

Green supply chain management: A Review

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Abstract -

Green Supply Chain Management has appeared as an environmental innovation with integrates environmental concerns into supply chain management. The main objective of this study is to correlate the term Supply Chain Management with the Green Supply Chain Management. Green Supply Chain Management has appeared as an environmental innovation with integrates environmental concerns into supply chain management. The main purpose of this study is to demonstrate the new innovative areas of this emerging field. The study is focused on application of GSCM in the developed firms including all those innovations that are relevant to environmental and social sustainability towards operation management and supply chain management. It shows that GSCM is the advance change to improve to conventional supply chain management method. .

Key Words: *conventional, modern supply chain management, innovations in GSCM,*

1. Introduction-

Green supply chain management integrates the environmental thinking into supply chain management, including product design, material resourcing and selection, manufacturing process, delivery of final product to the consumer as well as end of life management of the product after its useful life. In the early days, there was the conventional supply chain management that provides the management of flow of goods and services. It integrates the transpose and storage of raw material, work in process inventory, and finished goods from the point of origin to point of consumption (1). The Interconnected channels and node businesses are involved in provision of product and services required by end of customers in supply chain. Supply chain management draws heavily from the area of operation management, logistics and strives for an integrated approach. The degree of economic growth is rising the degree of energy as well as material consumption, which contribute the environmental issues and resource depletion problem(12). It has become rising significant for firms facing competitive, regulatory, and community pressures to provide a better supply chain management which should be balanced with

economic and environmental aspects. So, nowadays many firms are adopting some changes related to environmental issues which also affected suppliers and customers (2). Also manufacturers need to work with their supplier of raw material and their component in order to produce environmental friendly products. By using their purchasing power, the industries can set up environmental criteria for their suppliers upstream in supply chain (3).

2. Literature review

Toke, Gupta and Dhandedkar (1) have reviewed a no. of issues to green supply chain and their management. The structure of the presentation was based on four major functions that could be considered as driers within the green supply chain management. These functions are purchasing, in bound logistics, production, and distribution and out bound logistics

Noor aslinda, senam, zakuan, jusoh and shoki (2) discussed an overview of GSCM literature in a developed countries and developing countries. Although some studies in the literature discussed the GSCM implantations includes drivers, practices and performance over the world, but there has still little research includes drivers practices and performance over the world. But there has still research about GSCM implementation an adoption in Malaysia

Neemavat and Namdev (3) has discussed the cost and complexity are perceived as higher barrier to implement GSCM which highlight the need of cost effective and easy to implement solutions. Brand building is one of the top incentives for green supply chain management, highlighting the importance of public perception of how companies operate the GSCM.

Kumar and Chandadkar (4) studied the present system of functioning of industries is deteriorating the environment and a soon a day will come when damage done to earth will become irrecoverable. Thus, it can be concluded that the GSCM is inevitable if the earth is to be kept green and appropriate methodology maybe adopted by industries to minimize the detrimental effect on environment.

Luthra, Kumar, Sanjay Kumar, Abid Haleem(5) studied the green supply chain management has been identified as an

approach for improving performance of process and product according to requirement of environmental regulation

Qinghua Zhu, Joseph Sarkis, Kee-Hung (6) argued that how many GSCM practices implications effectively closing the supply chain loops. Adoption of these practices is fundamental to China's involvement in these critical practices. Under pressure from foreign partners and customers and increasingly value to domestic environmental regulation, Chinese industries will further adoption of five major categories of GSCM

Benita.M.Bemon(7) demonstrated that the supply chain management concept grew out of reorganization that process of transforming raw material into final product and delivering to those products to customers is become increasingly complex. As such, it become increasingly apparent that analysis of individual supply chain management stages did not lead to improvement as whole. Thus, the concept of supply chain emerged to describe all production stages to raw material acquisition to final product delivery. Changes in the state of environment, leading to subsequent pressure and environmental legislation have necessitated a fundamental shift in manufacturing business practice.

Su Yol Lee (8) focused on importance of green supply chain initiatives, which are inter-organizational projects striving to improve environmental performance as well as economic efficiency throughout the entire supply chain. These initiatives have been successfully implemented only if the participation of all player, in particular SME suppliers, is guaranteed. His study investigates what factors facilitate SME suppliers to willingly take part in those initiatives

Francesco and Fabio(9) estimated that the most interesting result of their model concerns the role of EMss (environmental measurement system) 'nest' in which GSCM can easily originate and effectively grow. The key to the development of GSCM practices, according to their findings, seems to be that prompting the adoption of EMss (Environmental management system), also through the diffusion of the connected certifications schemes in order to facilitate and support their gradual extension towards supply chain activities.

Arimura, Darnall and Katayama (10) demonstrated that using Japan facility level data, the effect of ISO14001 certification on the promotion of more advance environmental practice named as green supply chain management. They find that ISO14001 promotes green supply chain management. Facilities with ISO14001 are likely to access 40% more of their supplier's environmental performance and 50% more likely to require that their suppliers undertake specific environmental practices

Ghobakhloo, Tang, Zulkifli, and Ariffin (10) presented a state-of-the-art and succinct framework of effective GSCM implementation which is based on the literature review of GSCM while integrating the whole gamut of activities in the

area. They have found that the key themes that came out of the GSCM literature over the last twenty years are the concepts of greening the product design, material management, manufacturing process, distribution and marketing, and reverse logistics

B.L.Lakshmimieera and Dr. Palanisamy (12) concluded that the subject launches a number of challenges for managers, academics and researchers. GSCM involves a paradigm shift in which the issue of sustainability is no longer seen as a source of costs, representing a potential source of competitive advantage for companies. Manufactures today are under pressure to adopt these strategies to create an environmental stance that is a driver for reduced costs and risks, increased revenues, and improved brand image. Organizations which have taken up the environmental position go beyond the basics of cutting waste and operating efficiently to adopt the strategy of Lean and Clean to be really green.

3. Conventional supply chain management

The supply chain management is defined as a planned production process in which raw material is converted into finished goods, the delivered to end costumers. Connected set of resources and process starts with the raw material sourcing and expands to delivery of finished goods to the end costumer (4). Therefore these are the basic definitions of supply chain management. The description of extended view of SCM and integration of extra activities in the function of supply chain is explained as follows,

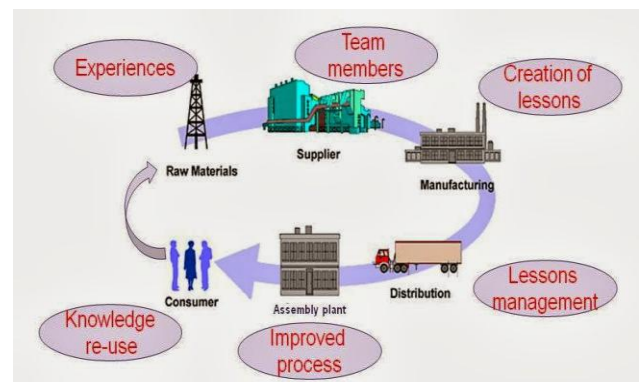


Fig 01

Little, A(1999) defines supply chain as the combined and co-ordinate flow flows of goods from the origin to final destination, also the information that are linked with it. According to Heaver , T.(1999) , supply chain is the group of manufacturers , suppliers , distributors , retailers and transporters , information and good logistics management service providers that are engaged in providing goods to consumers(5).

The objectives of supply chain management are lower the total amount of resources required to provide the necessary level of customer service to specific segment. Other writers have indicated objectives supportive of this overall goal including synchronizing the requirement of the customer with the flow of material from supplier reducing inventory investment with chain, increasing customer service building competitive advantage for the supply chain and value(6).

It has been observed that stiff competition in the industry has manufactures to focus on efficiency of total supply chain rather than on improvement of specific functional areas.(7).Integration supply chain practices now extends to the product development process. For example ,product development at the Toyota system is closely linked with the system and essential of this framework involves close, frequent, cross functional interactions both informal and formal and close monitoring by supervisors of their subordinates.(8)

4. Green supply chain management

Green supply chain management integrates the environmental thinking into supply chain management, including product design, material resourcing and selection, manufacturing process, delivery of final product to the consumer as well as end of life management of the product after its useful life. In order to achieve the GSCM, manufacturing organizations must follow the basic principles established by ISO 14000, and particularly, by state-of-the-art ISO 14001(9). In doing so, it is imperative that organizations develop procedures that concentrate on operations analysis, continuous improvement, measurement and objectives (10). However, to more systematically come up with guideline for effective GSCM implementation, it is based on following definition of GSCM: Green Supply Chain Management (GSCM) = Green Product Design + Green Material Management + Green Manufacturing Process + Green Distribution and Marketing.(2)

4.1. Green product

The main purpose of the green designing is to subtract the catastrophic effect on environment completely through systematic as well as sensitive design(11).The implementation of gscm design requires no renewable resources, impact the environmental minimally, and connect people with natural environment. Green design includes essential material selection, product procurement, package design and energy use. Green considers these important factors.

1. Design for environment
2. Eco design
3. Life cycle design
4. Other factors such as,

- A. Top management committee
 - B. Organizational structure
 - C. Reverse logistics function
 - D. Claim and reuse
 - F. Recycle remanufacturing and disposal
 - G. Environmental management system
 - H. Government regulations and legislations
 - I. Reducing energy consumption
- Green material management-

4.2 Material management-

Green material management is defined as environmental purchasing consist of involvement in activities that includes the reduction, reuse and recycling of material

For green material management, following processes of material selection, separation and material recovery should receive more support (13)

- 1) Different materials used in a product should be easy to separate;
- 2) While maintaining compatibility with the existing manufacturing infrastructure, fewer numbers of different materials in a single product should be used;
- 3) More adaptable materials for multiple product applications should be used;
- 4) Smaller number of „secondary operations“ should be used to reduce the amount of scrap and simplify the recovery processes

4.3 Green manufacturing

The general manufacturing process consumes excess amount of energy required from burning various natural sources such as coal, coke and natural gas and combustion causes air pollution. Manufacturing system evolution consist of lots of internal as well external factor. In today's global awareness of environmental risks and pressing needs to complete through efficiency, manufacturing system are involving into new paradigm.(12) The main purpose of green manufacturing is to save energy by supplying greener source of energy. The key factors of green manufacturing are,

1. The amount of energy
2. Resource utilization
3. Green degree of energy
4. Amount of hazardous waste
5. Number of reuses of Hazardous waste

4.4 Green distribution and marketing

Green marketing is the marketing of products that are presumed to be environmentally safe. Thus green marketing incorporates a broad range of activities, including product modification, changes to the production process, packaging changes, as well as modifying advertising(14).Green Manufacturing emphasizes green characteristics during sale and promotion of products and services and highlight reduced

environmental destruction. In particular, the factor of social responsibility plays an important role as mediator in the effect of green marketing on product or corporate reputation (13). Of the three factors of corporate image, product image and corporate reputation have a direct effect on purchase intentions, whereas social responsibility has an indirect effect on purchase intentions in the retail setting.

5. Innovations and results of green supply chain management

Innovation	Results
<p>Purchasing-</p> <p>Several electronics companies, including Nortel and Intel, have moved away from purchasing material toward receiving chemical services via chemical management programs. These services can include procurement, inventory management, data tracking, and waste management</p>	<p>By providing incentives for suppliers to reduce material quantities and by leveraging the suppliers' expertise, these companies have achieved Substantial savings and reduced wastes. Chemical management providers are no longer compensated based on the volume of chemicals they sell to their customers, but on value-added services. Instead, With appropriate incentives, providers are rewarded for reducing chemical usage (and costs), increasing productivity, or decreasing waste</p>
<p>Materials Handling</p> <p>A number of companies are switching to reusable packaging systems. 3M recently launched an Eco-efficient packaging business, and GM has a well established reusable pallets and containers program</p>	<p>By working closely with suppliers, GM successfully switched to reusable packaging systems and reduced its disposal costs by \$12 million between 1987 and 1992. Additionally, reusable containers can reduce solid waste, decrease product damage during Shipping, and eliminate ergonomic and safety problems.</p>
<p>Storage</p> <p>Several companies have changed their inventory storage procedures for maintenance, repair, and operating (MRO) materials by consolidating storage areas and requiring suppliers</p>	<p>Public Service Electric and Gas Company streamlined its purchasing And storage processes and saved more than \$2 million in 1997. The changes significantly decreased the disposal of obsolete paint and other materials, reduced storage</p>

to adhere to stringent material return Policies.	space requirements, And lowered carrying costs...
<p>MATERIAL RECOVERY</p> <p>By focusing on their high volume material flows and striving to eliminate wastes, several companies have justified material recovery projects by applying environmental accounting methods</p>	<p>Andersen Corporation (manufacturer of Andersen Windows and Patio Doors) developed a composite material from wood wastes generated during its manufacturing processes. This innovation is expected to yield a 50% return on investment and has already enabled Andersen to decrease solid lumber purchases by 750,000 board-foot</p>
<p>DISPOSITION</p> <p>Many companies are saving money by ensuring that major waste disposal costs are made explicit and attributed directly to the responsible product or business unit. Companies use this cost information to identify more financially attractive alternatives to disposal</p>	<p>Environmental accounting Commonwealth Edison, a Midwestern electric utility company, to greatly reduce its landfill disposal volume. A life cycle accounting approach highlighted the indirect costs created by a variety of activities, including disposal. Once these costs were made explicit, the company began developing a cost-effective method for grinding tree limbs.</p>
<p>Product Take Back</p> <p>A variety of companies have developed cost-effective ways to recover products from their distributors and customers</p>	<p>Kodak's logistics system currently recovers 70% of the cameras sold to consumers. Since its inception, over 200 million saver cameras have been returned to Kodak facilities</p>

6. Cost category

Cost category	Definition
<p>Conventional (least difficult to quantify)</p>	<p>Material, labor, other expenses, and revenues that are commonly allocated to a product or process.</p>
<p>Potentially Hidden</p>	<p>Expenses incurred by and benefits to the firm that are not typically traced to the responsible products or</p>

	processes, e.g., supervisor salaries and safety training courses.
Contingent	Potential liability or benefit that depends on the occurrence of a future event, e.g. potential occupational health and clean-up costs related to a spill of a hazardous substance.
Image/Relationship	Costs/benefits related to the subjective perceptions of a firm's stakeholders, e.g., a community group's resistance to a plant expansion or an insurer's concern about the lack of a formal environmental management
External (most difficult to quantify)	Costs/benefits of a company's impacts upon environment and society that do not directly accrue to the business, e.g., the benefits of reduced traffic congestion from a company's Telecommunication program.

3. Conclusions

From this study conclude that green supply chain management is an emerging field which integrates the environmental saving factors with the supply chain management. Also studied the diverse approaches of various authors towards the green supply chain management. From the study it can be concluded that GSCM is a modern way of conventional supply chain management. We studied the need of GSCM and constraints of conventional supply chain management. The results of studies are states that to overcome through the constraints of supply chain management, implementation of GSCM is necessary tool.

GSCM related financial impacts.

GSCM improves operations by employing an environmental solution:

- > improves agility – GSCM helps mitigate risk and speeds up innovations;
- > Increases adaptability – green supply chain analysis often leads to innovative Processes and continuous improvements;
- > promotes alignment – GSCM involves negotiating policies with suppliers and customers, which results in better alignment of business processes and principles

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