PhD Dissertation, University of Tennessee	1	0.44
Energy	1	0.44
Environmental Science & Policy	1	0.44
European Journal of Purchasing & Supply Management	1	0.44
First Worldwide Research Symposium on Purchasing and Supply Chain Management	1	0.44
Food Research International	1	0.44
Fuzzy Sets and Systems	1	0.44
Global Environmental Change	1	0.44
IATSS Research	1	0.44
IEE Proceedings–Science, Measurement and Technology	1	0.44
IIE Solutions	1	0.44
IIMB Management Review	1	0.44
Industrial Management & Data Systems	1	0.44
International Journal of Environmental Science	1	0.44
Interfaces	1	0.44
International Journal of Applied Science and Engineering Research	1	0.44
International Journal of Engineering and Management Sciences	1	0.44
International Journal of Hydrogen Energy	1	0.44
International Journal of Management Reviews	1	0.44
International Journal of Purchasing and Materials Management	1	0.44
International Journal of Technology Management	1	0.44
Journal of Applied Business Research	1	0.44

(*continued*)

Table I.
Break-up of literature obtained and reviewed by doing a keyword search on green supply chain (Management) practices and performance

Source: Reviewed journal/dissertation/book/conference proceeding	No. of papers	% of total
Journal of Engineering and Technology Management	1	0.44
Journal of Environmental Economics and Management	1	0.44
Journal of Environmental Management	1	0.44
Journal of Loss Prevention in the Process Industries	1	0.44
Journal of Management and Sustainability	1	0.44
Journal of Sustainable Development	1	0.44
Logistics & Supply Chain Management	1	0.44
Logistics Information Management	1	0.44
Management Decision	1	0.44
Management Science	1	0.44
Manual-Green Productivity and Green Supply Chain Manual	1	0.44
Operations & Supply Chain Management	1	0.44
Organizations and Society	1	0.44
Part I Biomass and Bioenergy	1	0.44
Physics Procedia	1	0.44
Procedia Environmental Sciences	1	0.44
Proceedings of the International Multi-Conference of Engineers and Computer Scientists	1	0.44
Process Safety and Environmental Protection	1	0.44
Purchasing	1	0.44
Renewable and Sustainable Energy Review	1	0.44
Renewable Energy	1	0.44
Resources Policy	1	0.44
Scientific Research and Essays	1	0.44
Sloan Management Review	1	0.44
Socio-Economic Planning Sciences	1	0.44
The Asian Journal of Shipping and Logistics	1	0.44
Transportation Research Part A: Policy and Practice	1	0.44
Trends in Food Science & Technology	1	0.44
Benchmarking: An International Journal	2	0.87
Computers & Chemical Engineering	2	0.87
Computers in Industry	2	0.87
Decision Support Systems	2	0.87
International Journal of Logistics Management	2	0.87
Journal of Advances in Management Research	2	0.87
Omega	2	0.87
Research in Transportation Economics	2	0.87
Supply Chain Management: An International Journal	2	0.87
Applied Mathematical Modeling	3	1.31
Biomass and Bioenergy	3	1.31
CIRP Journal of Manufacturing Science and Technology	3	1.31
Journal of Business Logistics	3	1.31
Production and Operations Management	3	1.31
The Journal of Strategic Information Systems	3	1.31
Energy Procedia	4	1.75
Ecological Economics	5	2.18

Table I. (*continued*)

Source: Reviewed journal/dissertation/book/conference proceeding	No. of papers	% of total
European Journal of Operational Research	5	2.18
International Journal of Operations & Production Management	5	2.18
Procedia-Social and Behavioral Sciences	5	2.18
International Journal of Physical Distribution & Logistics Management	6	2.62
Journal of Operations Management	6	2.62
Transportation Research Part E: Logistics and Transportation Review	6	2.62
Expert Systems with Applications	7	3.06
Resources, Conservation and Recycling	8	3.49
Industrial Marketing Management	11	4.80
Journal of Cleaner Production	11	4.80
International Journal of Production Economics	45	19.65
	229	100.00

Table I.

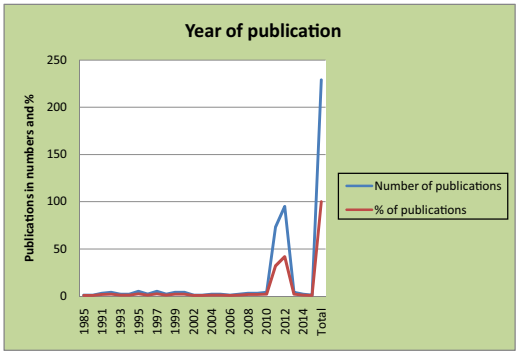

Figure 1.
The chronological distribution of the number of publications referred for doing the literature review

Table III. Table III clearly reflects that a large number of studies have been done pertaining to supply chain management, and then, the focus has largely shifted to the newer paradigm namely Green Supply Chain Management (GSCM).

From Table III, it is evident that there is great consistency in the usage of the term "Supply Chain Management" from 1985 to 2001, but in 1999, there is emergence of the usage of the term "Green Supply Chain Management" right through 2009. Accordingly, it seems that there is a paradigm shift in the definition from "Supply Chain Management" to "Green Supply Chain Management". Going through the future scopes of research papers pertaining to "Green Supply Chain Management" published in recent years, some of the future scopes of research were identified and then tabulated as shown in Table IV.

It was observed that a portion of the literature obtained by doing a key word search on "Green Supply Chain Practices" and "Green Supply Chain Performance" was not found to be relevant at all. There were papers obtained which were related to the subject of Green Supply Chain, but the focus of these papers was not the same as the chosen area of research. Such papers may be considered as not-relevant from

Year	No. of publications	% of publications
1985	1	0.44
1987	1	0.44
1991	3	1.31
1992	4	1.75
1993	2	0.87
1994	2	0.87
1995	5	2.18
1996	2	0.87
1997	5	2.18
1998	2	0.87
1999	4	1.75
2001	4	1.75
2002	1	0.44
2003	1	0.44
2004	2	0.87
2005	2	0.87
2006	1	0.44
2007	2	0.87
2008	3	1.31
2009	3	1.31
2010	4	1.75
2011	73	31.88
2012	95	41.48
2013	4	1.75
2014	2	0.87
2015	1	0.44
Total	229	100.00

Table II. Chronological distribution of the numbers of publications referred to for doing the literature review

the present research work point of view. The break-up of the publications obtained by searching on the key words "Supply Chain", "Supply Chain Management", "Green Supply Chain Practices" and "Green Supply Chain Performance" is illustrated in Table V and Figure 2. Even though the keyword search was done, still many publications were obtained that were not relevant to the subject of interest. Publications related to Sustainable Supply Chain Management (SSCM) also figured in the above searches though they were not specifically searched for. This is evident from Table V and Figure 2.

The future scope from the preliminary literature search prompted doing a keyword search on "Green Supply Chain Practices" and "Green Supply Chain Performance". Further the papers obtained from the detailed literature search could be classified on the basis of the subject addressed by them into three categories, namely, GSC (management) practices; GSC performance; and both GSC practices and performance. These categorized studies are tabulated in Table VI.

Various studies have viewed GSC practices as consisting of certain components as is shown in Table VII.

Various studies have viewed GSC performance as consisting of certain components as shown in Table VIII.

Serial no.	Year	Term	Author	Definition
1	1985	SCM	Jones, Riley	A way of dealing with the planning and control of materials movement from the suppliers to the end-users
2	1987	SCM	Brown	A complicated, dynamic chain of interconnected and interdependent entities, for satisfying the customer by delivering a value-added product or service
3	1991	SCM	Novak, Simco	Supply chain management consists of the physical flow of goods from supplier to manufacturer to distributor to the end-users
4	1991	SCM	Scott, Westbrook	The connection of each element of the manufacturing and supply process from raw materials to the end users across several organizational limits
5	1991	SCM	Scott, Westbrook	The connection of each element of the process from raw materials extraction to the customer who uses it in the end
6	1991	SCM	Ellram	Controlling the movement of goods from the supplier to a satisfied customer in a waste-free manner with a combination of processes, systems and organizations
7	1992	SCM	Towil, Naim, Wikner	A linked material and information flow system consisting of material suppliers, production facilities, distribution services and customers with a provision for forward and backward flow from each of the entities involved
8	1992	SCM	Christopher	Interconnected organizations with forward and reverse flows between the various constituent entities involved for delivering a value-added product to the customers
9	1992	SCM	Lee, Billington	A system consisting of raw material procurement function, facility for transforming the raw material to finished products through the use of manufacturing process for providing a value-added product to the customer
10	1992	SCM	Cavinato	The management of procurement and distribution functions by several firms working in harmony for providing a value-added product to the customer
11	1993	SCM	Ellram, Cooper	A way of integrating all the flows of the distribution channels from the supplier to the final customer
12	1993	SCM	Cooper, Ellram	SCM is an integrative way of thinking to manage all the movement along the distribution channel from the supplier to the user
13	1994	SCM	Berry, Towill, Wadsley	Supply chain management aims at building trust, exchanging information on market needs, developing new products and reducing the supplier base to a particular original equipment manufacturer (OEM) so as to release management resources for developing meaningful, long-term relationship
14	1995	SCM	Berry	A system whose constituent parts include material supplies, production facilities, distribution services and customers linked together by feed forward flow of materials and feedback flow of information

(*continued*)

Table III.
Chronological listing of definitions of supply chain management, green supply chain management and allied terms

Serial no.	Year	Term	Author	Definition
15	1995	SCM	Lee, Billington	The integration activities taking place along a network of facilities that procure raw material, convert them into goods and then products, deliver the products to customers through a distribution system
16	1995	SCM	Cox, Blackstone, Spencer	The functions of a company that help the value chain in providing products to the customer
17	1995	SCM	Saunders	External chain is the total chain of exchange from original source of raw material, through the various firms involved in extracting and processing raw materials, manufacturing, assembling, distributing and retailing to ultimate end customers
18	1995	SCM	Ganeshan, Harrison	A supply chain is an interconnection of facilities and distribution channels that performs the functions of procurement of materials, conversion of these materials into products and the distribution of these products customers in the end
19	1996	SCM	Johnson	A process of strategically managing the movement and storage of materials, parts and finished inventory from suppliers through the firm and on to the customers
20	1996	SCM	Thomas, Griffin	Management of material and information flows, both in and between facilities such as vendors, manufacturing and assembly plants and distribution centers
21	1996	SCM	Daugherty, Ellinger, Gustin	The physical network that begins with the supplier and ends with the customer
22	1997	SCM	Towill	An integration process based on flawless delivery of basic and customized services
23	1997	SCM	Monczka, Morgan	Integrated SCM is about going from the external customer and then managing all the processes that are needed to provide the customer with value in a horizontal way
24	1997	SCM	Saunders	Supply chain is the total chain of exchange from original source of raw material, through various firms involved in extracting and processing raw materials, manufacturing, assembling, distributing and retailing to end customers
25	1997	SCM	Kopczak	The set of entities, including suppliers, logistics services providers, manufacturers, distributors and resellers, through which materials, products and information flow
26	1997	SCM	Lee, Ng	A network of entities that starts with the suppliers' supplier and ends with the customers' custom the production and delivery of goods and services
27	1998	SCM	Tan, Kannan, Handfield	It is management philosophy that extends traditional intra-enterprise activities by bringing trading partners together with the common goal of optimization and efficiency

Table III. (*continued*)

Serial no.	Year	Term	Author	Definition
28	1998	SCM	Tan, Kannan, Handfield	Supply chain management encompasses materials/supply management from the supply of basic raw materials to final product with recycling and re-use where ever possible. It focuses on how firms use their suppliers' processes, technology and capability to get a competitive advantage. It is a management's way of thinking that extends beyond traditional intra-enterprise activities by bringing trading partners together with the mutually agreed goal of optimization and efficiency
29	1998	SCM	Christopher	The arrangement of upstream and downstream entities forming a link with suppliers and customers to give very high customer value economically throughout the entire link
30	1998	SCM	Christopher	Supply chain is the interlinking of organizations that are associated through upstream and downstream linkages, in the various activities that produce value in the form of products and services at the disposal of the customer
31	1999	SCM	Hicks	Systematic effort to provide integrated management to meet customer needs and expectations from the suppliers of raw materials through manufacturing to end-customers
32	1999	SCM	Houlihan, Houlihan	The integration of various functional areas within an organization to enhance the flow of goods from immediate strategic suppliers through manufacturing and distribution chain to the end-user
33	1999	SCM	Handfield, Nichols	A supply chain includes within its folds all activities related with the movement and conversion of goods right from the raw material extraction stage to the end-user, including the related information flows
34	1999	SCM	Beamon	An integrated process where raw materials are converted to usable products and delivered to customers
35	1999	GSCM	Beamon	It consists not only of all elements of a traditional supply chain but extends the one-way chain to a semi-closed loop including recycling, re-use and/or remanufacturing activities of the product and its packaging
36	2001	SCM	Chopra, Meindl	A supply chain consists of all phases involved, directly or indirectly, in satisfying a customer request
37	2001	SCM	Mentzer, DeWitt, Keebler, Min, Nix, Smith, Zacharia	It consists of planned strategic coordination among all the business function within and across the businesses within the supply chain for enhancing the performance of the individual businesses as well of the entire interconnected group of businesses
38	2001	GSCM	Bowen, Cousins, Lamming, Farukt	Green supply is indicative of supply chain management activities that are intended to improve the environmental performance of purchased items or of the suppliers that supply them. Green Supply may be in the form of greening the supply processes or in the form of product-based green supply

(*continued*)

Table III.

Serial no.	Year	Term	Author	Definition
39	2001	ESCM	Zsidisin, Siferd	At the firm level, Environmental Supply Chain Management (ESCM) is the set of supply chain management policies, actions and relationships in response to concerns related to the environment with regard to the design, acquisition, production, distribution, use, reuse and disposal of the firm's produce
40	2002	GSCM SCEM	Rao	It consists of filtering out suppliers for their environmental performance and then doing business with only those that meet regulatory standards. The forces for implementing this into the company operations range from reactive regulatory reasons to proactive strategic and competitive advantage
41	2004	GSCM	Lee	A GSC initiative can be defined as programs striving to transfer and disseminate environmental management, in certain advanced environmental management practices, throughout the supply chain, using the relationships between large-sized buying firms and their suppliers
42	2005	GSCM	Hervani, Helms, Sarkis	GSCM is defined mathematically as Green Supply Chain Management (GSCM) = Green Purchasing + Green Manufacturing/Materials Management + Green Distribution/Marketing + Reverse Logistics
43	2006	GSCM	Vachon, Klassen	Green Supply Chain practices could be in the form of Environmental Monitoring and Environmental Collaboration
44	2007	GSCM	Srivastava	GSCM includes activities for safeguarding the environment like product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers and end-of-life management of the product after its useful life
45	2009	GSCM	Shukla, Deshmukh, Kanda	GSCM includes strategic actions by collaborating partners and stakeholders of the supply chain to mitigate and/or eliminate the adverse impacts of business activities, spread across the chain, on the environment, thereby ensuring the sustainability

Table III.

Research methodology

The research methodology used can be summarized in four steps as follows as is also used in one of the recent review papers by Agrawal *et al.* (2015):

Material collection

To begin with, a number of books related to the subject of green supply chain (management) practices were referred to so as to understand the scope of the subject. To do this, a number of books focusing on the subject of "Greening the Supply Chain" and allied areas were obtained. Getting a feel of the scope of the subject, and also, reviewing the latest literature, it was of interest to do an exploratory empirical study in the area of green supply chain practices and green supply chain

Study	Future scope of research as suggested by recent studies
Chan *et al.* (2012)	Studying the mediating effect of GSCM on the impact of environmental orientation in other countries Exploring other management-based practice mediation mechanism, like marketing-based downward stream management practices Exploring the possible moderating effect of other contextual factors like market dynamism so as to know other contingencies that may be capable of affecting the GSCM performance relationship
Zhu *et al.* (2012)	Evaluating the performance of successful Chinese manufacturers adopting GSCM with the help of objective data What factors influence companies to lay varied emphasis on the implementation of GSCM practices? A study on how "laggards" can be stimulated to implement GSCM? A study on diffusion from early adopters to laggards in the context of GSCM Studying alternative motivating pressures (regulatory vs competitive) and how they influence the diffusion of innovation and the link with performance outcomes Disaggregated analysis to explain organizational differences among the different manufacturers adopting GSCM in terms of size, ownership and the type of industry Examining the relationship among individual factors of GSCM practices and individual factors of GSCM performance, so that managers identify the proper GSCM practices to strengthen and improve their performance in needed areas
Wu *et al.* (2012)	Taking companies' social position into consideration in studying GSCM Analyzing the relationships between GSCM drivers and GSCM practices by treating environmental certification as a control variable

Table IV.
Future scope of research identified from some of the recent research works

Serial no.	Key focus of the publications	Total Number	(%)
1	Supply chain (SC); and supply chain management (SCM)	67	29.26
2	Green supply chain management (GSCM)	60	26.20
3	Not relevant	37	16.16
4	Sustainable supply chain management (SSCM)	29	12.66
5	Green supply chain practices (GSC practices)	25	10.92
6	Green supply chain performance (GSC performance)	11	4.80
Total		229	100.00

Table V.
Breakup of publications obtained by keyword searches on supply chain management; green supply chain management; green supply chain practices; and green supply chain performance

performance. Accordingly, papers published in scholarly peer-reviewed international journals were obtained from available research library databases, namely, Science Direct, ProQuest and EBSCO, as well as from the search engine of google.com by searching the keywords "Green Supply Chain Practices" and "Green Supply Chain Performance". Apart from this, also dissertations searched and obtained in the above manner were referred to get more insight into previously done

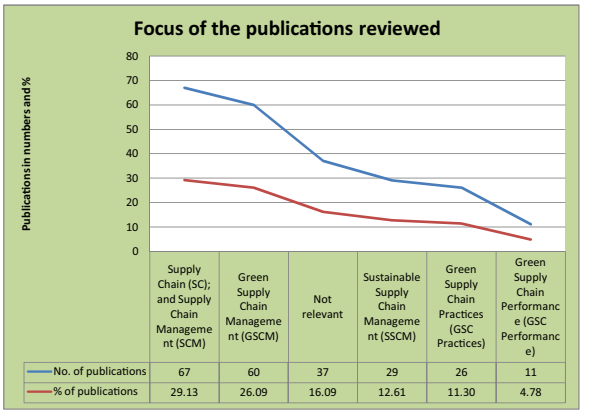

Figure 2.
Graphical break-up of publications obtained by using a keyword search

Green supply chain practices	Green supply chain performance	Green supply chain practices and performance
Klassen and Johnson (2004)	Beamon (1999a, 1999b)	Zhu and Sarkis (2004)
Zhu and Sarkis (2004)	Stuart and Emmett (2012)	Rha (2010)
Rao and Diane Holt (2005).	Kurien and Qureshi (2012)	Zhu *et al.* (2010)
Chien and Shih (2007)	Diab *et al.* (2015)	Ninlawan *et al.* (2010)
Zhu *et al.* (2008)		Li (2011)
Darnall *et al.* (2008).		Green *et al.* (2012)
Eltayeb and Zailani (2009)		Zhu *et al.* (2012)
Rha (2010)		Perotti *et al.* (2012)
Zhu *et al.* (2010)		Laosirihongthong *et al.* (2013)
Ninlawan *et al.* (2010)		
Nunes, Bennett (2010)		
Kirchoff (2011)		
Li (2011)		
Wu *et al.* (2012)		
Toke *et al.* (2012)		
Pandya and Mavani (2012)		
Perotti *et al.* (2012)		
Green *et al.* (2012)		
Zhu *et al* (2012)		
Chin-Chun *et al.* (2013)		
Lee *et al.* (2013a)		
Lee *et al.* (2013b)		
Lo (2014)		
Luthra *et al.* (2014)		

Table VI.
Summary of published literature addressing green supply chain practices and performance

research in the area of green supply chain (management) practices. The topic of research was chosen from among the future scopes of these papers and other literature thus obtained.

Descriptive analysis: The papers obtained by doing the keyword search are summarized journal-wise in Table I and chronologically in Table II.

Study	Components of green supply chain (management) practices
Klassen and Johnson (2004)	Environmental certification
	Pollution prevention
	Reverse logistics
	Life cycle assessment
	Design for the environment
Zhu and Sarkis (2004)	Internal environmental management
	External GSCM
	Investment recovery
	Eco-design
Rao and Diane Holt (2005)	Greening the inbound logistics phase of supply chain
	Greening the production phase or the internal supply chain
	Greening the outbound logistics phase
	Greening the reverse logistics phase
Chien and Shih (2007)	Green procurement practices
	Establishing a control list of environmentally hazardous substances
	Profiles for raw materials containing no prohibited substances
	Assessment tables for the environmental management of suppliers
	Green product approval data
	An auditing mechanism for green management
	Green manufacturing practices
	Green design
	Manufacturing of green products
	Recovery and reuse of used products
	Green products standards
Zhu *et al.* (2008)	Internal environmental management
	Green purchasing
	Customer cooperation
	Investment recovery
	Eco-design
Darnall *et al.* (2008)	Assess suppliers' environmental performance
	Require suppliers to undertake environmental measures
	Track the cost of waste
	Inform buyers of ways to reduce environmental impact
Eltayeb and Zailani (2009)	Eco-design and design for the environment
	Green purchasing
	Reverse logistics
Sarkis (2009)	Industrial ecology and industrial symbiosis
	Environmental management systems
	Product stewardship and extended producer responsibility
	Life cycle analysis
	Eco-design and design for the environment
Rha (2010)	Green supply chain internal practices
	Green supply chain external practices
	Green supply chain eco-design practices
Zhu *et al.* (2010)	Internal environmental management
	Green purchasing
	Customer cooperation with environmental considerations
	Eco-design
	Investment recovery

(*continued*)

Table VII.
Components of green supply chain practices as per various studies

Study	Components of green supply chain (management) practices
Ninlawan *et al.* (2010)	Green procurement
	Green manufacture
	Green distribution
	Green logistics
Nunes and Bennett (2010)	Green buildings
	Eco-design or DfE
	Green supply chains
	Green manufacturing
	Reverse logistics
	Innovation
Kirchoff (2011)	Eco-design
	Investment recovery
	Internal environmental management
	Cooperation with customers
	Green purchasing
Li (2011)	Suppliers environmental questionnaire
	Compliance statement
	Product testing report
	BOM
	Establishing environmental requirements for purchasing items
	Green purchasing
	Information system
	Joining local recycling organizations
	Collaboration on products recycling with the same sector industry
	Produce disassembly manuals
	Green design
	Top management support
	Environmental policy for GSCM
	Cross-function integration
	Manpower involvement
	Effective communication platform within companies and with suppliers
	Establish a environmental risk management system for GSCM
	Supplier evaluation and selection
	Applying LCA to carry out eco-report
	Establish an environmental database of products
	Cooperation with customer for green packaging
	Transport greening
	Consumer greening
Wu *et al.* (2012)	Green purchasing
	Cooperation with customers
	Eco-design
	Investment recovery
Toke *et al.* (2012)	Top management commitment
	Societal concern for protection of natural environment
	Government policies and regulations
	Eco-literacy amongst SCM partners
	Customer satisfaction through environmental performance
	Environmental management systems (ISO-14001)
	Proper workplace management: Housekeeping practices

Table VII. (*continued*)

Study	Components of green supply chain (management) practices
	Green product development
	Green procurement practices
	Availability of clean technology
	Lean manufacturing practices
	Economic interests
	Eco-labeling of products
	Reverse logistics practices
	Competitiveness
Pandya and Mavani (2012)	Internal management
	Green supply
	Cooperation with customers
	Investment recovery and Eco-design of products
	Reverse logistics
Perotti *et al.* (2012)	Green supply
	Distribution strategies and transportation
	Warehousing and green building
	Reverse logistics
	Cooperation with customers
	Investment recovery
	Eco-design and packaging
	Internal management
Green *et al.* (2012)	Green purchasing
	Cooperation with customers
	Eco-design
	Investment recovery
Zhu *et al.* (2012)	Suppliers environmental questionnaire
	Compliance statement
	Product testing report
	BOM
	Establishing environmental requirements for purchasing items
	Green purchasing
	Information system
	Joining local recycling organizations
	Collaboration on products recycling with the same sector industry
	Produce disassembly manuals
	Green design
	Top management support
	Environmental policy for GSCM
	Cross-function integration
	Manpower involvement
	Effective communication platform within companies and with suppliers
	Establish a environmental risk management for GSCM
	Supplier evaluation and selection
	Applying LCA to carry out eco-report
	Establish an environmental database of products
	Cooperation with customer for green packaging
	Transport greening
	Consumer greening

(*continued*)

Table VII.

Study	Components of green supply chain (management) practices
Chin-Chun *et al.* (2013)	Green purchasing
	Design for environment
	Reverse logistics
Laosirihongthong *et al.* (2013)	Green purchasing practices
	Product related to eco-design practices
	Packaging related to eco-design practices
	Reverse logistics practices
	Legislation and regulation
Lee *et al.* (2013a)	Water efficiency
	Waste reduction and recycling
	Sustainable furnishing and building materials
	Sustainable food
	Sustainable energy
	Disposables, chemical and pollution reduction
Lee *et al.* (2013a)	Practices based on internal pressures
	Commitment of GSCM from senior managers
	Support of GSCM from middle-level managers
	Cross-functional co-operation for environmental improvemen
	Total quality environmental management
	Practices based on external pressures
	Consideration of supplier's ISO 14000 certification
	Co-operation with customers for eco-design
	Co-operation with customers for cleaner production
	Co-operation with customers for green packaging
	Investment recovery (sales) of excess inventories/materials
	Sale of scrap and used materials
Lo (2014)	Green design
	Green purchasing
	Green manufacturing
	Green logistics
	Internal environmental management
Luthra *et al.* (2014)	Green product development
	Green design
	Green purchasing and green raw material procurement
	Green process planning
	Green manufacturing
	Green transportation and distribution

Table VII.

Category selection. Through this exercise one interesting future scope of research was identified as the association between components of green supply chain practices and the components of green supply chain performance. This study says that at a broad level, it has been established that green supply chain practices are associated with green supply chain performance, but it is not conclusively established that which component of green supply chain practices is strongly associated with which component of green supply chain performance. Subsequently, attempt was made to access and review as many papers, dissertations and books as possible to get a near true picture of the scope of the subject and also to review the work done by various researchers over the years in the area of green supply chain (management) practices and green supply chain performance. Table VI shows the studies addressing green supply chain practices;

Study	Components of green supply chain performance
Beamon (1999, 1999b)	Resource use
	Product recovery (remanufacturing, reuse, recycling)
	Product characteristics
	Waste emission and exposure hazard
	Economic
	Economic/emissions
Zhu and Sarkis (2004)	Components of organizational performance
	Environmental performance
	Economic performance
Rha (2010)	Supply chain output
	Supply chain resources
	Supply chain flexibility
Zhu *et al.* (2010)	Environmental performance
	Financial performance
	Operational performance
Emmett and Sood (2010)	Green supply chain planning
	Green supply chain procurement
	Green supply chain execution
	Carbon management
	Green supply chain migration
	Green supply chain continuous improvement
Ninlawan *et al.* (2010)	Environmental performance
	Economic performance
Li (2011)	Eco-design
	Green purchasing
	Green manufacturing capacity
	Green marketing and consumption
	Recycling products processing ability
	Level of information technology
	Comprehensive level
Green *et al.* (2012)	Environmental performance
	Economic performance
	Operational performance
Zhu *et al.* (2012)	Environmental performance
	Financial performance
	Operational performance
Perotti *et al.* (2012)	Environmental performance
	Economic performance
	Operational performance
Kurien and Qureshi (2012)	Financial perspective
	Energy efficiency saving
	Carbon trading
	Customer perspective
	Environmental policy
	ISO accreditation
	FTSE good index
	CRC league table
	EMS

(*continued*)

Table VIII.
Components of green supply chain performance as per various studies

Study	Components of green supply chain performance
	Innovation and learning
	Cleaner supply chain technology
	Renewable energy
	Environmental team
	Internal businesses
	Carbon emission ratio
	EMS certification
	EMS compliance
	FTS
	CRC league table
	Benchmarking
	Index
	Environmental index
	Social index
	Economic index
Diab *et al.* (2015)	Internal environmental management
	Collaboration with customers
	Green purchasing
	Eco-design and packaging
	Warehousing and green buildings

Table VIII.

green supply chain performance and both green supply chain practices and performance.

Material evaluation. Few studies have examined the association between green supply chain practices and green supply chain performance, but no such study has been prominent using the connotation of green supply chain practices as suggested by Klassen and Johnson (2004 and using the connotation of green supply chain performance as suggested by Stuart and Emmett, 2010 in one single study. Accordingly, it is proposed to test the hypotheses in future in accordance with the proposed research framework shown in Figure 3. The research framework shows the association between the construct GSC practices and the construct GSC performance. Further, the research framework shows the construct GSC practices as consisting of five sub-constructs, namely, environmental certification; pollution prevention; design for the environment; life cycle assessment; and reverse logistics. The research framework shown in Figure 3 also shows the construct GSC performance as consisting of six sub-constructs, namely, GSC planning; green procurement; GSC execution; carbon management; GSC migration; and GSC continuous improvement. It shows the association between each of the five sub-constructs of GSC practices with each of the six sub-constructs of GSC performance. Accordingly, a total of 31 associations are depicted in the proposed research framework. It is possible to frame research questions and the associated hypotheses based on these 31 associations. The set of constructs and sub-constructs corresponding to each of the research questions and the hypotheses to be tested is also depicted in Table IX. Regarding the validity, senior experts having a reasonable authority in this area were contacted and their opinion was taken regarding the constructs and how the hypotheses are proposed to be tested using a questionnaire. They have agreed with the idea of testing these hypotheses in this manner and also with the way in which these

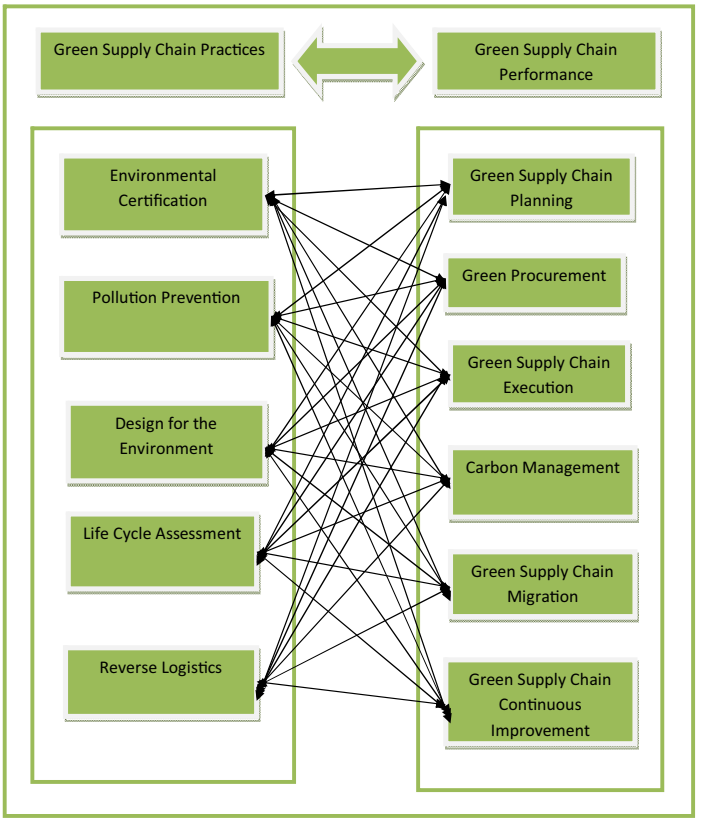

Figure 3.
Research framework showing the construct and the hypothesized relationships proposed to be tested

hypotheses were derived from the literature referred. They have validated the constructs for the purpose of testing the proposed hypotheses.

The proposed research framework

Figure 3 shows the constructs GSC practices and GSC performance. It also shows the five component sub-constructs of GSC practices, namely, environmental certification (EC); pollution prevention (PP); design for the environment (DfE); life cycle assessment (LCA); reverse logistics (RL). It also shows the six component sub-constructs of GSC performance, namely, GSC planning; green procurement; GSC execution; carbon management; GSC migration; and GSC continuous improvement.

Conclusion and future scope of research

Through an extensive literature review in the areas of GSC practices and GSC performance over the past three decades, it was possible to identify the various connotations of the terms GSC practices and GSC performance. This hints at studying the relationship between components of GSC practices and components of GSC performance in light of newer connotations. Accordingly, this paper explores the previously conducted research work but in light of a different connotation. It is believed

Table IX.
Research questions, hypotheses and constructs identified for a proposed correlational study

Research questions	Hypotheses	Related constructs: Construct set A	Related constructs: Construct set B
How do green supply chain practices associate with green supply chain performance?	*H31*. Particular components of green supply chain practices are predominantly associated with particular components of green supply chain performance	Green supply chain practices Environmental Certification Pollution prevention Life cycle assessment Design for environment Reverse logistics	Green supply chain performance GSC planning Green procurement Green supply chain execution Carbon management GSC migration GSC continuous improvement
How is environmental certification associated with green supply chain practices?	*H1*. Environmental certification has a significant positive association with GSC planning *H2*. Environmental certification has a significant positive association with green procurement *H3*. Environmental certification has a significant positive association with GSC execution *H4*. Environmental certification has a significant positive association with carbon management *H5*. Environmental certification has a significant positive association with GSC migration *H6*. Environmental certification has a significant positive association with GSC continuous improvement	Environmental certification (EC)	GSC planning Green procurement Green supply chain execution Carbon management GSC migration GSC continuous improvement

(*continued*)

Research questions	Hypotheses	Related constructs: Construct set A	Related constructs: Construct set B
How is pollution prevention associated with green supply chain practices?	*H7*. Pollution prevention has a significant positive association with GSC planning *H8*. Pollution prevention has a significant positive association with green procurement *H9*. Pollution prevention has a significant positive association with GSC execution *H10*. Pollution prevention has a significant positive association with carbon management *H11*. Pollution prevention has a significant positive association with GSC migration *H12*. Pollution prevention has a significant positive association with GSC continuous improvement	Pollution prevention (PP)	GSC planning Green procurement Green supply chain execution Carbon management GSC migration GSC continuous improvement
How is life cycle assessment associated with green supply chain practices?	*H13*. Life cycle assessment has a significant positive association with GSC planning *H14*. Life cycle assessment has a significant positive association with green procurement *H15*. Life cycle assessment has a significant positive association with GSC execution *H16*. Life cycle assessment has a significant positive association with carbon management *H17*. Life cycle assessment has a significant positive association with GSC migration *H18*. Life cycle assessment has a significant positive association with GSC continuous improvement	Life cycle assessment (LCA)	GSC planning Green procurement Green supply chain execution Carbon management GSC migration GSC continuous improvement

(*continued*)

Table IX.

Table IX.

Research questions	Hypotheses	Related constructs: Construct set A	Related constructs: Construct set B
How is design for environment associated with green supply chain practices?	*H19*. Design for environment has a significant positive association with GSC planning *H20*. Design for environment has a significant positive association with green procurement *H21*. Design for environment has a significant positive association with GSC execution *H22*. Design for environment has a significant positive association with carbon management *H23*. Design for environment has a significant positive association with GSC migration *H24*. Design for environment has a significant positive association with GSC continuous improvement	Design for environment (DfE)	GSC planning Green procurement Green supply chain execution Carbon management GSC migration GSC continuous improvement
How is reverse logistics associated with green supply chain practices?	*H25*. Reverse logistics has a significant positive association with GSC planning *H26*. Reverse logistics has a significant positive association with green procurement *H27*. Reverse logistics has a significant positive association with GSC execution *H28*. Reverse logistics has a significant positive association with carbon management *H29*. Reverse logistics has a significant positive association with GSC migration *H30*. Reverse logistics has a significant positive association with GSC continuous improvement	Reverse logistics (RL)	GSC planning Green procurement Green supply chain execution Carbon management GSC migration GSC continuous improvement

to respond to some unanswered questions. Questionnaires are being designed for testing the hypotheses corresponding to the research framework proposed to carry out empirical studies in selected sectors of industry in select geographical regions. Further ground work is being done in this direction for conducting an empirical study soon.

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