

Green Supply Chain Management with Artificial Intelligence Based Optimization

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Abstract- Green supply chain management (GSCM) has become a topic of interest for both business leaders and academic researchers alike. Over the last decade or so, the GSCM literature has grown considerably. Although sufficient literature exists about various aspects and facets of GSCM, earlier works and reviews have a limited focus and narrow perspective. This paper presents a comprehensive integrated view of the published literature of GSCM so as to facilitate further study, practice and research. First, we introduce the different definitions of GSCM and its' development. Second, we focus on reviewing the research on GSCM's decisions and models. Finally, we discuss the limitations of existing research on GSCM and indicate future research opportunities.

Keywords- Green Supply Chain Management, Review, performance evaluation

I. INTRODUCTION

The study on green supply chain and other related theoretical concepts began in the 1970s, the first 70 years, initially only adding the idea of environmental protection to the supply chain management. It is a secondary aspect of logistics management. Green logistics study caused wide spread concern in academic circles until in the early 1990s. Following the propose of the "return of logistics" and "green procurement", Manufacturing Research Comity (MRC) in the United States Michigan State University in 1996 first proposed a "green supply chain" concept when conducting the study "environmentally responsible manufacturing" (ERM), which was also known as Environmentally Conscious Supply Chain (ECSC) or Environmentally Supply Chain (ESC).

It seeks to consolidate the environmental impact of the manufacturing supply chain and use question of resources optimal, its purpose is to enable the supply chain's negative impact on the environment to the smallest, use efficient of resources to the maximum. At flows, the green supply chain changes the open-loop structure in the traditional supply chain, an increase of the recovery aspect, implement recovery and reuse of materials and energy, thus forming the logistics' "closed-loop". The green supply chain not only improve the utilization of resources, reduce waste pollution of products on the environment, but also reduce the manufacturer's operating costs, improve the competitiveness of the supply chain node enterprises.

At present, in the theoretical circles green supply chain management has not been yet precisely defined. In this

paper, consider: Green supply chain management is generally to be considered as the modern management model giving consideration of the environmental impact and resource efficiency in the whole supply chain; it involves suppliers, manufacturers, sales and users based on green manufacturing theory and supply chain management technology. Its purpose is to enable products' negative impact on the environment to the smallest, use efficient of resources to the maximum in the entire process, then achieve sustainable development of the enterprises and the supply chain.

II. SUPPLY CHAIN MANAGEMENT

The Supply Chain is the movement of materials as they move from their source to the end customer. According to Christopher the Supply Chain produce value in the form of products and service to the end customers through different processes and activities, which are performed by the network of organizations from the upstream and downstream linkages. The network, process and activities may consists of suppliers, purchasing, manufacturing centers, warehouses, transportation, distribution centers, and retail outlets, as well as raw material, work-in process inventory, and finished products that flow between the facilities.

III. SCOPE OF GSCM

GSCM scope ranges from implementing and monitoring of the general environment management programmers to more creating or controlling practices implemented through various Rs (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Re manufacture, Reverse logistics, etc.) towards attaining a GSCM waste minimization is

being considered as an important strategic. The waste, which is non-value adding activity, carried out in any operation. The most commonly perceived enemy to environmental protection in manufacturing and production operations. That is, manufacturing and production processes are reviewed as the culprits in harming the environment, in the forms of waste generation, ecosystem disruption, and depletion of natural resources.[2].

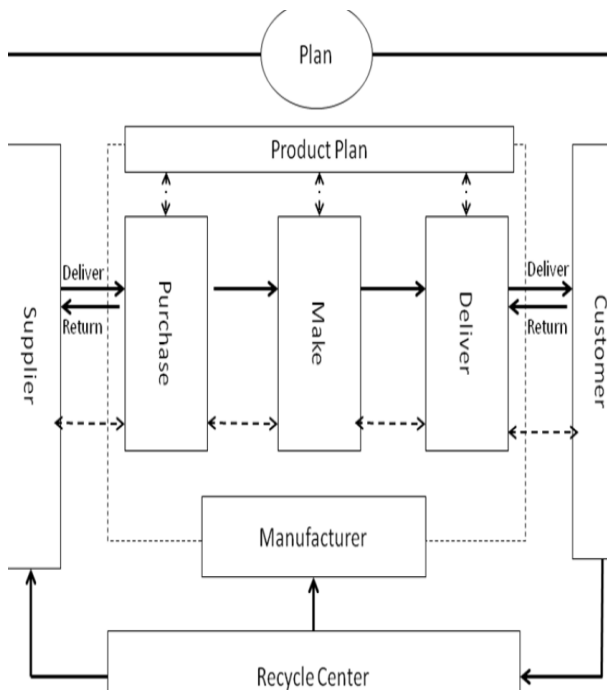


Fig. 1 Automotive Industry Green Supply Chain Model.

IV. LITERATURE REVIEW

The very first green supply chain came into context in 1989. Kelle and Silver's (1989) article was the first of this literature that developed an optimal forecasting system for organizations to use to forecast products that can be potentially be reused. This forecasting system, however, was highly contentious because returning individual containers is not usually known with certainty, so therefore, their findings may somewhat be incoherent.

The first green design literature came into context in 1991. Navin- Chandra's (1991) article was the first of the literature to consider the need for a green design to reduce the impact of product waste.

GSCM has gained popularity with both academics and practitioners to aim in reducing waste and preserving the quality of product-life and the natural resources. Eco-efficiency and remanufacturing processes are now important assets to achieve best practice.

(Ashley, 1993; Srivastava, 2007). Works of Ashley (1993); Allenby and Richards (1994) and Zhang, Kuo, Lu and Huang (1997) came into context and expanded the framework of green design. Life-cycle analysis was an example of a framework that came out of green design. Works of Arena,

Mastellone and Perugini (2003), Beamon(1999) and De Ron Penev (1995) all discussed life-cycle analysis as a framework Green Operations in terms of reverse logistics was an important concept that came out of the GSCM literature. Apart from Kelleand Silver's (1989) article, works of Pohlen and Farris (1992);Stock (1998) and Tibben and Limbke (2002) all provided case studies on reverse logistics. The use of plastics and bottler cycling are mentioned in some of these articles.

Izunildo Cabral, Antonio Grilo (2011)Supply Chain Management (SCM) is crucial to be present in global markets as now a days competition is between supply chains rather than companies. Current SCM paradigms like Lean, Agile, Resilient, and Green (LARG)are usually presented as individual management philosophies. The current challenge is to make the supply chain more competitive, capable of responding to the demands of customers in a market increasingly volatile and turbulent with agility, in conjugation with environmental responsibilities, and the necessity to eliminate processes that add no value. This paper present and discusses an information model for a SCM platform to support current integrated LARG paradigms [4].

Haiying CAO (2011) With the environmental issues becoming increasingly important and the gradual depletion of natural resources, people have realized the importance of the sustainable development, and the theory and practice of the green supply chain management(GSCM) have been paid more attention than before. Compared with the traditional supply chain, evaluating and choosing suppliers for a corporate become more complex based on GSCM. This article mainly discussed how the corporate evaluates and chooses its suppliers, including choosing steps, ways of choosing and evaluating and choosing system. I expect this article could help corporate build a long-term developmental strategy and gain the core competition. At the same time it can make corporate give dual attention to the social efficiency and consumers' long-term benefit [5].

Huiying YANG (2011) Green supply chain management is one kind of modern management patterns which changes the relationships between the traditional environment government and enterprise development, its development has the important influence on promoting the enterprise and society's sustainable development. According to the circular economy theory and the

structure of traditional supply chain, this paper constructs the green supply chain's system structure based on the circular economy, which includes four cycles from small to large and from partial to whole as follows: Reuse cycle, remanufacture cycle, Recycle, Nature-In-Loop. And analyzes the viewpoint that the own activity of human being only could pursue the semi-closed circulation, the completely closed macro cycle could only be realized by the union with nature, then proposes the way how to implement the green supply chain management in our country based on the idea of circular economy [6].

Jason J. Jung (2011) Green supply chain (GSC) is one of the main efforts aiming to integrate environmental parameters (or requirements) with supply chain management systems. It is a fast-moving and multidisciplinary field. This study conducts a bibliometric analysis of the field by collecting data from Web of Science (WOS) for the period of 1997 to 2010. In this short paper, we utilize a total of 151 papers with 1,526 citations from WOS. Based on these papers and citations, it evaluates the research performance of the GSC by identifying the most productive players, major scholarly communication media, highly cited authors, influential papers and emerging stars [7].

Bo Li, Yushan Jiang and Xiaolong Qu: - Green Supply Chain Management (GSCM) integrates environmental concept into supply chain management, such as, the design of green product. However, manufacturers require high investment to perform R&D green innovation, and the retailers may bear the risk of the consumers' acceptance in the market. Combining the manufacturer's investment of an environmental-friendly green product with the retailer's risk aversion, this paper investigates the optimal decisions of a green supply chain with a risk-neutral manufacturer and a risk-averse retailer. Through Stickler game model, we use conditional value at-risk (CVaR) criterion to evaluate the risk-averse behavior of the retailer under stochastic demand. The results show the great impacts of the retailer's risk-averse behavior on the green degree, the wholesale price, the retail price and the order quantity of green products relative to certain key thresholds.

Green Manufacturing- This is a very important area with in green operations. The techniques for minimum energy and resource consumption for flow systems in order to reduce the use of virgin materials are based on three fields of study: pinch analysis (Linnhoff 1993), industrial energy (Boustead 1979) and energy and life cycle analysis (Lee et al. 1995). The wasting of materials and energy either due to inappropriate design, or due to excessive number of defects should be avoided. Intel has worked in increasing the number of transistors in a single chip, which will result in fewer chips to build and fewer

chips to dispose (Gungor A, Gupta SM.1999) Using less energy is obviously good for the environment. It is also self-evidently good for business because it cuts companies' costs, and eventually avoids.

V. CLASSIFICATION BASED ON PROCESSES PERSPECTIVE

Over the last decade, a large number of GSCM papers have been published. We classify the existing GSCM literature into five broad categories based on the processes perspective in supply chain operations literature on green design; literature on green procurement; literature on green manufacturing and remanufacturing; literature on reverse logistics and network design; literature on green recycling and waste management. From the processes perspective, we can explore the whole process of green supply chain operations, including design, manufacturing, logistics, recycling, etc.

1. Green Design

Green design concepts have been used extensively in the GSCM literature for designing products with certain environmental considerations. Green design is a multidisciplinary field and requires different areas of expertise such as environmental risk management, product safety, pollution prevention, resource conservation, and waste management (Srivastava, 2007). Currently, green design literature can be categorized based on two main environmental approaches, life cycle assessment (LCA) and environmental conscious design (ECD). LCA is described as a process for assessing and evaluating the environmental, occupational health and resource related consequences of a product through all phases of its life. ECD tries to consider environmental issues during the product and process design and design the product as sustainable as possible (Hitchcock, 2012).

2. Green Procurement

Green procurement tries to minimize the environmental impacts of selected products and services. It refers to activities which most of them happen outside the organization boundaries. Hence, greening procurement processes and system is a major start point in greening SC. Green procurement has received attention from academics and practitioners (Lee, 2012). For example, Chen (2005) proposed that green purchasing provides a positive effect on the implementation of ISO 14001 environmental management. He also presented a framework of guidelines for green purchasing and there later implementing procedures.

3. Green Manufacturing and Remanufacturing

The main goal of green manufacturing is to reduce the product environmental impacts by using proper material and technologies, while green remanufacturing tries to restore worn-out products to like-new condition (Jensen,

2013). Disassembly is a systematic method of separating a product into its constituent parts, components, subassemblies or other groupings. It may involve dismantling and/or demolition and/or reprocessing. Reducing is a technique in which the consumption rate of scarce materials and/or energy is minimized. Recycling refers to activities performed to recover material from products. Reusing is the concept of using intact parts of used products for manufacturing activities (Fernandez & Kekale, 2005).

4. Reverse Logistics and Network Design

Implementing GSCM practices requires the flow of material from the final customers back to retailers, collection points, manufacturers, and/or disposal sites. Reverse logistics (RL) activities vary from product/industry to product/industry; but common activities are collection, transportation, inspection/sorting, storage, reprocessing (including recycling, reusing, repairing/refurbishing, etc.), and/or disposal. RL include four kinds of basic network: directly reusable network (DRN), remanufacturing network (RMN), repair service network (RSN), and recycling network (RN). R Literature is very extensive covering topics such as network design (Srivastava 2008), inventory, location-inventory, return demand estimation, SCasset management and investments (Kocabasoglu et al. 2007), and managerial issues (Fernandez & Kekale, 2005).

5. Data Collection -We are collection of data 15 year in Shree Ram industries in format of per month productivity and worker to work particular competition of project.

For training neural network the no. of input values should not be too large and should not be too small as it will affect the neurons structure. But the recorded values are very large. So to reduce these numbers the modeling can be done so as to get data sets values of the Per day productivity and Total labour.

After performing short circuit test and offline calculation which comprises of collecting data regarding various faults at different locations in terms of Per year productivity and Total labour the next step is to perform online calculation. Online calculation include the following step-

Step1- Training of neural network based on the collected data

Step2- Validation and testing of the data

Step3-Based on the testing of the data identify the productivity type and its industries.

Step4-Disconnect the productivity part from the healthy system using industries breaker and average industries mechanism.

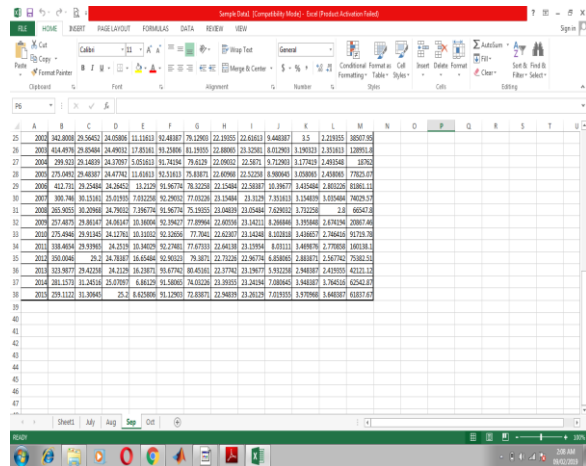


Fig. 2 Input matrix showing Industrial Data collection to 2002 to 2015 Based on Productivity.

VI. CONCLUSION

GSCM can reduce the ecological impact of industrial activity without sacrificing quality, cost, reliability, performance or energy utilization efficiency. GSCM throws various challenges to practitioners, academicians and researchers. The purpose of this paper is to briefly provide an overview of the Green supply chain literature. This paper has indicated that GSCM has helped to reduce the ecological impacts of industrial activity. Key academics have argued different angles to GSCM. Works such as Haiying 2011 discussed life-cycle analysis.

But the key themes that came out of the GSCM literature over the last twenty years are the concepts of green design, green operations, reverse logistics, waste management and green manufacturing. Much research, management education and many practical applications have focused on buffering the operations function from external influences, including the natural environment, in order to improve efficiencies, reduce cost and increase quality. The inherent complexity of environmental issues the irmultiple stakeholders, uncertain implications for competitiveness and international importance present significant challenges to researchers. Much research is needed to support the evolution in business practice towards greening along the entire supply chain. Effective approaches for data sharing across the supply chain need to be developed.

REFERENCES

- [1] E Nikbakhsh. Supply Chain and Logistics in National, International and Governmental Environment. Physica-Verlag HD, 195-220, 2009.
- [2] G A Zsidisin, S P Siferd. Environmental Purchasing: A Framework for Theory Development. European Journal of Purchasing & Supply Management, Vol. 7, No.1, 61-73, 2001.

- [3] J D Linton, R Klassen, V Jayaraman. Sustainable Supply Chains: An Introduction. *Journal of Operations Management*, Vol. 25, No.6, 1075-1082,2007.
- [4] Izunildo Cabral, António Grilo: Modelling Lean, Agile, Resilient, and Green Supply Chain Management Proceedings of the ITI 2011 33rd Int. Conf. on Information Technology Interfaces, June 27-30, 2011, Cavtat, Croatia.
- [5] Haiying CAO The Study of the Suppliers Evaluating and Choosing Strategies based on the Green Supply Chain Management,978-1-61284-109-0/11/\$26.00 ©2011 IEEE.
- [6] Huiying YANG: Research on the Construction and Management of Green Supply Chain based on Circular Economy,978-1-61284-109-0/11/\$26.00 ©2011 IEEE.
- [7] Jason J. Jung: A Bibliometric Analysis on Green Supply Chain Management: A Preliminary Result,2011 IEEE Conference on Commerce and Enterprise Computing.
- [8] YANG Jie, QU Sixiao. Study on Stages and Characteristics of Green Supply Chain Management for Firms. *Sichuan Environment*. June 2010.pp.114-116.
- [9] Zhu Q. & Sarkis, J., (2006) “An inter-sectoral comparison of green supply chain management in China: drivers and practices”, *Journal of Cleaner Production*, Vol. 14, No. 5, pp 472–86.
- [10] Large, R.O. & Thomsen, C.G., (2011) “Drivers of Green Supply Chain Management Performance: Evidence from Germany”, *Journal of Purchasing and Supply Management*, Vol. 17, pp 176-184.