



Supply Chain Consulting Solutions

Humanitarian View Focus on Green Supply Chain

S. P. Anbuudayasankar, K. Ganesh, S. C. Lenny Koh, P. Sivakuma

Abstract— You might have heard over a thousand times that the present is vastly more challenging and fast moving than the past. You might have read over a thousand articles on Supply Chain Management (SCM). What we wish to say is some thoughts for the future of SCM considering the humanitarian view. What are the modern mantras of SCM we hear today? Customer Relationship Management (CRM)? Supplier Relationship Management (SCM)?, Enterprise Resource Planning (ERP)? Zero defect? Zero inventory? Radio Frequency Identification (RFID)? Geographic Information System (GIS)? And Global Positioning System (GPS)? You must have heard enough and more of these. But we wish to put forth some issues that we think are relevant for the future of supply chain (SC) consulting solutions considering the humanitarian view.

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Keywords— Supply Chain Consulting; Green Supply Chain; Humanitarian View

I. INTRODUCTION

WE are repeatedly told that, for us, customer is the king. Do we pause to think of the set of people who make our customers happy even without knowing them? I mean our suppliers! As much as a typical company has 80 percent of its revenues coming from 20 percent of its customers, in many organizations, 20 percent of their vendor base supplies up to 80 percent of the purchased parts, materials, and products.

But how are suppliers treated today? On one side, we have Business to Business (B2B) or tier 2 suppliers who are fairly sensitive to the input side of their supply chain. They treat them well, trust them, keep up good communication with them and clear their bills promptly. They even reach out to help them when they are in trouble. Good companies do focus on supplier relationships.

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Unfortunately, we cannot say the same of many of our Original Equipment Manufacturer (OEMs). This is where the customer-supplier relationship turns into a "bully-victim" relationship! Customer will practice zero inventory but supplier has to keep a warehouse close to that site and maintain inventory to feed the customer Just in Time! In my opinion, the only permissible inventory is the ore that lies under the ground, yet to be mined out! "Passing-the-buck" approach down the value chain is not a sustainable business model! And then the other condition: "Give us a 3 % price reduction every year!" I am free to raise the price of my product periodically but my supplier will not get the benefit of any of those price increases!

Supplier relationship management (SRM) can be viewed as the systematic management of supplier relationships to optimize the value delivered through those relationships over a course of their life cycles. The goal of SRM is to streamline and make more effective the processes between an enterprise and its suppliers. The importance to supplier is as critical as the importance we give to our employees. Most of the company looks at the value to employees as money. Rather, there is something beyond that needs paramount importance. That is ergonomics for the employees!

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II. ERGONOMICS IN LOGISTICS AND SUPPLY CHAIN

All of us know the extent to which automation has invaded our shop-floor. Set-up times have fallen drastically, precision has improved, quality is being talked of in the ppm range but handling still remains mixed. While there is mechanized handling at the shop-floor to some extent, most of the loading and unloading of the trucks is done manually. There are times when inhuman weights are lifted, high risks are taken and even acrobatics performed! There is some sensitivity to situations where there is risk of accident but practically nothing is being done to the activities that cause slow injuries and render a person unfit for work in a matter of 5 to 6 years!

Companies may not be interested so much in human issues here but if we alert them to the price of poor utilization and costs that may be the result of workers' compensation claims, employee dissatisfaction and lost work time, may be they'd listen! These factors are bound to affect end-product pricing and constitute an indirect cost that you or your customer pays.

Ergonomics can play a role in reducing these logistics costs. For example, poor pallet and container selection may be a problem. Wooden pallets may be less expensive to purchase initially than plastic pallets, but they are not as durable and they are a source of worker injuries. Moreover, pallets are often repaired in the plant and that takes time from other activities. The right ergonomic specifications can also help avoid the loading and unloading problems that can result in late deliveries and waste. For example, tires may be literally jammed into a delivery truck to minimize costs, but then workers unloading the truck are forced to pry them out, taking unnecessary time and setting up the potential for injury. Travel time may be impacted by driver discomfort or injury. Companies should carefully examine truck cab design and seats to make sure they are comfortable and don't result in unnecessary driver fatigue. And by choosing trucks with automatic transmissions, companies prevent the cumulative stress placed on drivers, particularly in urban areas, who must constantly shift and use the clutch.

Ergonomics can be viewed as the principal engineering discipline involved in the physical planning for inbound and outbound logistics: from the suppliers to points of storage or use; for the materials handling in receiving and shipping and between processing operations; and for material storage. The engineering ergonomist may have to work with suppliers, providing specifications to minimize injuries, lost work time and inefficiencies to the human system, as well as specifications related to the materials management. Other objectives for the procurement, transportation, production planning and control, warehousing and information systems must also be included in the ergonomics process.

The employee will be satisfied through proper ergonomics along with the value of money. But, employees and we belong to a society. Ergonomics in supply chain and logistics add value to individual, but, beyond that, society will be affected by the functions of effective logistics and supply chain. Will the logistics affect our society?

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III. EMERGENCY LOGISTICS IN SUPPLY CHAIN

SRM, Ergonomics and Sustainable logistics development helps individuals, companies and society to the greater extent. One of the incidents needs utmost care beyond the above. That is called emergency logistics management!

Quick response to the urgent relief needs right after natural disasters through efficient emergency logistics distribution is vital to the alleviation of disaster impact in the affected areas, which remains challenging in the field of logistics and related study areas (Sheu, 2007)

Emergency logistics management has emerged as a worldwide-noticeable theme as disasters, either artificial or

natural, may occur anytime around the world with enormous consequences. This may hold particularly under conditions of large-scale calamities such as the Chichi earthquake in Taiwan, the Bam earthquake in Iran, the tsunami in the Indian Ocean, as well as the Hurricane Katrina in the United States (US), which need quick-responsive emergency logistics systems for efficient disaster relief supply and recovery. For instance, the Indian Ocean tsunami of 2004 engendered by a major earthquake has reportedly caused more than 200,000 casualties, 100,000 missing, and more affected people who had their homes and livelihoods swept away. Despite the fact that such a catastrophe had increasingly raised global humanitarian supports in relief supply and rehabilitation, emergency logistics remains the key to efficient and effective alleviation of disaster impact in the immediate aftermath.

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IV. GREEN SUPPLY CHAIN

Rarely do business interests align with environmental issues. A burning issue today is the environmental damage brought upon by the unlimited amount of Carbon dioxide and carbon monoxide that are released into the atmosphere by every mode of freight transport, most notoriously, automobiles, which happen to be the most handy and hence the most popular form of transport! We hear that the people of a state in the United States of America (USA) have consciously opted to restrict their purchase of foodstuff that originates within a 200-mile radius.

In business today, companies cannot ignore environmental issues. Companies are integrating their supply chain processes to lower costs and better - serve customers. These two trends are not independent; companies must involve suppliers and purchasers to meet and even exceed the environmental expectations of their customers and their governments (Walton *et al.* 2006)

To help evaluate the alternatives that will affect the external relationships among organizations Sarkis (2003) presented a strategic decision framework that will aid managerial decision-making. Their decision framework is based on literature and practice in the area of environmentally conscious business practices. Their focus is on the components and elements of green supply chain management and how they serve as a foundation for the decision framework.

Forget about emissions – we don't see them, we wish to believe that it is not our concern. But let me point out something that we experience every day – traffic jams! Shouldn't we foresee a situation in which everybody wanting everything just in time can actually lead to excessive traffic on the roads, congestion and delayed deliveries, as a consequence? We heard such reports from Japan quite some

years back. We know our roads... We leave the rest to your imagination!

Sheu (2008) presented a linear multi-objective optimization model formulated to optimize the operations of both the nuclear power generation and the corresponding induced-waste reverse logistics. Factors such as the operational risks induced in both the power generation and reverse logistics processes are considered in the model formulation. Sheu *et al.* (2005) also presented an optimization-based model to deal with integrated logistics operational problems of green-supply chain management. In the proposed methodology, a linear multi-objective programming model is formulated that systematically optimizes the operations of both integrated logistics and corresponding used-product reverse logistics in a given green-supply chain.

Zhu *et al.* (2008) reported results from a cross-sectional survey with manufacturers in four typical Chinese industries, i.e., power generating, chemical/petroleum, electrical/electronic and automobile, to evaluate their perceived green supply chain management practices and related them to closing the supply chain loop. Their findings provided insights into the capabilities of Chinese organizations on the adoption of green supply chain management practices in different industrial contexts and that these practices are not considered equitably across the four industries. Academic and managerial implications of our findings are discussed. Chen and Sheu (2009) demonstrated that a proper design of environmental-regulation pricing strategies is able to promote Extended Product Responsibility for green supply chain firms in a competitive market.

If commodities have to move (that is, perhaps, inevitable) how much can we shift to rail as the mode of transport? Can we integrate road and rail such that cross-docking happens seamlessly, 3PL players aggregate freight and book full wagon loads or full freight trains? Shouldn't the railways, instead of mourning its loss of market share from 80% in the 50's to 8% at present, look for ways of integrating with logistics firms so that trucks are essentially used for short distance runs to the nearest railway yard, instead of dispatching two drivers to take a truck from Tamil Nadu to Assam and driving for a whole week? Already, some movers are reporting huge savings in travel time by moving freight to North East by rail.

What's the way? How to solve this issue? Can companies and individuals try something called sustainable logistics development?

Sustainable development is emerging as a dominant paradigm that is likely to play an important role in the design of any societal and economical policies. There are three main requirements for sustainable development: resource conservation, environmental protection, and social as well as economic development. In this context, the concept of

reverse logistics in a supply chain provides a way to reduce and reutilize waste.

It is "eco-efficient" to recycle. This will defer the consumption of natural resources. Recycling, despite its limitations such as difficulties in organizing collections and in sorting them, has their advantage such as creation of jobs for. What if making the most of waste is also part of our new economy?

The need of the hour is firms that follow their product throughout its life cycle and offer recycling solutions to their customers.

Recycling is necessary. Luckily, we are increasingly aware of this today: not only to avoid collapsing under the weight of rubbish tomorrow; but also to economize on valuable natural resources. For example, plastics are (ultimately) made from crude oil or gas - fossil fuels that will run out one day. It is therefore preferable to try to use them a second time.

Gone are the days when once a delivery had been made the supplier no longer cared what happened to their product. Now firms follow their product throughout its life cycle and offer recycling solutions to their customers.

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V. INDUSTRIAL ECOLOGY

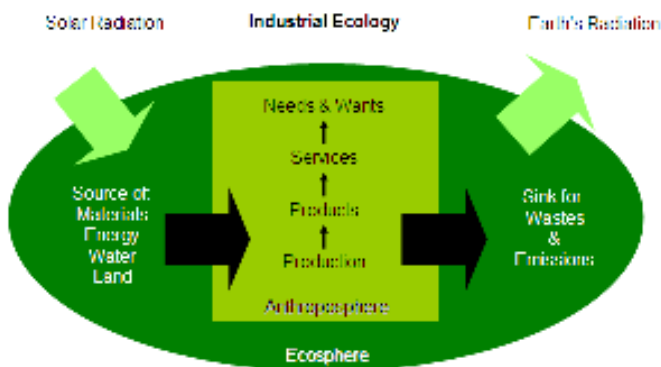
Industrial production and consumption systems use the environment as source of resources and sink for wastes and emissions.

Industrial ecology is a new approach to the industrial design of products and processes and the implementation of sustainable manufacturing strategies. It is a concept in which an industrial system is viewed not in isolation from its surrounding systems but in concert with them. Industrial ecology seeks to optimize the total materials cycle from virgin material to finished material, to component, to product, to waste product, and to ultimate disposal (Jelinski *et al.* 1992)

McMahon *et al.* (2010) found that recent biomass accumulation greatly exceeded the expected growth caused by natural recovery. They have also collected over 100 years of local weather measurements and 17 years of on-site atmospheric CO₂ measurements that show consistent increases in line with globally observed climate-change patterns. Combined, these observations show that changes in temperature and CO₂ that have been observed worldwide can fundamentally alter the rate of critical natural processes, which is predicted by biogeochemical models. Identifying this rate change is important to research on the current state of carbon stocks and the fluxes that influence how carbon moves between storage and the atmosphere. These results

signal a pressing need to better understand the changes in growth rates in forest systems, which influence current and future states of the atmosphere and biosphere.

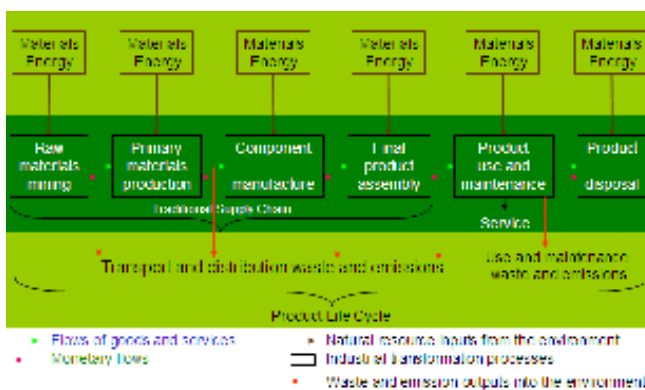
Industrial ecology is an emerging concept for the establishment of ecologically sustainable industrial development of industrial zones and estates. Optimizing materials and energy flows among facilities within specific regions or industrial ecosystems is a basic industrial ecology strategy. As such, life cycle analysis and management and green supply chain management are related approaches (Zhu et al. 2004)



Source: Geyer (2008), Bren School

Fig. 1 Industrial Ecology

A more detailed view of industrial production and consumption systems is called Life Cycle Perspective



Source: Geyer (2008), Bren School

Fig. 2 Life Cycle Perspective

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VI. PERSPECTIVE OF INDUSTRIAL ECOLOGY

Most environmental impacts are caused by the material transformation processes of the economy. To make good environmental decisions it is necessary to identify and assess

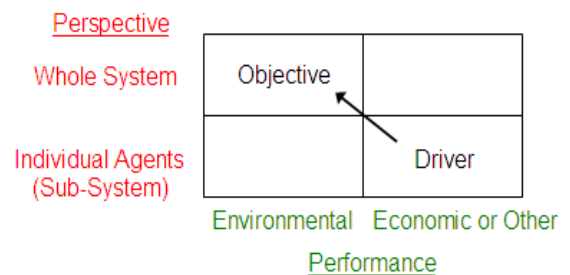
all relevant environmental impacts of all relevant transformation processes.



Source: Geyer (2008), Bren School
Fig. 3 Inputs and Outputs in the process

Industrial Ecology needs to have some idea on the actors in the industrial ecology and what motivates their actions.

- Industrial and consumer activities are process-based but agent-driven.
- One production and consumption system consists of many agents
- Environmental impact is based on whole system performance (life cycle perspective)
- Agents, however, usually base their decisions on criteria other than environmental (e.g. economic performance), which are applied to smaller sub-systems.



Source: Geyer (2008), Bren School
Fig. 4 Perspective vs. Performance

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VII. TWO CHALLENGES OF INDUSTRIAL ECOLOGY

1) How to coordinate the agents?

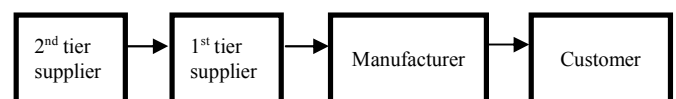
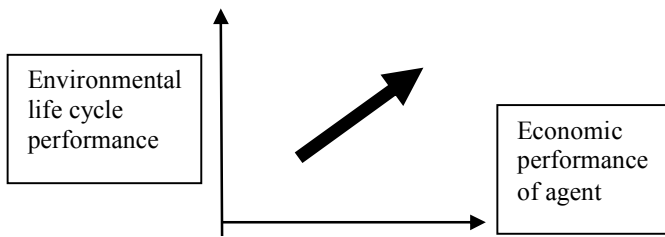


Fig. 5 Supply Chain Management

2) How to generate double dividends, or win-win scenarios



Source: Geyer (2008), Bren School
Fig. 6 Green Supply Chain Management

Supply chain is a materials and information network composed of the involved enterprises and departments throughout the entire product lifecycle from the material gaining, production to semi-finished products or finished products, assembly, transportation, use, service till disposal. Currently, the market requirements tend to be various and changeable, and the competitions are more stinging; it is very difficult for a single enterprise to develop under such environment. Supply chain management is to make the enterprise combine the upstream enterprises and downstream enterprises to participate in the market together as an alliance, in order to seek the development benefits together and resist the market risks by the alliance instead of a single enterprise action.

The thought of green supply chain management comes from the increasing pressure on the enterprises to protect the environment. With the development of researches on the product's life cycle, it is gradually recognized that the actions of a single enterprise or the technologies for a certain stage of a product's life cycle can not effectively reduce the environmental impacts during the entire product life cycle. The Green Supply Chain Management (GSCM) integrates the supply chain management with the thought of the environmental protection in order to reduce the environmental impacts during the entire product life cycle by the harmony and the common actions of the partners in a supply chain.

The concept of green supply chain was first introduced by MRC of Michigan University in 1996, and its aim is to synthetically consider the environmental impacts and resource utilization in the manufacturing supply chain. At present, the greenness of supply chain is mainly implemented through the following three aspects: 1) greenness of technology. It mainly studies the greenness of every applied technology in every part of supply chain, including green design, clean production and recycling technology etc; 2) greenness of management. Environmental management is receiving more and more attention in supply chain management, greenness of management is to reduce the environmental impacts of supply chain by the harmony and management of supply chain combining with ISO 14000; and 3) greenness of material flow. It is to make material flow effective and green by the management of material flow.

Closed-loop supply chain forms reverse flow by products recycling, which can increase the utilizing ratio of resources and decrease environmental impacts.

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VIII. EARLY SUCCESS BY GREEN SUPPLY CHAIN

Commercial firms have had early success using Green SCM principles.

- Texas Instruments: Saves \$8 million each year by reducing its transit packaging budget for its semiconductor business through source reduction, recycling, and use of reusable packaging systems (20% annual savings).
- Pepsi-Cola: Saved \$44 million by switching from corrugated to reusable plastic shipping containers for one liter and 20-ounce bottles, conserving 196 million
- Commonwealth Edison: Produced \$50 million in financial benefits from managing materials and equipment with a life-cycle management approach.
- Dow Corning: Saved \$2.3 million by using reconditioned steel drums in 1995. Also conserved 7.8 million pounds of steel.

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IX. IMPROVEMENT BY GREEN SUPPLY CHAIN

- ❖ Green Supply Chain improves operations by employing an environmental solution.
- ❖ Improves Agility—Green supply chain management help mitigate risks and speed innovations.
- ❖ Increases Adaptability—Green supply chain analysis often leads to innovative processes and continuous improvements.
- ❖ Promotes Alignment—Green supply chain management involves negotiating policies with suppliers and customers, which results in better alignment of business processes and principles.

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X. BASIS OF GREEN SUPPLY CHAIN

The product life cycle is the basis of green supply chain management



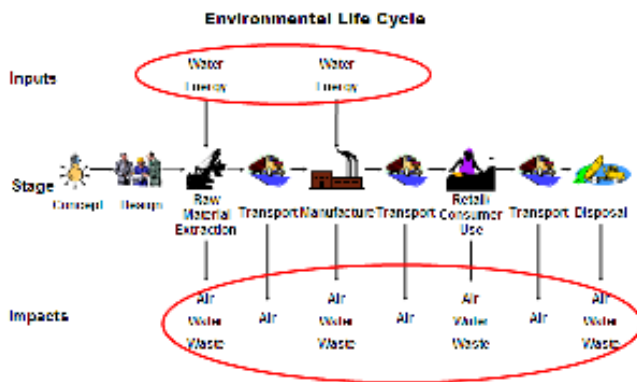
Source: LMI (2009)

Fig. 7 Supply Chain in the Environmental Life Cycle

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XI. IMPACT OF GREEN SUPPLY CHAIN

The environmental impacts of each life cycle stage are examined for reduction.



Source: LMI (2009)

Fig. 8 Environmental Life Cycle

A systematic look for double dividends is shown in the following table.

Table. 1 Environmental vs. Economic performance

Environmental life cycle performance	Economic performance		Supply chain change is
	Profits increase	Profits decrease	
Increases	Profits increase	Revenues increase	win-win
		Costs decrease	win-win
	Profits decrease	Revenues decrease	win-lose
		Costs increase	win-lose

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XII. GREEN SUPPLY CHAIN CHARACTERISTICS & INDEX

Compared with traditional supply chain, green supply

chain has the following characteristics:

1) Greenness. Green supply chain emphasizes the environmental attributes of supply chain. It requires the minimum consumption of resource and energy, and the minimum environmental impacts of the supply chain system besides the basic functions.

2) Close-loop. Green supply chain adds a role of recycler that can be the manufacturing trader or the special recycling enterprise. The recycling process can realize the reuse of products or parts, and the recycling of material and energy, which form the closed-loop of material flow. It not only increases the utilizing ratio of resources, but also reduces the environmental impacts of used products, as well as the costs.

3) Integration. Green supply chain regards environmental protection as one of the strategic targets of the whole system; thus, the requirement of system integration is much higher than that of traditional supply chain. It requires high integration and sharing of system information, and that each part should take coherent action to ensure the realization of system targets.

The forming of closed-loop supply chain and the implementation of environmental management extend supply chain from both time and space, as a result, the material flow, capital flow, information flow and operation flow involved in the running of green supply chain become more complicated, and the difficulty of supply chain management is increasing with it as well. The aim of GSCM is to make the material flow value added by harmonizing and controlling of the material flow, the capital flow, the information flow and the work flow of the GSC, and to provide high quality products and services to customers with fastest time-to-market, lowest cost and environmental impacts. The performance assessment of GSCM is just to evaluate the approaching degree of the GSC running process and results to the foregoing aims. Therefore, the performance assessment of GSC has great significance to implement effective GSCM.

Many organizations have come to realize that organizational strategies and practices that incorporate consideration of the natural environment can be a source of competitive advantage. Although proactive and value-seeking approaches to greening have been suggested in management literature, few grounded theories and frameworks can be found in the domain of supply chain operations. Many theories point to the need for research that goes beyond the fragmented contribution of reverse logistics and green supply chain. A framework of the green supply chain index that can be used to develop quantitative models to manage the process of greening the supply chain is critical in the current trend. A gap analysis in order to compare different supply chains that can help managers to assess the degree of greenness of existing supply chains within or across sectors and to determine the gap between the current supply chain and the ideal or the targeted green supply chain

and therefore to plan the activities to be performed, the resources to be deployed and the steps to be followed to reduce/eliminate this gap is needed.

Solution to Green Supply Chain Index – A Gap Analysis Model

Step 1: Determine the Attributes of Green Supply Chain to be considered in the Analysis

Step 2: Normalize the amount of the attributes using 0-10 Scale

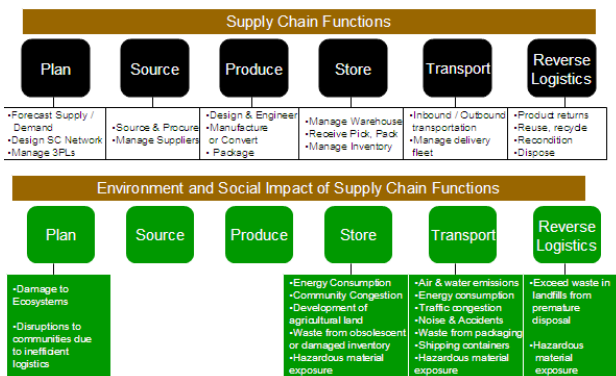
Step 3: Mark the values on the axis

Step 4: Calculate the greenness effort of the organization and the greenness gap

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XIII. FUNCTIONS IN GREEN SUPPLY CHAIN

The critical functions of green supply chain with respective to SCOR model is

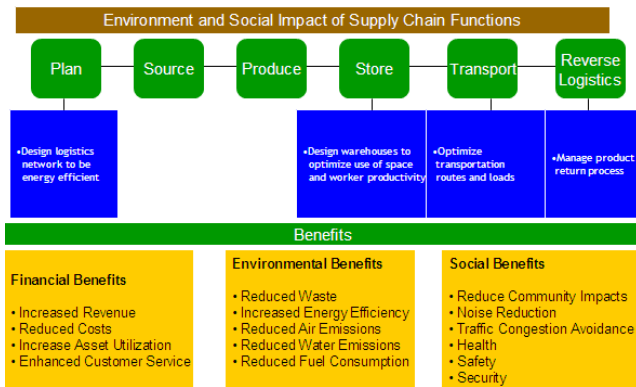


Source: Smart Steps (2009)
Fig. 9 Functions in Green Supply Chain

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XIV. BENEFITS AND SCOPE OF GREEN SUPPLY CHAIN

The benefits and scope for consulting green supply chain with respect to Supply Chain Operation Reference SCOR model.



Source: Smart Steps (2009)
Fig. 10 Environmental and Social Impacts of Supply Chain

Table. 2 Current Businesses vs. SSC
Source: Smart Steps (2009)

Current Business Trend	Implications for SSC
Sustainable Purchasing Policies	To win and retain customers
Evolving role of 3PLs	Ensuring alignment between 3PL's business practices and a shipper's sustainability objectives is critical
Corporate social responsibility statements	To enhance corporate responsibility positions
Government regulations and incentives at the product, facility and transport levels	To lower emissions and improve energy efficiency
Just-in-time manufacturing and direct-to-consumer business models	Lighter weight and more efficient packaging and transportation methods
Producer responsibility policies	Need to design products and packaging and implement reverse logistics practices
Diminishing supply and increasing costs of fossil fuels	Freight optimization

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XV. CRITICAL GREEN SUPPLY CHAIN ANALYSIS

Historically, GSC management focused on the upstream supply chain.

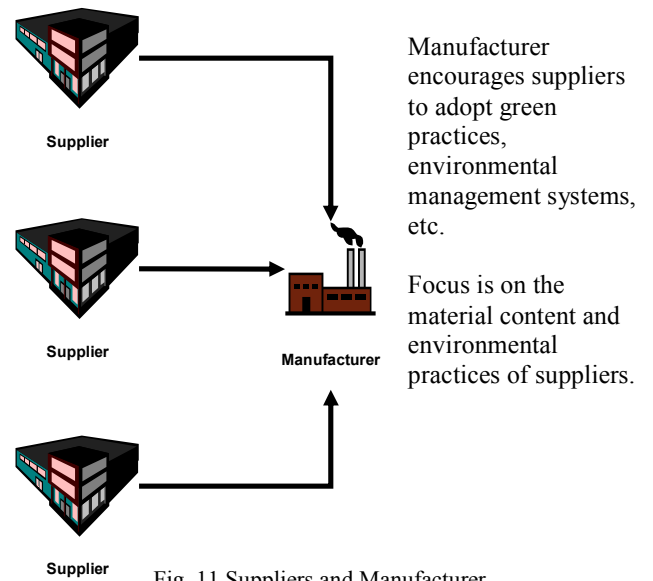


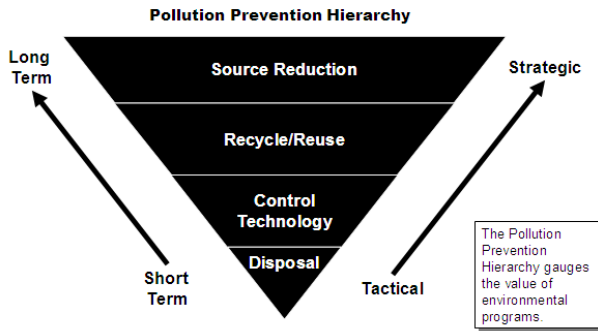
Fig. 11 Suppliers and Manufacturer

Now, Green Supply Chain programs are moving from compliance to value creation.

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XVI. GREEN SC AS STRATEGIC ANALYSIS TOOL

Companies are starting to view Green Supply Chain as a strategic analysis tool.



Source: LMI (2009)

Fig. 12 Pollution prevention Hierarchy

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XVII. GREEN SC BEST PRACTICES

Aligning GSC improvements with your business goals creates strategic value.

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- Align green supply chain goals with business goals
- Evaluate the supply chain as a single life cycle system
- Use green supply chain analysis as a catalyst for innovation
- Focus on source reduction to reduce waste
- Before embarking on green supply chain improvements, you need to determine the role of the environment in your business.
 - Product Differentiation?
 - Managing Competitors?
 - Cost Reduction?
 - Risk Management?
 - Redefining Markets?
- When green supply chain programs are properly aligned to corporate goals, these become leading indicators of business success.
 - Environmental indicators on the Balanced Scorecard
 - Greater drive for innovation
 - Stakeholder support

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XVIII. PHILOSOPHICAL SUSTAINABLE WAY

Sustainable transport is about finding ways to move people, goods and information in ways that reduce its impact on the environment, the economy, and society.

Some options include:

- Using transport modes that use energy more efficiently, such as walking or cycling and public transport
- Improving transport choice by increasing the quality of public transport, cycling and walking facilities, services and environments
- Improving the efficiency of our car use, such as

using more fuel efficient vehicles, driving more efficiently, avoiding cold starts, and car pooling

- Using cleaner fuels and technologies
- Using telecommunications to reduce or replace physical travel, such as tele-working or tele-shopping
- Planning the layout of our cities to bring people and their needs closer together, and to make cities more vibrant and walkable
- Live without petrol? Are you ready?
- Have e-office!

Other imperatives for the future include working from home by taking advantage of modern communication aids and information technology as is prescribed by the ancient wisdom of India.

XIX. FUTURE – PHILOSOPHICAL THINKING

Before we conclude, we call upon you to think along these lines:

What will we do:

- ❖ When traffic jams make commuting impossible?
- ❖ When global warming puts our coastal cities under water?
- ❖ When natural minerals are exhausted and recycling is the only alternative?
- ❖ When the world runs out of petroleum?

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XX. PHILOSOPHICAL DIGEST

Think of a decade beyond. Think of how you need to prepare yourselves for eventualities that sound fiction today!

Way of Voluntary Simplicity!

Voluntary simplicity means doing/having/living more with more time, meaning, joy, satisfaction, relationships, community; less money, material possessions, stress, competition, and isolation. It doesn't mean depriving you; it doesn't mean buying "cheap" and always pinching pennies; it doesn't mean poverty. It does mean wanting what you have and finding joy in having less; and recovering the connection with other people and with the Earth that alone makes life really worthwhile. Voluntary simplicity is a growing movement of people who have realized that happiness and fulfillment do not lie in having more money, or new and bigger things, but rather in the time spent with loved ones and connection with community. They are questioning the consumer society's insistence that possessions, especially of the newest design and color, are the means of fulfillment, or that any material possession can possibly be "to die for."

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