Introduction to Green Supply Chain Management

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VENKATESH GANAPATHY

INTRODUCTION TO GREEN SUPPLY CHAIN MANAGEMENT

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Introduction to Green Supply Chain Management
2nd edition
© 2017 Venkatesh Ganapathy & bookboon.com
ISBN 978-87-403-1760-2

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1 INTRODUCTION

Learning Objectives

- Understand what is green supply chain management and why is it gaining prominence
- An overview of research on green supply chains
- Waste : how it affects operational efficiency of a business
- Strategies for implementation of green supply chains
- Role of green supply chains in making a business future ready

1.1 WHAT IS GREEN SUPPLY CHAIN MANAGEMENT?

Environmental awareness is increasing day by day. Supply chain has now become such an important function that embedding environmental issues in day to day supply chain issues has become inevitable for sustainable development. This has led to the interest in Green Supply Chain Management.

The concept of supply chain includes the flow of materials from the source to the point of use. Organisations are investing in managing the supply chain effectively. The focus is now on productivity – how can we maximize the output with the given input resources (Mohanty, RP 1997, p. 274). Supply chain is also called as a value chain (Extended enterprise). This is a loosely connected network of companies that work together to provide goods or services to a market.

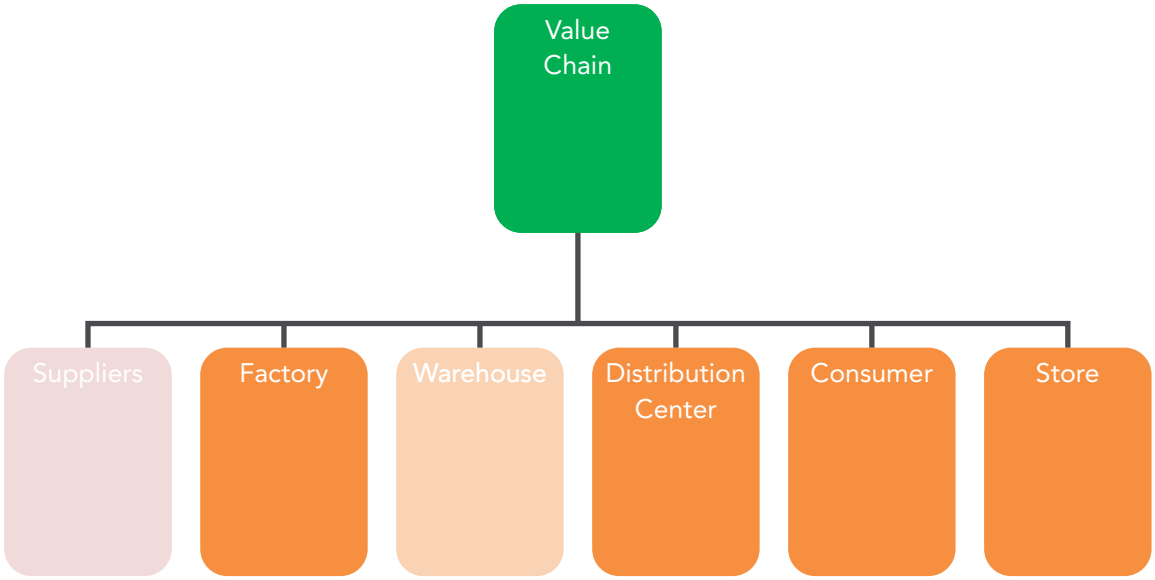

Fig: 1.1. The Supply Chain or extended enterprise

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The emphasis on total quality management, sustainable development, business process re-engineering, ISO 14000 and lean manufacturing has led to a paradigm shift in productivity. Supply chain is at the core of all this. Green Supply Chain Management has become the core of sustainable development. Going green is also becoming a socially relevant concept today.

Green Supply Chain Management encompasses Green Design, Green Manufacturing, Green Logistics and Green marketing too. Distribution that is an important wing of supply chain plays an important role in the success of marketing efforts. If a green product has been manufactured in an environmentally responsible manner, then it needs an efficient distribution mechanism for the product to reach out to the customer.

1.2 WHY GREEN SUPPLY CHAIN MANAGEMENT?

Reducing waste and environmental pollution, using less energy and material resources are not only good for the environment but are best for supply chain because they cut operational costs (Mohanty, RP 1997, p. 274). A company's performance is going to be measured by resource productivity. Waste minimization is an integral component of green supply chain. Waste is any activity that does not add value to a business.

When a company manages waste efficiently, it means that its resource productivity is high and the business is able to manage cost efficiencies very well. This leads to operational efficiency and increase in the profit margins. As the company gains exposure and experience in managing the resources efficiently, the business becomes more sustainable and over a period of time the company is able to achieve competitive advantage in the market place. A green supply chain strategy has become essential for a business that wants to be future ready.

1.3 THE NEGATIVE INFLUENCE OF WASTE

Resources for an organisation are available in the form of materials, machines, labour, information, capital, technology, time, space, energy. These inputs are transformed into outputs through the production process.

When there is a waste, the available machine capacity and labour time decreases. Without the waste, the same machine and labour could have been used to increase the production. Due to the waste, the plant's production targets become difficult to achieve (Mohanty, RP 1997, p. 275). When production targets are not achieved, delivery targets cannot be met. This leads to the products not reaching the customers on time. Customers get dissatisfied and this affects the future sales.

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Having excess inventory is also a waste. When inventory is in excess, working capital is blocked in such material and the materials is also subject to other risks like risks of obsolescence, theft and decay. When such capital is not used efficiently, the business is adversely impacted as the company continues to service the loans with interest payments without a corresponding increase in the sales of the finished goods.

All non value adding activities need not necessarily be waste. May be the secondary activities are being done in a fashion that doesn't add value. If there is an intervention in the process to correct such secondary activities, then they become value adding activities in the long run.

1.4 AN OVERVIEW OF RESEARCH ON GREEN SUPPLY CHAIN

Patrick Penfield of the Whiteman School of Management (Kumar Rajesh et al 2012) defines green supply chain management as the process of using environmentally friendly inputs and transforming these inputs into outputs that can be reclaimed and re-used at the end of their lifecycle, creating a sustainable supply chain.

Srivastava (2007) defines green supply chain management as integrating environmental thinking into supply chain management , including product design, material sourcing and selection, manufacturing processes, delivery of final product to consumers and end-of-life management of the product after its useful life.

Besides improvement in environmental performance, adoption of green supply chain management should also be profitable for the business (Kumar Rajesh et al 2012; Rao & Holt, 2005; Green et al, 2012). Green supply chain management has to be an organization wide process just like other supply chain processes like Total quality management or Environmental management systems (Kumar Rajesh et al 2012; Broek, 2010). The environmental impacts of a supply chain should be considered cumulative over all the stages. Thus, if you buy greener raw materials that do not cause any harmful effect on the environment but continue to waste energy during the manufacturing process, the effect of green supply chain management ceases to be cumulative. Greening of the different phases of supply chain leads to an integrated green supply chain. (Kumar Rajesh, 2012; Srivastava, 2007; Rao & Holt, 2005).

The implementation of green supply chain strategies faces a road block in terms of lack of clear understanding and having a clear strategy for implementing it. (Kumar Sanjeev et al 2012; Simpson et al, 2008). Organizational complexities like size and relationships, product returns, recycling etc make implementation of green supply chains a cumbersome affair. Additionally, when a customer has doubts about how green a product is, it becomes another stumbling block (Sarkis et al, 2010). Customer perception about recycled materials also impacts implementation of green practices in logistics.

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Performance of green supply chains needs attention and identification of the right KPIs (key performance indicators) can be rewarding for the business (Maria et al 2012; Jose et al 2012); Hervani et al 2005). Supplier development programs to facilitate their engagement and participation in an organisation's green supply chain management efforts are a viable option. (Sarkis et al, 2010; Large Rudolf et al, 2011).

The literature review points out that future direction of research in green supply chain management centre around green manufacturing, green logistics and looking at reverse supply chain in greater detail. For instance, the linkage between lean manufacturing and green supply chain management is being explored (Large Rudolf et al, 2011; Toke et al, 2010; Johansson et al, 2010). Lean manufacturing reflects on reduction of waste and non value adding activities. One of the objectives of green supply chain management is resource optimization by reduction in waste. How can the two concepts be married to derive a meaningful outcome of future research sounds interesting. Technology enabled green supply chains that are also intelligent is another potential area of research.

1.5 STRATEGIES FOR A GREEN SUPPLY CHAIN

So, having understood what green supply chain management is and why we need one, we now look at the various strategies for institutionalizing green supply chains within an organization. (Mohanty, RP 1997, p. 276).

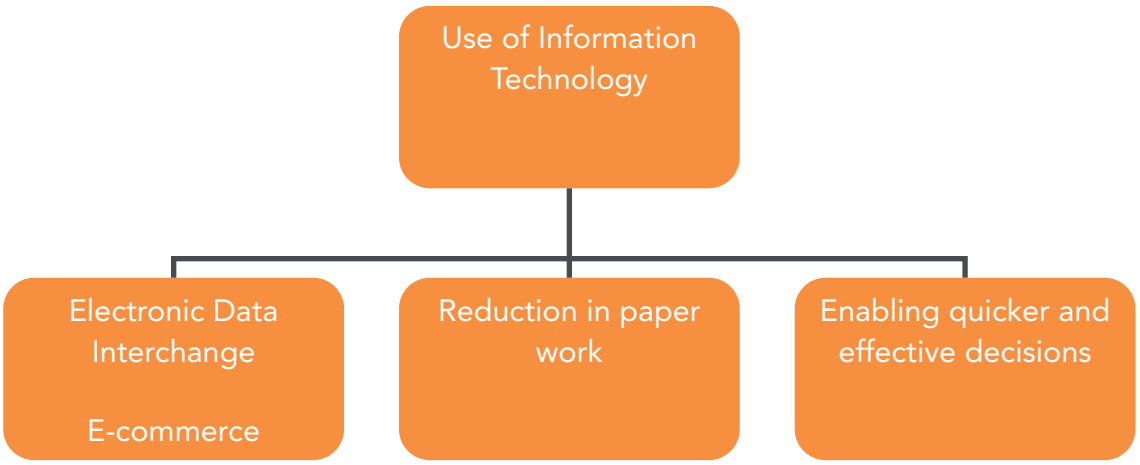

Figure 1.2: Using information technology as a strategy

Electronic data interchange is a computerized system whereby customers, suppliers and a firm can share and transmit information electronically in real time. This helps in maintaining an optimal level of inventory. As the information is available on a real time basis, decisions are faster and production and shipping schedules become more efficient.

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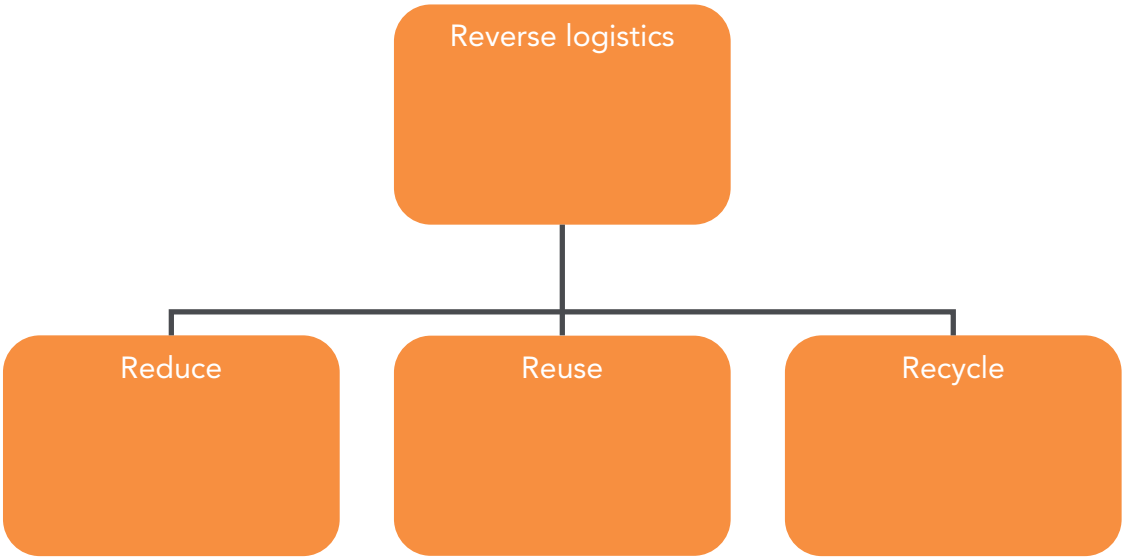

Figure 1.3: Reverse Logistics

Decisions regarding the materials a company purchases and disposes can have a significant impact on the environment (Mohanty, RP 1997, p. 277) and on the company's bottom line. Recycling of materials such as paper, aluminium and glass has received considerable attention in recent years. Broadly, the reverse logistics strategies are classified as Reduce, Reuse and Recycle.

Reduce involves a better environmental approach. This involves using no more materials than necessary. For example – rather than use solvents in excess for cleaning the machines, it makes better sense to use only the desired quantity. Increasing energy efficiency also reduces the waste.In the chemical industry, refillable iso-containers are being increasingly used. Both products and packaging are being recycled or returned for proper disposal. Several companies now buy used computers, salvage the parts and sell them for use either as replacement parts or for assembling new computers. Purchasing of reusable materials eliminates the entire recycle process.

Reverse flow logistics requires management attention in developing a logistics network, establishing distinct inventory management systems and measuring the impact of this across the entire supply chain. There are international regulations that will require that companies track their environmental legislation across the entire supply chain. This has become more pronounced after globalization.

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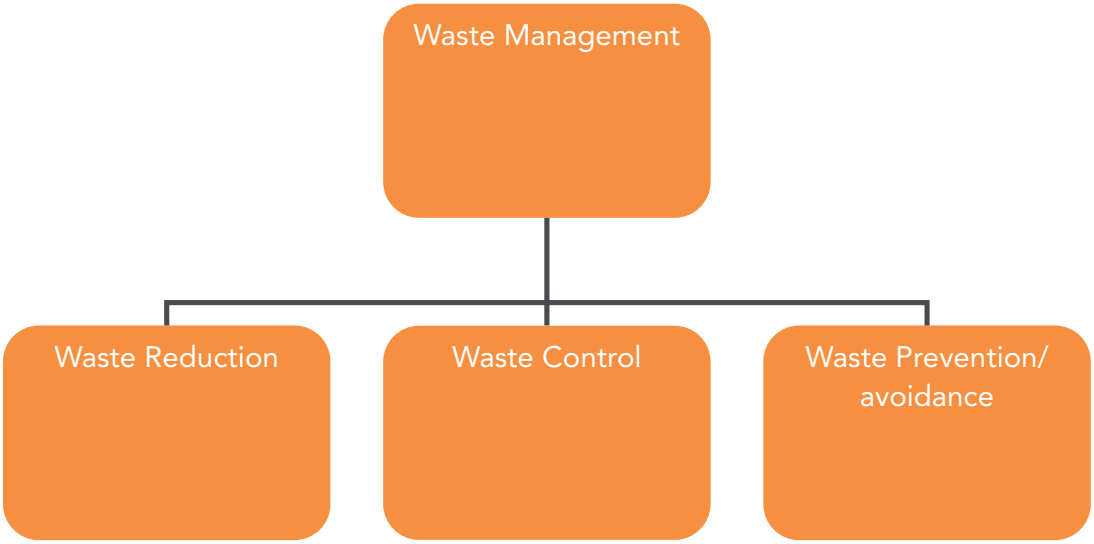

Fig 1.4: Waste management as a strategy for green supply chains

Reduction of waste or controlling it is more of a corrective initiative (Mohanty, RP 1997 p. 279). Waste prevention or avoidance is more of an idealistic goal.

All the strategies mentioned above are interdependent and can impact each other. For instance, waste management leading to improved quality of finished products can lead to lesser sales returns and so lesser effort for reverse logistics. Better information sharing among all the stakeholders can reduce excess inventory and therefore wastage of resources. Implementation of each of these strategies thus leads to a synergistic output.

Earlier academic research has clubbed reverse supply chain under the 'Green' category. However, of late, research has begun to understand the subtle differences between Green supply chains and reverse supply chains.

1.6 ROLE OF GREEN SUPPLY CHAINS IN MAKING A BUSINESS FUTURE READY

A learning organisation has to be prescient and keep itself abreast of latest changes in technology. It has to adopt the techniques by which these changes can be leveraged to achieve customer satisfaction of the highest order. Escalating costs of doing business, changing technologies, complex regulations, unpredictable markets and the impact of globalization are affecting the way businesses have to be transacted across the globe.

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Enterprises have to implement smarter analytics, smarter technologies and smarter processes in their endeavour to become a solutions provider. Future ready firms can anticipate the needs of the future and demonstrate remarkable agility buttressed by their capability to innovate. For instance, instead of asking how to meet a challenge, future ready organizations find out how they can obliterate this challenge altogether and may be convert this into a potential business opportunity. Such firms believe in reengineering their processes to face the future much before. This gives such firms a distinct competitive advantage.

Companies all over the world are taking steps to be ahead of global competition – in producing world class quality and providing excellent service. These companies want to be known as environmentally responsible companies. There is a greater desire now to comply with requirements of environmental regulations, to satisfy their global customers who place exacting demands. Reduced waste leads to reduced cost which leads to greater competitiveness. Greening efforts can't be confined to the four walls of a factory; it has to extend beyond. But challenges faced by external stakeholders need a greater understanding. The drivers for green supply chain management implementation range from reactive (regulatory requirements) to proactive (strategic reasons). Companies become responsible for environmental liabilities of suppliers. Hence, integration of environmental concerns across the entire supply chain has to become part of long term strategy. (Rao Purba, Greening the Supply Chain, 2008)

To Summarise

- Embedding environmental aspects in day-to-day supply chain issues has become important for sustainability leading to development of green supply chains.
- Going green has also become socially relevant.
- Productivity, waste management, resource optimization and use of IT for strategic competitive advantage has become essential for sustainability.
- Green Supply Chain Management is gaining more and more relevance as other supply chain philosophies like Total Quality Management, Lean Manufacturing, ISO 14000.
- An integrated green supply chain strategy is strongly recommended so that greening efforts can be across all the phases of the supply chain.
- Reverse logistics, green design, green purchasing strategies are being explored more and more ; however there is lesser focus on green manufacturing
- Commonalities and differences between green manufacturing and lean manufacturing have incited research interest.
- Implementation of green supply chain management can make a business future ready.

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2 BENEFITS OF GREEN SUPPLY CHAIN MANAGEMENT

Learning Objectives

- Understand what is sustainable supply chain management
- Why has sustainability become a central theme in supply chain management
- What are the advantages/ benefits of implementing green supply chains in an organization
- How can an organisation leverage the benefits of green supply chains for strategic competitive advantage

2.1 SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Environmental concerns including climate change, energy use, environmental pollution and resource depletion are not problems that can simply be wished away. Indian and Chinese economies are growing at double-digit rates and as the world population continues to grow, resources become scarcer. Businesses are now becoming more and more aware that their supply chains must be designed for sustainability. Design processes so that environmental friendly inputs create outputs that can be recycled and do not pollute the environment (Sanders 2012, p. 25).

Starbucks ensures that the harvesting practices of their growers do not damage rainforests. Nestle faced lots of problems from environmental activists when it was found that palm oil sourced from the forests for making "Kit-Kat" was done by their suppliers at the cost of depletion of scarce resources. Nestle did not respond initially but later on it was forced to take action. Thus, firms cannot wash their hands saying that they are not liable for the environmental damage caused by their suppliers.

Packaging and transportation are other aspects of supply chain that are important to sustainability. Companies can save money by designing smart packages. Filling trucks as full as possible, rather than moving half-empty trucks, is an important environmental strategy. 3M also has introduced adjustable decks in trucks so that the number of daily truckloads is reduced. Dell has worked with United Postal Service so that delivery strategies reduce the carbon footprint.

Such practices that companies adopt are not good only from the compliance point of view but these are also good practices. When a firm works with suppliers to protect the environment, it is assured of a long term supply.

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2.2 SUSTAINABILITY AS A CENTRAL THEME IN SUPPLY CHAIN MANAGEMENT

In the last few decades, companies have become accountable for the environmental and social impact of their products and services and the associated supply chains. The activities involved in supply chain management impact these concerns – including biodegradable product packaging, responsible product disposal, controlling of manufacturing & transportation emissions and sustainable sourcing practices. Thus, sustainability has become a central theme in supply chain management (Sanders 2012, p. 375).

Let us take an example for sustainable sourcing. If a company is supplied by Supplier A whose inputs are not environment friendly, then the company becomes liable for the environmental damage. If environmental activism against Supplier A results in stoppage of production of the said raw-material, this can affect the company's manufacturing process. If the substitute raw material is not available quickly, the company may not be able to supply the goods to the market and eventually the company will lose out to competition.

Supply chains can have adverse environmental and social consequences in terms of polluting the environment, health and human safety risks and the cost of waste. Sustainable SCM is concerned with changing practices to reduce these negative consequences. Product design, product manufacturing, packaging, transportation, logistics, sourcing, product end-of-life disposal – all these aspects of supply chain can be influenced by sustainability. Thus management practices have to be such that they are environmentally and socially responsible.

Sustainability is defined as meeting present needs without compromising the ability of future generations to meet their own needs. Supply chain management must meet consumer demand sustainably. For determining sustainability, managers must analyse the inputs and outputs at each stage of the supply chain.

2.3 BENEFITS OF IMPLEMENTING GREEN SUPPLY CHAINS

When a company improves its sustainability performance, it derives benefits galore. Financial pay-offs include reduced operating costs, increased revenue, lower administrative costs, lower capital costs and stock market premiums. Customer related payoffs include increased customer satisfaction, product innovation, increase in market share, improved reputation and new market opportunities. Operational payoffs include process innovation, productivity gains, reduced cycle times, improved resource yields and waste minimization. Organizational payoffs include employee satisfaction, improved stakeholder relationships, reduced regulatory intervention, reduced risk and increased organizational learning. Environmental sustainability [protection of environment] and social sustainability [maintaining society's well being] are interconnected. [Sanders 2012, p. 377–8].

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Implementing green supply chains leads to

- Increased Legal compliance
- Increased compliance with governmental regulations
- Increased revenues
- Satisfaction of moral and social obligations
- Improved brand equity
- Better relationships with suppliers
- Better relationships with customers
- Better employee relations
- Long term sustainability of the firm
- Community development

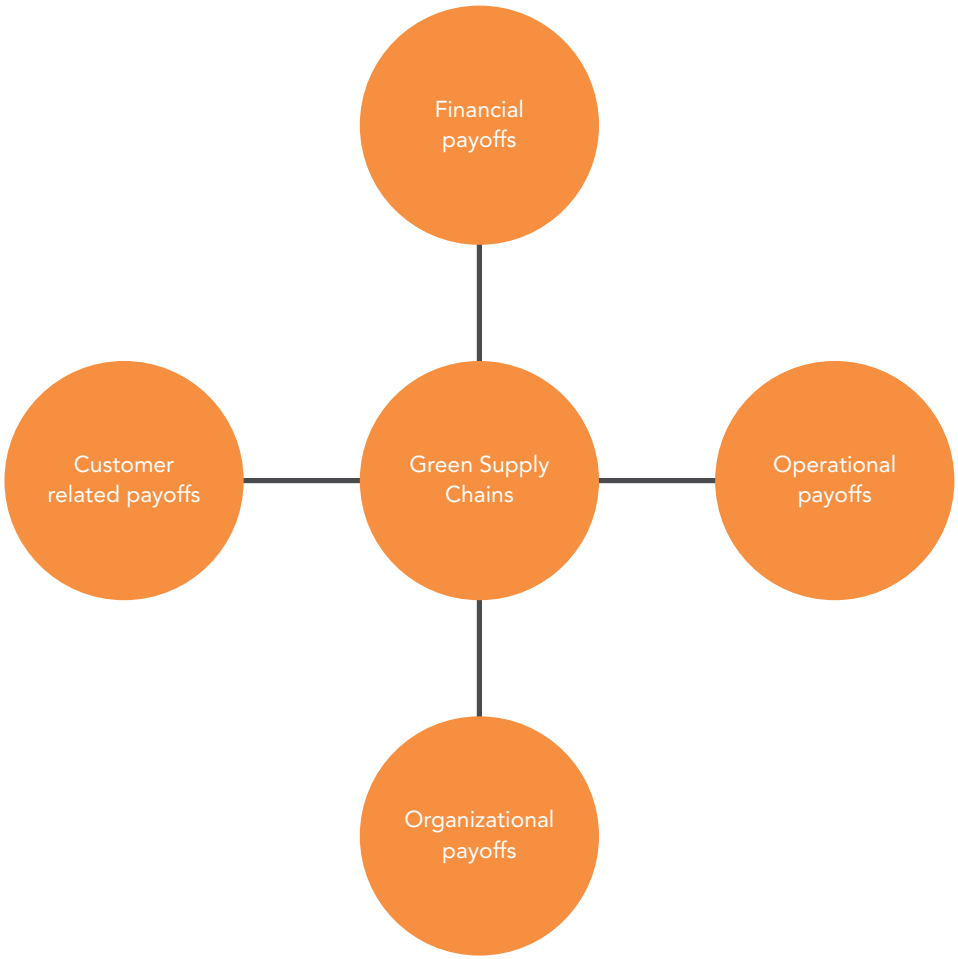

Fig. 2.1 Benefits of Green Supply Chains

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2.4 LEVERAGING BENEFITS OF GREEN SUPPLY CHAINS FOR STRATEGIC COMPETITIVE ADVANTAGE

Companies need to survive in a tough external environment. Competition is intensifying thanks to globalisation. Technology is becoming a game changer. Companies that want to expand their global footprint can do so if they are able to meet the stringent environmental and social norms dictated by foreign governments. Unless a firm is able to develop its capabilities to implement green supply chains and move towards a sustainable future, it is not possible to succeed in its international business efforts.

Now, how can this benefit an organisation from the strategic stand-point? In times when recessionary cycles in the economy are more frequent due to the impact of globalization, a firm that expands its presence in foreign shores doesn't have to depend on the domestic market alone. For instance, it was reported in the Indian media that companies like Tatas succeeded even during recessionary times because when there was recession in the EU, they were able to offer their products at a price that the local players in the EU were not able to offer. This means that when a firm implements green supply chain management, it can taste success in foreign markets.

When competition in domestic market intensifies, the company can look at doing business in other countries where there is a demand for its products and services. This has become easy as a result of globalization and countries like India and China opening up their markets for foreign players. Trade negotiations as part of GATS (General Agreement on Trade in Services) and GATT (General Agreement on Tariff & Trade) have catalysed the entry of multi national corporations from developed countries in emerging economies like India and China.

To Summarise

- Sustainability is at the core of supply chain management.
- Environmental concerns, growing population and scarcity of resources are making businesses look at sustainability.
- Firms are responsible for the environmental liabilities of their suppliers and so sustainability at every stage of the supply chain has assumed greater importance.
- Implementation of green supply chain management can provide long term strategic benefit to an organisation and also give it a competitive edge in the market.

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3 CHALLENGES IN IMPLEMENTATION OF GREEN SUPPLY CHAIN MANAGEMENT

Learning Objectives

- Understand the challenges and complexities in supply chain management
- How the evolution of green business practices has added to the complexity
- Specific challenges in implementation of Green supply chain management
- Recommendations to overcome these challenges

3.1 CHALLENGES AND COMPLEXITIES IN SUPPLY CHAIN MANAGEMENT

In the early '80s, logistics management evolved as a separate discipline as the availability of the right product at the right place at the right price became important. Can we also add that the right product had to be of superior quality? Quality has become a buzzword for close to two decades now with the onset of quality management philosophies propounded by quality gurus who were inspired by Japanese management practices. By mid-'90s, logistics management had matured and thus was born the discipline of supply chain management.

Globalization, innovation and technology development have led companies to look at resource pooling rather than focusing on own resource capabilities. Supply chain has therefore become a powerful tool for cost reduction in order to deliver superior value to the customer.

After cost reduction was carried out internally and externally, manufacturing companies started having a different set of problems like conflicts with business partners, inventory pile-up, information distortion in the supply chains adding to demand uncertainties and fluctuations. Supply chain management had to become more demand driven and consumer focused.

Companies like Starbucks, P&G, Wal-Mart & Dell based their business models around best supply chain management practices and reaped the rewards of the same. Many service organizations tried to adopt the TQM philosophy but due to the inherent differences between services and goods, they faced challenges. Ritz Carlton was one of the first hotel chains that implemented the TQM philosophy.

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Today competition is not between firms, it is between supply chains. So, firms that have efficient supply chains gain a competitive edge in the market place. To maintain this position, they cannot afford to be complacent. They have to constantly look inwards and outwards and focus on continuous improvement.

3.2 EVOLUTION OF GREEN PRACTICES – ADDING TO THE COMPLEXITY

The ISO 14000 series consists of standards related to EMS[1] (ISO 14001 & ISO 14004) and standards related to environmental management tools, such as environmental auditing, environmental performance evaluation, environmental labeling and life cycle assessment. The EMS standards provide the framework for the management systems and the life-cycle assessment standards focus on evaluation and analysis of products and processes. (Leenders et al 2010, p. 293)

Supply managers must be concerned with ISO 14000 standards because in the long run, firms with EMS should provide lower costs and offer fewer problems to their customers. Firms that control waste and conserve energy as part of EMS are not only environmentally responsible but they are also efficient. Dealing with such companies reduces the risk of a firm's environmental liabilities.

Governments, shareholders and consumers are pressuring firms to develop and implement policies that protect the nature. Industrialized countries are setting aggressive recycling targets for their industries. Germany has passed ambitious legislation that imposes responsibility for recycling consumer waste on manufacturers. Supply managers can identify materials suitable for recycling or reuse, examine alternative and innovative disposal options and source raw materials that are not only environment friendly but are also able to maximize production yields. (Leenders et al 2010, p. 295).Companies like Starbucks and IBM are ensuring that environmental aspects are incorporated in supplier contracts.

3.3 CHALLENGES IN IMPLEMENTATION OF GREEN SUPPLY CHAINS

Often the extent and mode of implementation of green supply chains varies from one firm to another firm. In some cases, the focus is mainly on the suppliers without looking at a firm's own manufacturing processes. In such a case, the efforts are at the risk of being somewhat half baked.

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The other challenge is finding answer to the question that will implementation of green supply chain management lead to improvement in economic performance of a firm? Implementation of green supply chain management involves lot of time and effort and decision making by the top management. It needs sustained efforts. It is not a one-time exercise.

Businesses tend to adopt a reactive approach to meet regulatory norms. They do not adopt a proactive approach to look at the implementation of green supply chains from a strategic perspective. If a business only looks at generating quick returns from green efforts, it is mistaken. The returns will materialize over a period of time after sustained efforts.

If inbound logistics has to become green, then firms have to look at the manufacturing processes of their suppliers in greater detail. This can present a challenge in the form of resistance from suppliers who may be unwilling to divulge their core competencies or trade secrets. As suppliers expose themselves to customers more and more, they also end up becoming more transparent with regards to pricing. Not all suppliers may be willing to bite the bait. In some cases, smaller suppliers may expect that the customers support them in their green efforts for want of resources like manpower, technical know-how and funding.

Suppliers look at the EMS as a managerial process that involves enormous effort and documentation – something that may not give them immediate returns. Moreover, if all customers do not clamour for green products, the suppliers may not be interested in tweaking their systems and processes for a few customers. If they do, they will be forced to pass on the additional cost burden to the latter which may not be acceptable to them.

For example, in chemical industries, effluent treatment plants require substantial investment and effort. Some industries in Mumbai and down South in India have been accused of letting out their effluents in the river water causing pollution and health scare among the communities. Some industries having political clout use it for circumventing the rules and regulations mandated by the State.

If the state regulations are not exacting it is difficult to convince the suppliers to go green. A business firm has to engage with suppliers to help them understand, albeit in a harmonious way, the long term benefits of greening the business. If you do not do it today, you shall be forced to do it tomorrow at a much higher cost.

The greatest challenge in implementing green supply chains is in changing the mindset of people. One has to really get people excited to make a positive difference for the cause of environment protection.

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On many occasions, waste disposal presents challenges in the form of not having agencies to carry out the same or agencies charging the organizations heftily for disposal of hazardous waste. Absence of competition leads to a monopoly and therefore unfair pricing for such services.

If we follow the just-in-time philosophy and lean concepts, then we only order inventory that is required just before production. This may mean that goods have to be transported several times. This may add to the environmental pollution and increased fuel consumption. Fuel, as we all know, is a non renewable resource. This has led to batching of orders so the truck is full load. Companies can work around this problem by having arrangements with transport operators and other customers to have part loads delivered to each of them as per their requirement. Cross docking has become popular in retail industry where the need for intermediate storage during delivery is obviated.

3.4 RECOMMENDATIONS TO OVERCOME THE CHALLENGES

To motivate suppliers to green their business, companies have to conduct seminars and workshops and initiate a productive discussion with other suppliers. Under one forum, companies and their suppliers can share know-how, best practices and problem solving experiences. Suppliers in the same industry can be brought together for stimulating discussions on greening their supply chains.

Environmental awareness programs for suppliers, helping suppliers to establish their own environmental programs, supplier relationship programs – all these are steps to overcome the challenges in the implementation of green supply chains.

It is also important to involve suppliers and employees at an early stage in the green efforts. Keeping the customers aware about the relevance of green efforts is also imperative.

To Summarize

- Supply chain management evolved due to the growing importance of logistics management
- Quality has become the buzz-word.
- Supply chain has become a powerful tool for cost reduction and add value to customer
- Environmental performance has to also lead to improvement in economic performance.
- Companies will benefit if their approach is proactive than reactive.
- Changing the mindsets of people is the greatest challenge in the implementation of green supply chain management.

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4 MEASURING THE PERFORMANCE OF GREEN SUPPLY CHAINS

After reading this chapter, readers will understand

1. The need for measuring the performance of green supply chains
2. Challenges involved in measuring the performance of green supply chains

4.1 INTRODUCTION

Regulatory pressures, competitive forces and marketing pressures have made a firm's commitment to environmental management practices mandatory. The successful implementation of green supply chain management practices needs a strong commitment from practicing managers and leadership teams. There is no robust method now to measure performance of green supply chains though academic research is moving in this direction.

Companies suffer from the lack of necessary tools, management skills and competencies and knowledge that acts as a severe bottleneck in the green supply chain management implementation. Trade negotiations as part of WTO, Foreign direct investments and entry in international business all dictate a greater environmental consciousness on the part of businesses.

4.2 LITERATURE REVIEW

Environmental compatibility, increased flexibility and robustness are key targets for today's and tomorrow's supply chains says Francoise Broek (2010). As environmental issues become more relevant for business, the top management is keen to know the return on investment in green efforts. Therefore measuring the performance of supply chains using conventional methods is not enough. What is needed is focus on performance measurement from an environmental stand point.

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Current Supply Chain KPIs	Sustainability KPIs
Availability to consumer (out-of-stock)	CO2 emissions
Cost reduction	Traffic congestion
Financial KPIs: > Return on Investment (ROI) > Inventory turns	Energy and other natural resources consumption
Traceability	Reusable packaging
Fill rate	Co-modal transport

Ilsuk and Hokey (2011) look at how countries achieve logistics efficiency at the cost of environmental degradation. They talk about a green logistics performance index as an indicator of a country's green logistics efficiency. The Logistics performance index was a benchmark created by World Bank and its academic partners. Green supply chain strategies refer to the efforts to minimize the negative impact of firms and their supply chains on the environment. Green efforts can lead to lean efficiency. Improved environmental performance of a firm means better competitive edge, improved revenue, increased market share and more positive corporate image. A country's focus on rapid economic development can undermine its environmental protection.

Kenneth et al (2012) attempted to contribute significantly to the empirical investigations related to the impact of green supply chain management practices on performance. They created a model that incorporates green supply chain practices that link manufacturers with supply chain partners [both upstream and downstream] to support environmental sustainability throughout the supply chain. Data collected from 159 manufacturing managers were analyzed using a structural equation modeling methodology. Manufacturing managers provide data reflecting the degree to which their organizations work with suppliers and customers to improve environmental sustainability of the supply chain. Generally, the adoption of GSCM practices by manufacturing organizations leads to improved environmental performance and economic performance, which, in turn, positively impact operational performance. Operational performance enhances organizational performance.

Sang Lee et al (2012) explored green supply chain management practices and their relationship with organizational performance in case of small and medium enterprises that serve as suppliers to large customers in the electronics industry. Three organizational variables that were used are employee satisfaction, operational efficiency and relational efficiency. 223 SMEs were interviewed from the Korean electronics industry. They found a direct link between GSCM practice implementation and business performance. Business performance is improved when GSCM enhances operational efficiency.

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Srivastava (2007) reports that performance of supply chains must include green elements like for example – include mechanisms for product recovery. Material selection, green purchasing, waste management, packaging and regulatory compliance, greener manufacturing and operations, focus on third party logistics service providers.

Sungjae (2013) says that a performance index that measures an organization's environmental impact directly such as consumption of raw material, management of energy and the amount of waste is a good idea.

4.3 CHALLENGES IN MEASURING THE PERFORMANCE OF GREEN SUPPLY CHAINS

Academic research on measuring the performance of supply chains has evolved only in the last few years. Interest on green supply chain management has increased due to regulatory and competitive pressures. Companies adopt a proactive approach either to stay ahead of competition or to explore greater value that can be derived from green efforts. Companies still looking at reactive approaches may find it difficult to sustain green efforts because in such a case, the wrong message gets propagated to employees. Engagement of employees is a crucial success factor in successful implementation of green supply chains.

The challenges in measuring the performance of green supply chains results due to the fact that there is no single or composite index that is available. There are a host of factors that can contribute to environmental performance. But it is virtually impossible to measure all of them. What is needed is prioritization of these elements so that focused efforts can be in the direction of those elements that can significantly influence performance of green supply chains. For example, green logistics may play a very important role in business operations. In such a case, companies can opt to streamline all the activities under green logistics and establish performance parameters. Thereafter once these practices are institutionalized, the company can look at other performance parameters. What is most important is prioritization and making the right choice.

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Often companies struggle in making a beginning to understand how to measure the performance of green efforts. As green initiatives take a long time in delivering return on investment, it makes sense to keep profitability as a performance measure only after establishing a performance management system and after testing it for a few years. Profitability cannot be the sole criterion for measuring the performance of green supply chains. Once a company has all other performance measures in place, then it is possible to correlate the effect of these measures on business profitability. For example – reduction of pollutants may be a performance measure and this may involve some upfront costs. If over a period of time, reduction of pollutants can bring a positive effect in improving the brand image and if this can result in greater sales of the firm's products and services, then it is easier to correlate the benefit of the green effort (viz. reducing the pollution) with improved margins.

4.4 SUMMARY

Measurement of performance of green supply chains can be a challenge for organizations that only adopt a reactive approach to implementing green supply chains as a result of regulatory pressures. Companies that work proactively to implement green efforts and those that do so due to the realization that green efforts can lead to tremendous value for the business in the long run are the ones who will find it a bit easier to install a performance management system for measuring the efficacy of their green efforts.

As of now, academic research on measuring the performance of green supply chains is still in its infancy. Companies can look at composite indexes or specific performance indexes after prioritizing the key elements that can make a difference to the successful implementation of green supply chains. Profitability cannot be the sole criterion for measuring the performance of green supply chains at least in the initial stages.

Incremental approaches in measuring the performance of green supply chains will go a long way in inspiring confidence among the employees to support the green efforts of an organization.

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5 GREEN DESIGN & SELECTION OF GREEN TECHNOLOGY

Learning outcomes

- Define green design / technology
- Understand closed-loop manufacturing
- Define product stewardship
- Understand the relation between product stewardship and green design
- Enumerate the benefits of green design
- Reasons for growing importance of green design

5.1 GREEN DESIGN/ TECHNOLOGY

Design is the activity in which ideas or market requirements are given specific physical form, starting from initial sketches or conceptual designs, through prototype development, to the detailed drawings and specifications needed to actually make the product. Design can be seen as a process of bringing form and order to both technical and non-technical solutions as well as satisfaction of user needs. (Conway & Steward, 2013, p. 9).

Green design is the incorporation of environmental aspects into the design process. So, while designing a product, if all its impacts on the environment can be studied then this will provide scope for tweaking a product design to improve its environment friendliness.

Whether it is the quality revolution of the ’80s or the supply chain revolution of the ’90s, best practices call for integration of environmental management with ongoing operations. Green design denotes designing products with certain environmental considerations. Considering design issues along with environmental safety and health over full product life cycle during new product and process development is vital. Scope of green design includes environmental risk management, product safety, occupational health and safety, pollution prevention, resource conservation and waste management. (Srivastava, 2007).

Greening the production phase involves achieving a cleaner production phase through prevention of pollution at source. Integration of customer focus, worker involvement and supplier co-ordination in a streamlined manner is important. Green design is one of the steps to achieve this integration. Green & sustainable principles in areas such as product design, production processes and technological systems help to achieve substantial environmental and economic benefits. (Rao Purba, 2008, p. 16).

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Many battery manufacturers in Asia have redesigned their products to remove the use of mercury in their product. Mercury is a toxic element and though it was used to prolong battery life, it can leak out of the battery and contaminate the environment. Brands like Everready, Duracell, National have implemented such green designs. Green manufacturing aims to reduce the ecological burden by using appropriate material and technologies.

CFCs [Chlorofluoro carbons] were earlier widely used in refrigerators. But CFCs are known to contribute to the depletion of ozone layer. Sharp Corporation redesigned their refrigerators by replacing CFC with another chemical that does not cause harm to the environment. Even many cars have been redesigned so that this environment friendly chemical can be used as a refrigerant in the air conditioning system of the car.

A paper mill in Indonesia replaced bleaching chemicals with Oxygen to treat the pulp. By doing so, it lowered the chemical and biological oxygen demand of its effluents. They also had a fiber recovery system so that good fiber could be sourced from rejected pulp.

5.2 CLOSED LOOP MANUFACTURING

In a closed loop process, the output of the process is recycled and put back into the production process. Two examples of closed loop manufacturing are interesting to cite here. In National Steel Corporation, the production process generated waste pickle liquor consisting of water, ferrous chloride and hydrochloric acid. One of the options was that the company could have put a new waste water treatment plant. The company chose to adopt the closed loop approach. It set up a hydrochloric acid regeneration plant which could recover the raw hydrochloric acid from the waste liquor in a recoverable form that can be reused again in the production process. Thus, the company was able to eliminate the discharge of hazardous waste into the environment.

Even cement plants collect dust from the cement kiln exhaust pipe and recycle it back to the kiln. Recycling waste water is also not uncommon in cement plants.

In practice, it is not sufficient to design a recyclable product. Product has to be supported by a supply chain that ensures recycling. Without the support of the supply chain, even products that can be recycled end up in the landfill. The main challenge in designing green products is how to do these activities (like green manufacturing, remanufacturing, recycling) economically. There are bound to be technical challenges in designing products that are environment-friendly. Even if these aspects are taken care of, commercial aspects in closed loop manufacturing are important for sustainability of supply chains.

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5.3 PRODUCT STEWARDSHIP & GREEN DESIGN

Product Stewardship focusses on minimizing the adverse environmental impacts arising at every stage of the life cycle of products manufactured by a company. So, conservation of materials at every stage is essential. Minimization of waste and pollution throughout the life cycle is equally important. Product stewardship can be attained by Design for Environment (DFE) in which adverse environmental impacts that may arise in a product's life cycle are examined right at the design phase.

For remanufacturing efforts, green design is crucial. So, what happens in remanufacturing? The product is received from the customer after its use and is broken down into its parts and the components. These are then reconditioned, retested and assembled into a new product. Product stewardship, DFE and remanufacturing features cannot work on its own without the involvement of suppliers who are needed at every stage in the life cycle of the product. The environmental effects at the disposal stage needs evaluation at the design stage. The supplier involvement needs to be underscored here.

Thus to put it simply, DFE identifies potential environmental hazards early in the life cycle of the product. Environmental hazards in manufacturing are avoided. Energy requirements during manufacturing are reduced. End of life environmental impact is minimized through design for reuse and recycling.

5.4 BENEFITS OF GREEN DESIGN

Green design plays an important role in the sustainability initiatives of an organization. The key challenge for any organization is – how to design products or services that directly or indirectly contribute to sustainability? How can purchases be made that contribute to sustainability? It is easier to evade the issue by saying that so long as the Government allows it, it is fine. But one fine day the regulatory authorities may issue directives to close down a supplier's polluting plant and then the firm realises that there are no alternative resources to replace the raw material. This is the reason green design plays a significant role. For instance, automotive industry used catalytic converters to reduce harmful emissions only after substantial awareness was created about harmful emissions of carbon monoxide and nitrous oxide from automobiles.

Green design involves environmental conscious design taking life cycle assessment of product/ process into account and understanding how design decisions affect a product's environmental compatibility. Replacement of hazardous material with a less toxic material can also be part of a green design effort.

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Even the real estate sector has opened up to the possibility of using green design in the layouts of buildings. This gives a competitive edge in the market. Total Environment is the name of a real estate company in Bangalore. It is unique because this firm constructs green buildings and they do the design themselves. The developer sells flats at a premium because the apartments are designed in a way such that they consume minimum energy – the windows are large enough to allow light and fresh air into the house. His apartments are constructed amidst a canopy of trees, shrubs and plants that it gives one a feeling of living amidst a forest. It is a pleasant sight to watch the design of buildings developed by "Total Environment" and it is definitely not affordable for the average middle class citizen in a city like Bangalore that has become the Silicon Valley of India. Green buildings are a given a rating called LEED rating [Leadership in Energy and Environment Design] by US green building council.

Green design thus enables a business not only to be successful but also to be sustainable. If you look from a tactical lens, green design efforts will prove to be an expensive affair but if you look from a long term perspective, you will realise that green efforts are rewarding in the long run. Green design eliminates problems for an organization at a later stage. Green design helps understand what the recycling efforts of an organization should be at an early stage. It identifies the need for engaging with the suppliers at an early stage to achieve success in the green efforts.

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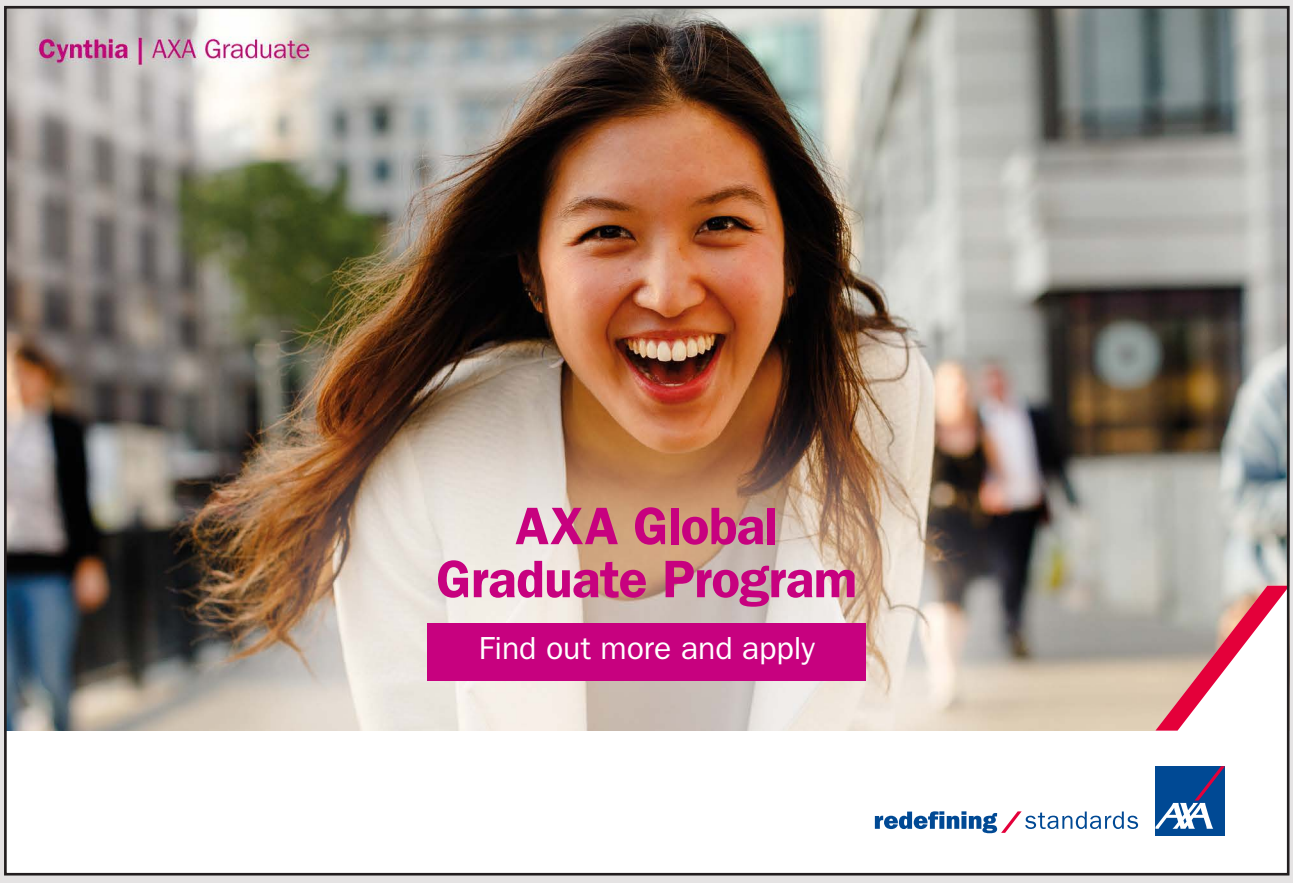

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5.5 GROWING IMPORTANCE OF GREEN DESIGN

Integration of supply chain management is the key for sustainability. End to end supply chains necessitate the blending of green aspects in each and every element of the supply chain. So, if we have a green technology and we are able to manufacture it in the factory in a manner that does not release harmful pollutants in the atmosphere, we have indeed made a good beginning in our green efforts. However is that enough? If our logistics processes cause harmful impact on the environment or if we do not have a process for recycling harmful waste, then the green efforts that we undertake are incomplete. This is the reason a great amount of stress is laid on integrating environmental aspects in all the functional elements of supply chain.

It is important for companies to make suppliers part of the engagements and discussions on greening efforts. The manufacturing process may need fine tuning to use the new green raw material. Or if a process is changed and the supplier is not kept in the loop about it, this may actually result in a greater amount of pollutants that are released in the environment. So, green design efforts in particular, need the involvement of suppliers at an early stage.

Organisations are realizing that business sustainability is proving to be a challenge in the wake of competition, a dynamic external business environment, changing consumer preferences, increasing awareness about environmental issues and regulatory intervention that is becoming tougher. A business that wants to spread its wings in foreign countries will have to consider environmental aspects of doing business in a foreign country. The problems are exacerbated by the fact that regulations may vary from one country to another. Adopting an environmental consciousness in the organization right from the beginning is extremely important if the business wants to retain its success.

Green design has to be well-integrated so that manufacturing, storage, transportation, distribution, consumption and disposal are able to reap the benefits of a design that is environment friendly. Design does not merely include products, it also includes packaging. The new requirement is that products have to be environment friendly as well as recyclable. Corrugated packaging is easier to recycle, so it is used. Standardised reusable shipping containers are replacing disposable ones.

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Fig 5.1: Corrugated packaging

5.6 SUMMARY

Incorporating environmental aspects in design is how green design can be described. Green design helps to identify the potential environmental aspects right at an early stage. Supplier involvement in green design at an early stage is important. Today, it is not just about protecting the environment. Recycling efforts are also getting increased mileage. Most recycling efforts are able to manage the technical complexities but economic or commercial bottlenecks are much more difficult to overcome. They need tenacity of efforts and single-minded focus. Returns on green efforts will take a while to materialize. Half baked attempts will increase the costs so there has to be an attempt to integrate all elements of supply chain while implementing green efforts.

Nexe Tire's N'blue eco tyre has won the US Green Good Design Award 2014. The awards are organized by the Chicago Athenaeum Museum of Architecture and Design in cooperation with the European Center for Architecture, Art, Design and Urban Studies. It selects award winners in the categories of environmentally friendly products, people, organizations and architects, with the N'blue eco being named the winner in the product category at this year's Green Good Design Awards. Their intention is promote "excellent environmentally friendly design".

The N'blue eco is the most popular environmentally friendly tyre developed by Nexen. It reduces rolling resistance while improving fuel efficiency through a construction designed to minimize energy loss and optimized tread patterns.

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6 GREEN PURCHASING

Learning Objectives

- Understand the drivers for green purchasing efforts
- What are the different elements in green procurement
- Role played by large enterprises in promoting green efforts along the whole supply chain

6.1 GREEN PURCHASING AND SUPPLIER RELATIONSHIPS

Purchasing is obtaining supply of raw materials from a supplier for manufacturing a product or delivering a service. Purchasing includes participation in the selection of a vendor, selection of material, utsourcing, negotiation, purchase, delivery planning, stocking, materials management, and design. Sungjae (2013) quotes Carter while defining green procurement as the participation of the purchasing department in the practical use, reuse, and conservation of resources that occur in supply chain activity.

A green purchasing policy assumes that activity will extend to the supply chain, including the acquisition of raw material, supplier selection and evaluation, supplier production, supply logistics, packing, practical use, reuse, and abandonment of a product generally.

Green procurement is a purchasing policy for production that does not damage the environment; additionally, it improves a product, a process, and the environment-friendly nature of a company by purchasing suitable and cost-effective technology as well as environment-friendly materials.

Elements of green procurement can be delineated as below:

- Listing of suppliers
- Environmental audit of suppliers and their installations
- Accreditation of green suppliers
- Development of clean technology and processes
- Supplier education and training
- Supplier competency development
- Rationalisation of green suppliers
- Inclusion of small scale suppliers by motivation and training

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Large enterprises often do not have resource constraints and this makes them more amenable to green efforts. But the SME sector is often short of capital and then they are in a dilemma about using scarce capital for environmental projects. Only effective networks can pull the SME sector towards implementing green efforts with sincerity and commitment. Large enterprises can play an important role in influencing the whole supply chain to promote efforts in the right direction of implementing a green supply chain business model.

Companies have to develop green supplier selection management practices. A criteria has to be developed for evaluating green suppliers. Firms have to voluntarily reduce the environmental impacts of their operations. The biggest challenge is integration of environmental, social and economic performance. With government regulations tightening and increase in the public awareness about green issues, firms simply cannot ignore environmental issues.

Design for environment, lifecycle analysis, ISO 14000 standards, Total Quality Environmental Management and Green supply chain Management are relevant and important as part of environmental consciousness.

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7 GREEN LOGISTICS

Learning objectives

- Understand the growing importance of logistics
- Reason for interest in green logistics
- A broad overview of literature in green logistics
- Future of green logistics

7.1 GROWING IMPORTANCE OF LOGISTICS

The discipline of supply chain management has actually evolved from logistics. Logistics is, to put it simply, the process by which goods are transported from one destination to another. Logistics is responsible for supply and distribution of goods and services. The final product has to be made available to the customer at the right time. A product may be priced appropriately; it may be of excellent quality; but if it is not available to the customer at the right time, it makes no sense. All the marketing and sales efforts will come to a naught, if logistics is inefficient. Inefficient logistics processes will render superb efforts by other functions futile. This is the reason the logistics function has assumed great relevance in today's knowledge era.

When the logistics processes are efficient, a company's bottom line improves. It makes the business more sustainable in the future. Business success can never be taken for granted. Market conditions are changing all the time. The Government policies, globalization, intense competition in the market place, growing demands of fastidious customers, the use of technology in business and the growing influence of Internet in trade and commerce has made it imperative for an organisation to think on its feet all the time. Business, at the end of the day, is all about making the right decisions at the right time.

Thus, logistics has become increasingly relevant today more so as competition is not between firms but between supply chains. Firms are realizing that all functions in an organization must be hardwired to the logistics function as this is where the real strength of an organisation lies.

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The last mile delivery concept is fast gaining ground. The term "last mile" was originally used in telecommunications but now it is widely applied to the field of supply chain management. Transporting goods via freight rail networks and container ships is the most efficient and cost-effective manner of shipping. When goods arrive at a freight station or a port, they must be transported to their final destination. This last leg of the supply chain is considered less efficient and comprises upto 28% of the total cost. To put it simply, even if all other processes are efficient, the last stage by which a product or service is made available to the customers can have bottlenecks and these have to be overcome to improve delivery efficiencies.

7.2 REASON FOR INTEREST IN GREEN LOGISTICS

An increasing share of organizational value is derived from suppliers in terms of their ability to support an organisation's greening efforts. Primarily the suppliers are expected to deliver good quality goods on time. But the definition of quality is changing. If a customer wants a greener product, the quality specifications have to change. The supplier has to be agile to respond to this change. So, if he is supplying a raw-material that is not environment friendly, then he has to offer a substitute material that is more environment-friendly. These decisions can't happen overnight. These decisions are results of continuous engagement between customers and their suppliers.

The greening of the supplier would create advantages for the lead company in terms of integrating and aligning supply chain activities to make their operations more efficient and cost effective. Cost savings can be passed on to the consumers so that there is greater value for the latter. This may require a firm to visit the manufacturing locations of its suppliers to ensure that their production processes are not causing any adverse effect on the environment. Additionally, by ensuring that the suppliers send full-load trucks and ensuring that their vehicles carry the "Pollution Under Control" certificate, companies take a further additional step in greening their business. All these efforts will need an engagement with the suppliers to help them understand the reasons for greening the business and their role in the same.

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Green logistics is generating lot of interest because logistics is one of the causes for increasing the levels of environmental pollution. A truck that lets out harmful emissions and makes several trips carrying less than half the truck load capacity is a classic example of waste as well as an activity that is adverse to the environment. Proper planning and concrete actions should take care of such issues. Unnecessary and wasteful movement of goods before it reaches the final destination also contributes to operational inefficiency. Logistics productivity can be a great source of revenue for the company in terms of cost savings. After all, a rupee saved is rupee earned! So, if a firm starts looking at improving the fuel efficiency of its vehicles, the savings resulting from it will run to crores of rupees especially if the organisation is a large conglomerate.

Another reason for interest in green logistics is that companies are realizing it is not just about protecting environment – it is about increasing the productivity, reducing the cost, improving the profit margins and rendering greater value to the customer. This translates to growth and sustainability of business. Success in green logistics efforts can give an organisation a competitive edge in the market place.

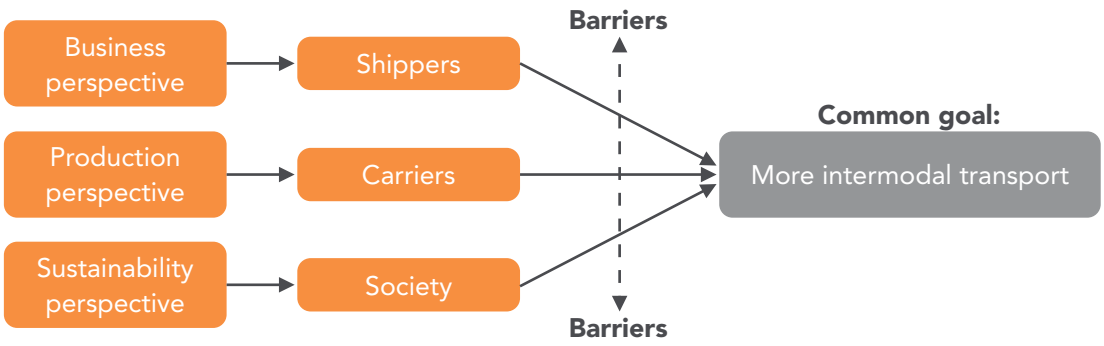

Fig. 7.1: Intermodal transportation

Use of multi-modal transportation (combining road, railways, waterways and airways as means of transport) is gaining ground to drive logistics performance. Use of unleaded gasoline in vehicles to reduce emissions is a green effort that can reap rich rewards in the future. Going forward, hybrid vehicles (diesel/petrol + electric) and electric vehicles may be used for transportation.

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7.3 A BROAD OVERVIEW OF LITERATURE IN GREEN LOGISTICS

One of the methods to make logistics greener is a shift to intermodal rail road transportation. Green logistics research has focused on presenting the carrier's view point but it is important to understand the shipper's perspective as well. In traditional logistics management theory, a firm has to consider the trade-off between customer service versus cost. In a purchasing decision for transport, the trade-off between transport quality and price is not so important when a shipper is considering a modal shift (ie using multiple modes of transportation). The major trade-off in such a case is that of purchase convenience versus price, assuming equality in transport quality. Role of carrier is important in multimodal transportation (Eng-Larsson & Kohn, 2012).

Green Reverse Logistics has been examined and an attempt has been made to define the same (Hazen et al, 2011). Overlap of Green supply chain management with reverse logistics leads to Green Reverse Logistics. Research was carried out to compare the consumer perceptions about recycled, reused and remanufactured products. The general opinion is that consumer is to averse anything that is not new and places a lower premium on products that are recycled or remanufactured. But the findings of the research were surprising. Consumer's perception about recycled products matched their perception about brand new products. This may be due to greater awareness created by environmental agencies and has triggered a positive reaction about the quality of recycled products. However, the perception about reused and remanufactured products is lesser than that of brand new products. The consumer perceptions need to be influenced in a positive manner to ensure success of green efforts.

In a research carried out on logistics companies in China, organizational support, quality of human resources, regulatory pressure, governmental support and compatibility of green practices with the existing systems had significant positive influences of adoption of green practices. Uncertainty in the business environment and the complexity of green practices exacerbate the negative influences. Surprisingly, customer pressure in China is not a major driver for green logistics measures. (Yu Lin & Hui Ho, 2011).

A comparison was made between US firms and non-US firms regarding their perspectives on green logistics practices.The results indicated that these firms had similar perspectives on issues surrounding green logistics. Green concerns will continue to expand the scope of logistics as well as influence the way logistics managers do their jobs. Salvage, scrap disposal, handling customer returns are fast gaining ground. The logistics manager has to pay more attention to those areas that can have an impact on the environment. Packaging is one such area as it has raised concerns about solid waste disposal. So efficient packaging is becoming a necessity. (Murphy & Poist, 2003).

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Logistics excellence in the future is going to be determined by the ability to effectively manage the environmental issues. Companies are redesigning logistics to make the activities more energy efficient and environment friendly. The overall objective of green logistics is to reduce environmental impact of logistics activities, lower production costs and improve product value. This may be the reason why some researchers have proposed the use of a GLPI – Green logistics performance index. This index can be used to gauge the environmental performance of logistics companies across industries and countries. The index considers the three components of logistics – use of environment friendly materials, green packaging design and green transportation. Smaller firms adopt green practices as a reactive approach to environmental regulation while larger firms are able to embrace greening efforts in a pro active fashion because they have resources to spare for such efforts and they believe that going green will make their business more sustainable (Hung Lau, 2011).

Innovation need not be restricted to manufacturing companies alone. Logistics companies can also increase their abilities to implement green innovations by growing their awareness about green technologies, by motivating their employees to learn new technology and by training their employees to become knowledge workers. (Hui Ho et al, 2009)

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Shippers generally have a biased perception towards green practices of transportation service providers. They believe that the efforts of the transport operations to green their operations are sub optimal. But their perception may be incorrect as transportation service providers may actually be doing what is required for greening the business. Eventually they may overdo leading to service overkill. Thus, while greening the business efforts is important, it should also be demand based and it should consider optimum utilization of resources. Gradual greening of operations considering the demands of the market place is a best bet. There can be a pro active approach but nothing that involves gold plating. (Martinsen et al, 2012).

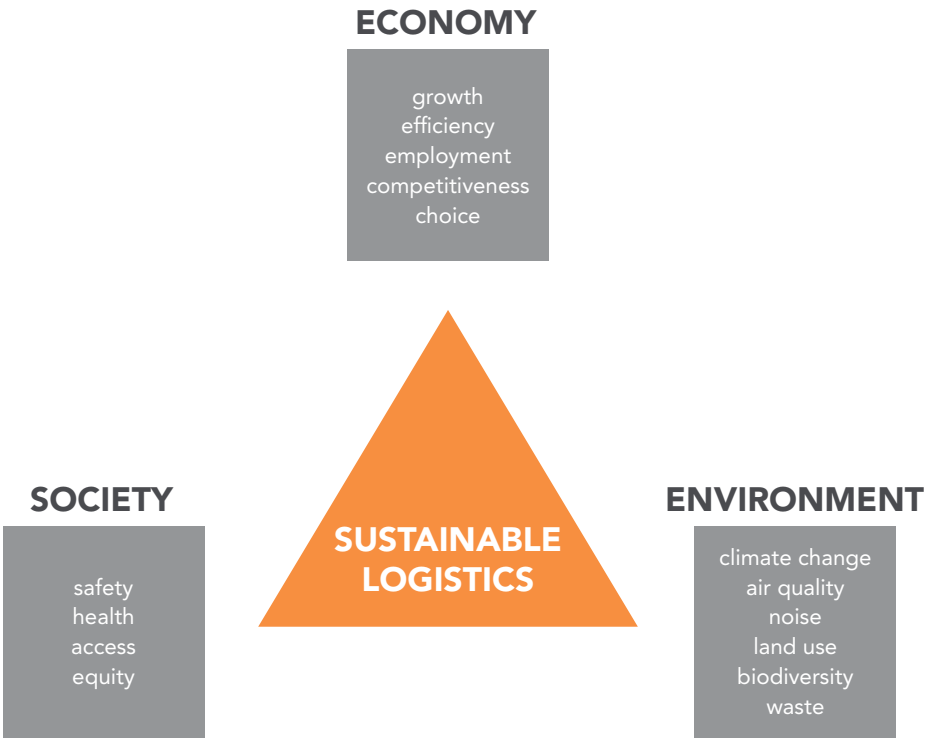

Fig. 7.2 Sustainable logistics

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Sustainable logistics manages and balances the demands from society, environment and the business itself.

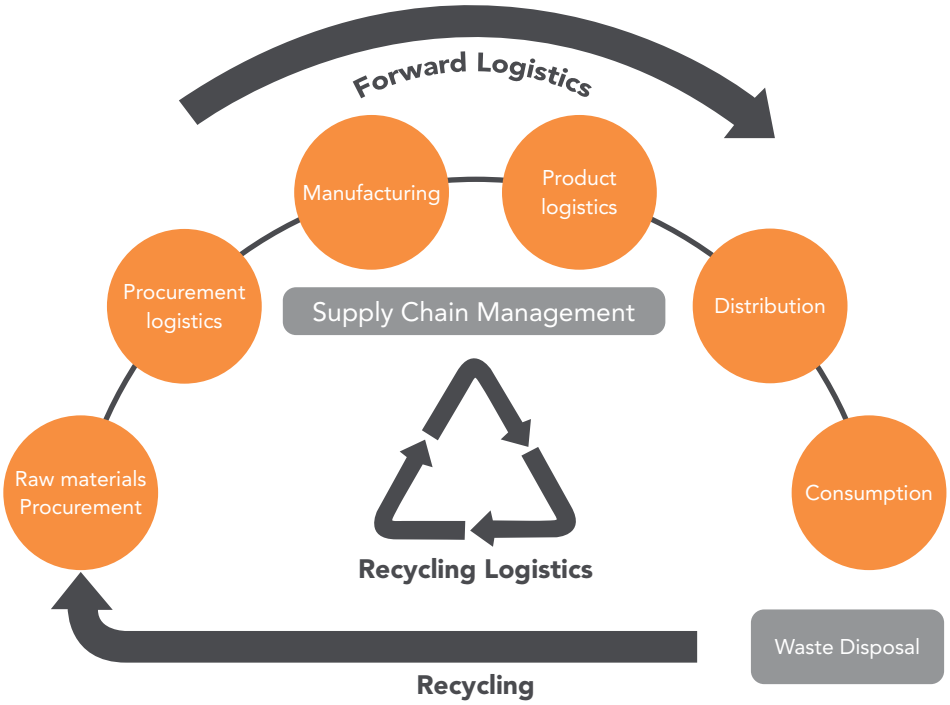

Fig. 7.3 Recycling logistics

7.4 FUTURE OF GREEN LOGISTICS

There can be challenges in the implementation of green logistics notwithstanding the fact that environmental issues are causing a fundamental shift in the competitive landscape. Sustainability has become the new buzzword. Mismatch of expectations between shippers and logistics service providers can exacerbate matters. The Governmental rules/regulations may change and that could cause further bottlenecks. Capital investments may be required for a transport operator who wishes to change his old fleet of pollution generating trucks. But he may not have access to capital. Packaging innovations need to consider the customer perspective as well instead of merely looking at the environmental aspect. Trade-off between inventory policies and green logistics programs may be difficult to achieve. On one hand, you wish to have a lower inventory to reduce cost and on the other hand, you may order inventory more frequently and this would mean greater number of transportation trips and less fuel efficiency. However, all these challenges are not insurmountable. They can be managed with tact and precision. They have to be as sustainability is also becoming a key driver for innovation.

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The canvass of green logistics is wide and overlaps other functions within the organization. Use of environment friendly materials in production or recycled parts in remanufacturing reduces the adverse impact on environment but also reduces manufacturing costs. Innovations in packaging design help minimize waste and reduce costs. Transportation becomes greener by consolidation of orders, optimization of schedules, rationalization of distribution frequency and reduction in fuel consumption.

Purchasing, packaging and transportation represent the major logistics functions in a supply chain. So, efforts to green them can be treated as equivalent to greening the logistics function itself.

When one organization innovates to make the logistics function environment friendly and tastes success, this motivates other similar organizations in the same industry to do so. Though there is not much data on how a firm can achieve competitive advantage by going green, increasing awareness about environmentalism is bound to tilt the scales in favor of those organizations that are more proactive in their approach to support environment friendly endeavors.

Environmental issues can impact logistical decisions throughout the value chain. Efficient warehouse design can reduce the number of empty or partially empty forklift trips. This means greater capacity utilization of fork lift trucks and therefore greater productivity. Freight consolidation can greatly improve fuel efficiency and this can reduce costs and increase profit margins.

On their part, every organisation can conduct environmental audits, initiate community development efforts, publicize environmental accomplishments, train their personnel and encourage greater involvement by the state. The state cannot be merely prescriptive in its approach. The state has to be facilitative in its approach so that quick solutions can be found for nagging problems that can come in the way of successful implementation of green logistics efforts.

The future of green logistics also depends on the success of the reverse logistics efforts by organizations.

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8 THE CONFLICT BETWEEN LEAN AND GREEN

After reading this chapter, readers will understand

- The common aspects between lean and green
- The impact of globalization on green supply chain implementation
- The differences between lean and green approaches

8.1 INTRODUCTION

Green efforts, lean processes and globalization of supply chains are converging to create a complex business environment. Green supply chain strategies are nothing but efforts to minimize the negative impact of firms and their supply chains on the natural environment. The focus of lean is more on reduction of waste.

Intersection of these strategic initiatives is not yet explored. Firms may be missing the synergies available from concurrent implementation. Lean strategies like just in time delivery of small lot sizes can involve increased transportation, packaging and handling that may contradict a green approach. Firms have to recognize this conflict and create trade-offs. Negative impact of just in time approach can be dealt with by using reusable packaging or by adapting the lot size to optimize cube utilization during transportation to achieve both lean and green goals.

Regulatory differences across the globe add to the complexity. Due to widespread acceptance of lean supply chain practices and growing pressure for environmental management, firms have been adopting environment friendly practices in the waste reduction agenda. Green efforts will need working with suppliers as well as customers.

What metrics can firms use to measure environmental footprint in a global context? ISO 14000 certification is a global metric. MNCs have good knowledge transfer capabilities, have high research and development focus, and learn from their experience of manufacturing in different countries. Not following environmental regulations can also lead to reputational damage for an organization.

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As a result of globalization, a company now operates in many countries. Differing legislations in different countries can be difficult to manage. Firms can get confused whether to standardize or customize according to the regulation in each nation. Companies like Volvo and P&G integrated global environmental concerns into their business strategy. P&G realized that involving their suppliers in environmental issues at an early stage is important. Integration of strategies and information sharing both upstream and downstream is important for successful implementation of green and global supply chains. Motorola succeeded in green efforts because of suppliers. There is increased interest between lean and green practices as greater synergy can be obtained by combining both the efforts.

Innovative firms with continuously improving manufacturing processes are likely to take on environmental innovation. Lean and green practices need not be always compatible. Spray paints are cost effective and can lead to better quality management but the impact of such paints can be environmentally damaging. Lack of awareness about green issues can be costly and time consuming. There is a prevalent notion that environmental practices do not pay. This is true if a company does not know how to implement green initiatives in the right fashion.

Both lean and green efforts need external audit. Reducing generation of undesired by products can be an example of synergy between lean and green. Lean practices can lead to environmental benefits. Environmental practices can lead to improved benefits and support the lean agenda.

8.2 FIVE PRINCIPLES OF LEAN THINKING

Let us now look at the five principles of Lean thinking. These principles have become the cornerstones for success in Lean manufacturing.

1. Identify Customers and Specify Value - The starting point is to recognise that only a small fraction of the total time and effort in any organisation actually adds value for the end customer. By clearly defining value for a specific product or service from the end customer's perspective, all the non value activities – or waste – can be targeted for removal.
2. Identify and Map the Value Stream – The Value Stream is the entire set of activities across all parts of the organisation involved in jointly delivering the product or service. This represents the end-to-end process that delivers the value to the customer. Once you understand what your customer wants the next step is to identify how you are delivering (or not) that to them.

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3. Create Flow by Eliminating Waste – Typically when you first map the Value Stream you will find that only 5% of activities add value, this can rise to 45% in a service environment. Eliminating this waste ensures that your product or service "flows" to the customer without any interruption.
4. Respond to Customer Pull – This is about understanding the customer demand on your service and then creating your process to respond to this. This involves producing what the customer wants and delivering it to him when he wants it.
5. Pursue Perfection - Re-organizing individual process steps is vital but it is also important to link all these steps together. It needs to be remembered that this is an ongoing process. As you start linking all the steps, more and more layers of waste become visible and the process continues towards a point of saturation when all the non value added activities have been eliminated. Thereafter the challenge is to focus on the activities that add greater value and keep on top of it.
6. Focus on delivery – Constantly and consistently delivering value to the customer becomes the focal point then. Organisations need to remember that change has to be sustainable.
7. **Value stream mapping** – This can be an excellent tool for service industries. It helps in analyzing the flow of materials and information needed to deliver goods and services to a customer. By analyzing customer complaints, process inefficiencies can be rectified. Even when there are no complaints, it helps to relook at the processes and analyse how they can be improved further. To reiterate, lean is not just about looking at ways of reducing wastes resulting from processes that are inefficient. It is also about generating greater value by looking at existing processes and eliminating any activity that does not add value.

8.3 IMPROVING LEAN EFFORTS – A FEW GUIDELINES

- Have a clear understanding of what lean means for your business. The objectives have to be clear.
- Set realistic, specific, measurable goals that are time bound and that are achievable.
- Dedicate resources to implement the Lean program at multiple levels. Have Lean champions across the organization
- Investments in the lean program must be guided by the company's ROI guidelines
- Think big but start small. It is essential to have a road map where the initial milestones can be easy to achieve
- The lean program has to be more action oriented with less rhetoric. People believe what they actually see. So, people must be made an integral part of the lean efforts of an organisation so that they can actually see what success looks like.

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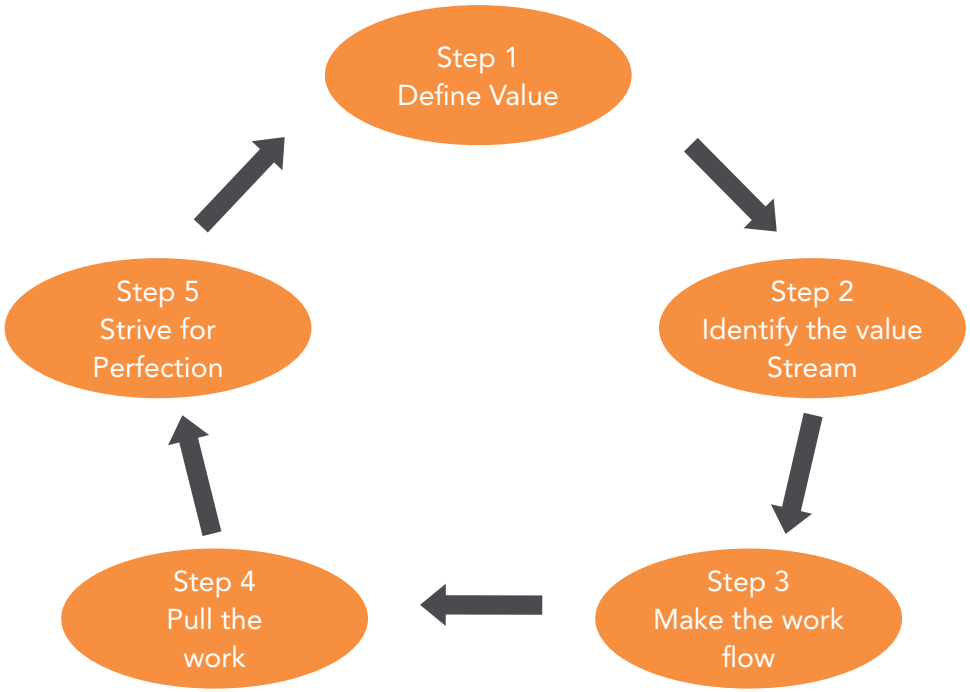
- Quick wins inspire confidence and lend credence to lean efforts. This requires setting targets and focusing on meeting them.
- Top management involvement, as in every quality movement, is essential to give direction and guidance and steer the efforts of the teams in the right direction.
- Change in mindset is hard to achieve but once it is achieved it can work wonders. Employee engagement is important for achieving this goal.
- Communication channels have to be open to promote free flow of communication.
- Benchmarking the organisation both internally and externally will further add greater meaning to the lean efforts.



How adopting lean/green manufacturing practices can generate environmental benefits for a large MNC automotive manufacturer – Certain aspects of lean manufacturing namely employee training, inventory reduction and use of value stream mapping result in real environmental benefits including reduction in input consumption (water and raw-materials). Managers do not always understand the synergy between lean manufacturing and environmental improvement.

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Environmental improvement is based on making more efficient use of materials and natural resources, which in turn, depends on operational and process decisions that look at minimizing or preventing pollution. Lean manufacturing has led to collateral green benefits. Employees can take action during the production process to avoid failures that might lead to rework or unnecessary use of resources. 5S helps employees follow standardized procedures and maintain a clean work place which helps them avoid improper disposal of waste and incorrect use of inputs. Plants using lean production practices achieve high levels of pollution prevention.

Managers do not know or are not keen to synergize the efforts between green and lean.

8.4 TO SUMMARISE

Companies that are innovative in manufacturing processes are likely to be more creative in addressing environmental concerns to reduce costs and risks. Close relationships between production, end users and suppliers help in industrial and environmental innovations. Commonality between green design and manufacturing strategies is due to the fact that both are dependent on productivity improvement, quality, cost reduction, continuous improvement and technological innovation.

Many research studies have proved that efforts to lower the costs of waste management and disposal and to reduce waste and emissions need not negatively affect corporate performance and can actually improve it. But these can't be generalized. However, researchers like Florida say that if a company is good in manufacturing innovations, it will be easy for this company to introduce environmental innovations.

If total quality management is a method for engaging production workers to improve product quality through incremental improvements in processes and products, then Total quality environmental management extends the TQM logic to include manufacturing practices and processes that affect environmental quality. Employees have to be involved in continuous improvement to help improve manufacturing practices and also in implementing total quality environmental management. Earlier some companies were outsourcing toxic production processes up the supply chain but now there is a greater need for collaborative approach. Firms are realizing the value of working with suppliers to improve their environmental performance. Passing on the environmental burden to other suppliers cannot make a company abdicate its responsibility.

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Companies of all sizes are enhancing the fundamental supply chain changes by considering the environmental impact of their decisions and actions. When accountants do not allocate the costs of waste disposal, training fees, recycling costs, costs for reducing pollution to the appropriate products and processes then this can lead to incorrect reporting of costs. Thus, proper environmental accounting techniques are also important. Those managers who are overlooking the environmental aspects of supply chain are also overlooking the opportunities to increase the responsiveness and efficiency of supply chain.

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Figure 1: Misallocation of Environmental Costs[4]

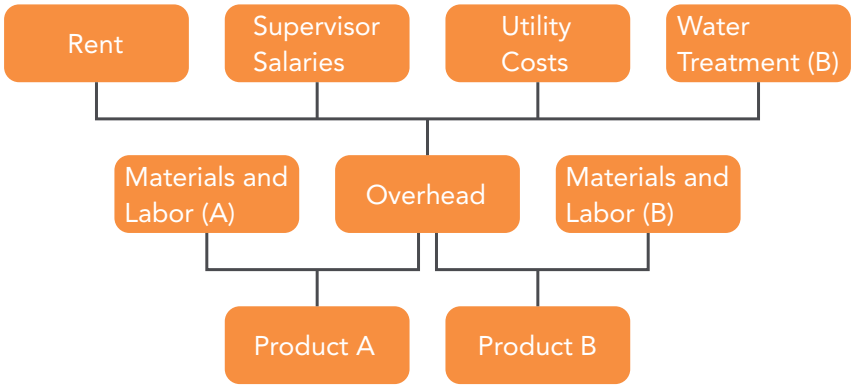
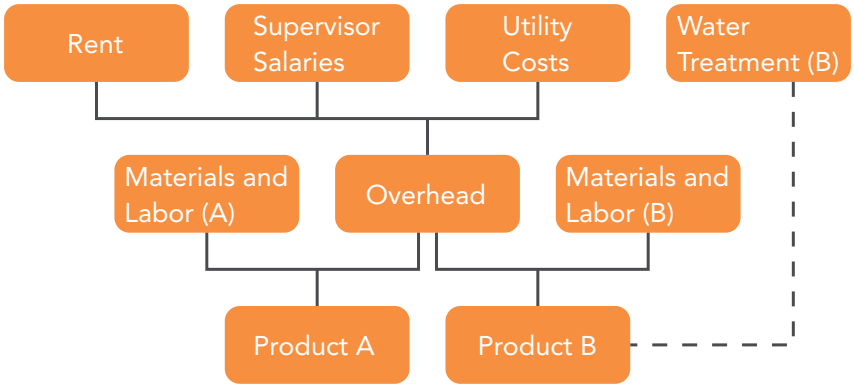
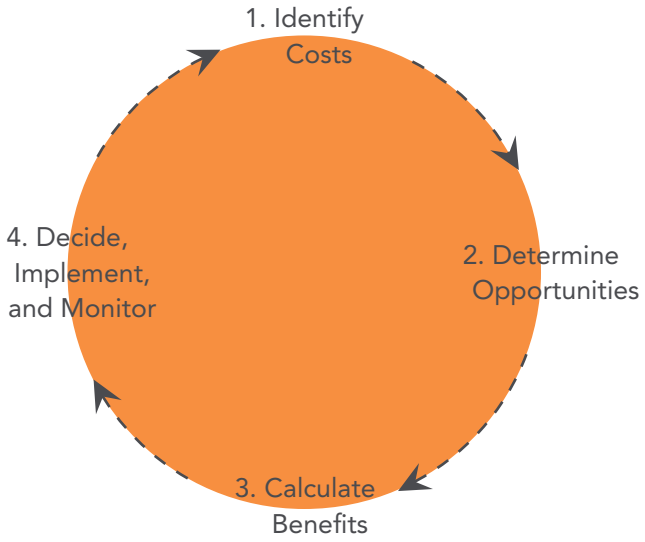


Figure 2: Improved Allocation



Ideally companies have to create a decision framework based on the following steps:



Proper accounting can lead to greater opportunities for increasing overall efficiency and productivity.

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9 GSCM: LINKS TO QUALITY STANDARDS, TQM AND CRM

Learning objectives

After reading this chapter, readers would be able to understand

- The correlation between quality management and customer relationship management.
- the growing importance of quality standards
- the need for integration of different standards

9.1 INTRODUCTION

Today there is a greater need for businesses to focus on quality. Competition is intensifying in the market. Customers are becoming more fastidious. There is growth of international business and multi lateral trade due to globalization. Geographical barriers are crumbling. Companies like Amazon believe that they would rather listen to their customers than focusing on what competition does. Market intelligence is not about knowing what competitors are doing. It is more about what they are not doing.

Companies are getting vital clues from retailers, wholesalers and manufacturers. So, where does all this converge? Are businesses getting bogged down by multiple philosophies? Are they unable to focus on what is more important for them? This chapter shall help the reader to understand why there is a greater need for integration of all the philosophies without losing focus on the customer.

9.2 TQM, CRM, ISO STANDARDS

The total quality movement started in the manufacturing sector. Japan became a developed country due to the quality movement. Despite having a shortage of natural resources, the quality movement put Japan on the world map. In fact, the American automotive industry that was running into major losses and was struggling to deal with quality and productivity issues started looking at the Japanese automotive sector with indignation at first and then with awe and inspiration later on. Americans started buying vehicles made by Japanese manufacturers and this forced the American manufacturers of automobiles to look at quality issues more seriously. Productivity in the American automobile industry became more relevant in view of the competition from Japanese car makers.

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Today, the services sector has started looking at TQM even though due to the nature of services it is far more difficult to initiate TQM in services sector. Manufacturing is more machine dependent whereas services are more people dependent.

The TQM movement gave rise to the need for quality standards. Companies started focusing on acquiring quality certifications like IS0 9000, ISO 9001, QS 9000 so much so that over a period of time, these standards became more commoditized robbing companies of the competitive advantage that these had created earlier. As issues of environmental abuse by businesses became more rampant, a new environmental quality standard called ISO 14000 was born. From an outsider's point of view, all this looks very progressive. But from an insider perspective, most of these standards increased the work load for employees, made them more accountable and the efforts became more performance driven. While there is nothing wrong with this, the problem arose when auditing on such matters became more prescriptive and less facilitative. The term audit has negative connotations. So, many auditors decided to adopt an approach in which there was active engagement with the employees and an attempt to understand the challenges of employees in greater detail. Companies on their part had to offer incentives to employees for their efforts in making the business comply with these standards.

The entire quality movement or for that matter the quality standards has revolved around the customer. No definition of quality is complete without bringing the customer in focus.

When marketing function started talking about breeding customer loyalty by retaining them this gave rise to the legendary customer relationship management. While the service sector began looking at this more seriously, manufacturing continued to focus on quality. The truth is that all these efforts are inter-related. If customer is important, then quality has to be given more attention. Quality became a key enabler of customer relationship management whether it was the quality of the finished product or quality of the service interactions that the customer had.

Academic research has now started exploring the converging points among all these efforts. This is because companies do not want to reinvent the wheel all the time and do not want to overload their employees with information, processes and procedures. The idea is to keep things simple. The commonalities among these different approaches can be better understood if customer needs are understood well. Then the differences between these approaches can be given more attention.

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For example – quality of a finished product may be important for TQM as well as CRM. So, any efforts in improving quality will benefit both these initiatives. CRM may need greater technological intervention than TQM and so this aspect can be brought into focus. TQM may need greater engagement with employees and customers for continuous improvement on issues concerning quality. Understanding the points of convergence and the points of divergence are essential for adding greater value to the customerGreen supply chain management has been envisaged as bringing environmental elements in all aspects of supply chain. Regulatory pressures and pressures from customers are driving the need for the green movement in business. Greening efforts are not becoming an option – they are becoming a necessity. Environmental compliance is gradually becoming a hygiene factor for doing business. It is becoming linked to the brand equity of a product or service.

It is interesting to note that whether it is green supply chain management or quality movement or CRM, everything boils down to meeting customer needs. Going forward, it is expected that the definition of quality also will be incomplete without reference to any improvement in the environmental performance of a business.

The integration of green supply chain management with other efforts and in particular environmental standards like ISO 14000 is a must. Companies who are complying with ISO 14000 environmental management system should look at the green supply chain funnel so that their standards actually exceed that which is mandated by ISO 14000. Alternatively, it makes better sense for a company that is looking at green supply chain management to pursue ISO 14000 certification. Leveraging the advantages of green supply chain management to build an environmental management standard will create twin benefits for a business. Sustainability is at the core of every business today. The sooner businesses realize this the better it is for them. So, environmental compliance will lead to better business practices, make supply chains more productive and efficient and give companies the licence to operate and grow their business. The regulation in different regions of the world may be different and if a company can develop the ability to overcome the complexity due to differing standards it will do the business a world of good.

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When green supply chain management practices seamlessly blend with other philosophies, businesses can synergize the same to improve overall operational efficiency. Experience in one market can help the business to avoid mistakes in other markets. If the green regulations in a country are inferior to that in another country and if a firm is doing business in both these countries, it makes better sense to standardize the green efforts in both these countries. Initially it may appear to be a case of gold plating, but it need not be so. Doing more for the environment may appear to be costly in the short term but it can be extremely rewarding in the long term.

9.3 SUMMARY

- Sustainability is the core of every business today.
- Green supply chain practices can be blended with other philosophies to improve operational efficiency.
- Environmental consciousness may be costly in the short run but it can be rewarding in the long run.

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10 GREEN BUILDINGS: SUSTAINABLE DEVELOPMENT IN REAL ESTATE

Learning outcomes

1. Understand the concept of green buildings
2. Understand adverse environmental impacts of conventional buildings
3. Learn about LEED rating and green building certification mechanisms
4. Identify the need for green buildings and their benefits to society
5. Learn about successful examples of green buildings in India
6. Learn about the importance of green supply chain management practices in real estate sector and the challenges and risks involved.

10.1 INTRODUCTION

The concept of green is becoming popular in the construction sector as well not only in developed economies but also in the developing economies. One of the major challenges of the twenty first century is to explore ways of mitigating the risks due to adverse environmental impacts of construction sector. Attempts to bring environmental consciousness in real estate/ construction sector have been fragmented. Net green outcome of a construction project results from the cumulative efforts of all actors involved in the various supply chain stages. Green supply chain management can be a way forward to ensure consolidation of fragmented efforts to green the construction supply chain.

Assessment of green supply chain management framework in construction sector will involve understanding risks involved, barriers to green supply chain integration and getting a handle on the best practices that can be sustainable. The economic, environmental, social and organizational impact of green practices in construction industry must be clearly understood. Academic studies have discovered that implementation of green practices may be challenging but they lead to positive impact on environmental performance. It is a fallacy to assume that environmental performance is achieved at the cost of economic performance. Builders need to appreciate the fact that environmental performance will eventually lead to strategic benefits – a myopic approach will only focus on short term expenditures and short term benefits.

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In this chapter, let us look at the concept of green buildings in more detail and try to understand the benefits of green buildings. The chapter also includes the recent development with regard to growth in the number of certified green buildings in India, the benefits of green buildings and how the green supply chain management practices can fuel further growth of green buildings.

10.2 WHAT IS A GREEN BUILDING?

A green building is defined as one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building. A green building generates less waste and provides healthier spaces for occupants. Green Building Practices aim to reduce the environmental impact of buildings by efficiently using energy and water.

National Association of State Fire Marshals in the US defines: "A green building is the practice of creating a sustainable / high performance structure as one that is a holistic approach to design, construction, demolition, thus minimizing to acceptable levels, the building's impact on environment, the occupants and community."

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10.3 ADVERSE IMPACT OF CONVENTIONAL BUILDINGS

- Increase in green house gas emissions
- Global warming – depletion of ozone layer
- Over exploitation of non renewable resources
- Environmental degradation
- Desertification
- Deforestation and soil erosion
- Diminishing productivity of land and water
- Deteriorating quality of life

Looking at the adverse benefits of conventional buildings, it is clear that there is an urgent need to create awareness about the need for green buildings. The way construction sector treats environmental issues with disdain and recklessness is a sad commentary on continuing abuse of environment with scant regard to future sustainability. In India, the debris from demolished buildings is just disposed off in an open ground without looking at safe and environment friendly methods of disposal. The intervention by state becomes essential.

10.4 NEED FOR GREEN BUILDINGS

Cities are engines of socio-economic development and social interaction but they exploit natural resources in such a manner that it threatens the long term prosperity and social well being of man kind. Trees are felled for constructing roads, gardens give way to building complexes and lakes are ill-maintained leading them to become sewage dumping yards.

As population increases, there will be more buildings, more concrete, more power consumption, more need for water. But what about the supply? People keep on drilling tube wells to have access to ground water but the enthusiasm is missing when it comes to rain water harvesting, recycling of used water, desalination of sea water. Today, sustainability is considered as if it is a luxurious need. In fact, sustainability is a real need. **Sustainable development is not an option, it is a must.**

Buildings are integrated systems that have to interact with the environment. Conventional buildings use more power, more water and more building material. These buildings have a negative environmental impact in all stages in their life cycle because there is no attempt at conservation of resources. In India, the green homes are certified by Indian Green Building Council (IGBC).

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A sustainable building optimizes, restores and renews consumed resources. There is an integrated approach between environment, social and economical to protect the environment. It lays down the road map for a future where natural resources are not exploited. The awareness is increasing in the West. In Spain conventional building roof tops have installed solar panels as a green initiative.

10.5 BENEFITS OF GREEN BUILDINGS

The basic principle for green buildings is – increased efficiency and minimal wastage throughout its life cycle – from construction till its demolition. Green Buildings prioritize conservation of resources, health and environment. These buildings provide healthier indoor environments, reduce energy consumption, minimize material consumption, reduce waste, recycle waste, and reduce release of pollutants to air, water and land in construction, operation and disposal. They also reduce solid waste disposal by providing solutions like compost bins to reduce matter going to landfills. People have to understand that sustainability leads to happiness.

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Existing buildings can be converted to green buildings. As green buildings have reduced operational cost, they get more lease rentals. Hygiene factors in an office get uplift if it is a green building. There is no link between building height or utilization of space with sustainability. High rise buildings can also be green. Though green buildings will need an initial outlay that may be higher than that of conventional buildings, they prove to be cost-effective in the long run.

Indian cities are expanding vertically. Now is the time to introspect on the mistakes made by Western world – inefficient usage of resources in particular? Efficiency and sustainability go hand in hand.

Other benefits of green buildings are:

1. More fresh air to breathe
2. More natural sunlight
3. Efficient air conditioning
4. Better fire safety management
5. Power savings and back up

For example in case of a fire, the fire panels which are connected to AHUs shut down by cutting the supply of oxygen, which will help curb the spreading the fire. Additionally fire panels connect to the Public Address system on each floor and can aid in speedy evacuation of the building.

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The fire doors are made of special materials with a fire rating of two hours. Similarly, the BMS (building management systems) manages indoor air quality. The system integrates the indoor environment management and other external sensors to monitor air quality and energy consumption in various sections of the building. There is provision for monitoring and activating alarms, shut down air conditioners, and transmit information to a central console for quicker evacuation in case of a fire. Solar panels on roof top provide standby power.

The right building architecture and building products can help use energy and water efficiently. Not so well planned glass buildings end up consuming high electricity for air conditioning as the glass lets in too much heat. If the design is such that less glass is put on that side of the building which is exposed to sun light, then this can lead to savings in energy cost.

There are glass panels that reflect most of the heat back and provide maximum light inside. These are called as low heat glass panels. There are also sandwich panels that have double insulated glass windows to cut out the heat as well as sound. Solar energy taps the renewable resources but the solar panels need more space. Smaller buildings with 3-5 storey's can install solar panels on roof tops but for high rises this is not a solution. Rain water harvesting is an important component in a green building.

In a project in Gulf, a new technique was introduced whereby there were two walls with a cavity in between. The physical principle used was when hot air which has more moisture than cold air raises the moisture condenses. This water is tapped in the sandwich wall. A system was devised to suck hot air from bottom and run it through a cavity between sandwich walls. As hot air rose it cooled and the moisture condensed into water. This water was collected in little drains at the bottom of the cavity and was used to irrigate the entire landscape of the property.

10.6 MATERIALS FOR GREEN BUILDINGS

Novacem, a British company manufactures cements that actually absorb carbon di oxide during the manufacturing process rather than emitting it. In India, the green issues to be addressed are material availability and equipment required for construction. It is important to know the type of green materials available locally. Some of the Green materials and equipment available in India are:

1. Fly ash cement, fly ash block
2. Recycled aluminium, recycled steel, recycled tiles
3. Bamboo products, Green Roof, Low VOC paints
4. HFC based high efficiency chillers

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10.7 GREEN BUILDING MOVEMENT IN INDIA

The Green Building movement in India was triggered off when CII-Sohrabji Godrej Green Business Centre building in Hyderabad was awarded with the first and the prestigious Platinum rated green building rating in India. Since then, Green Building movement in India has gained tremendous impetus over the years.

As on January 2017, more than 3947 green building projects are coming up with a footprint of over 4.48 billion sq feet. These are registered with the Indian Green Building Council, out of which 960 green building projects are certified and fully functional in India. Today all types of buildings are going the Green way- Government, IT Parks, Offices, Residential, Banks, Airports, Convention Centre, Institutions, Hospitals, Hotels, Factories, SEZs, Townships, Schools, Metros etc. The number of certified green buildings was 212 in 2012. So, just in a matter of five years, the number has swelled. This indicates the importance being given to construction of green buildings. Even 5 star hotels have realized the importance of going green and have combined aesthetic sense with environmental consciousness during construction.

10.8 LEED RATING

It is an internationally acclaimed rating system. LEED stands for **Leadership in Energy and Environmental Design**. It is a popular green building certification program used world wide. It includes a set of rating systems for the design, construction, operation and maintenance of green buildings, homes and neighborhoods that aims to help building owners to be environmentally responsible and use resources efficiently.

The LEED 2009 performance credit system aims to allocate points "based on the potential environmental impacts and human benefits of each credit." These are weighed using the environmental impact categories of the United States Environmental Protection Agency's Tools for the Reduction and Assessment of Chemical and Other Environmental Impacts and the environmental-impact weighting scheme developed by the National Institute of Standards and Technology (NIST).

To participate in LEED 2009, a building must comply with environmental laws and regulations, occupancy scenarios, building permanence and pre-rating completion, site boundaries and area-to-site ratios. Its owner must share data on the building's energy and water use for five years after occupancy (for new construction) or date of certification (for existing buildings).

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Some of the top ranked projects that have got Leed rating under exacting conditions are:

1. CII – Sohrabji Godrej Business Centre, Hyderabad (20,000 sq ft)
2. ITC Green Venture, Gurgaon (170000 sq ft)
3. Grundfos Pumps, Chennai (32000 sq ft)
4. Wipro Technologies, Gurgaon (175000 sq ft)
5. NEG Micon India Pvt Limited , Chennai (18000 sq ft)
6. Olympia Technology, Chennai (1200000 sq ft)
7. Tata Housing Xylem, Bangalore (340490 sq ft)

Mumbai City's proposed iconic Park Hyatt tower is a 301 mt tall, mixed use structure. When it is completed, it will be India's tallest and greenest building. India Tower (previously known as the Park Hyatt Tower; also known as the Dynamix Balwas Tower or DB Tower) is a 126-storey, 700-metre (2,300 ft) super tall skyscraper that began construction in the city of Mumbai, India, in 2010.
Green buildings give a return on investment over a period of 5-7 years. Green buildings in Maharashtra will have 5% extra FSI. All government buildings in Maharashtra will be green. Even plumbing products are being stamped as Green. Green products and technologies are need of the hour to combat issues of energy and global warming. Products that meet the requirements of Green buildings are now available. As regards the LEED rating that has achieved widespread acceptance, Silver is the common level of certification. There are other certifications like LEED gold and LEED Platinum.

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10.9 EXAMPLES OF SUCCESSFUL GREEN BUILDINGS IN INDIA

Christopher Charles, a Pune based architect came up with the idea of office in the garden and the office of Suzlon One Earth is a magnificent structure and one of India's first buildings to be LEED-certified. Suzlon one earth is 100% powered by onsite and offsite renewable sources. The campus has 18 hybrid wind turbines that fulfil 7% of the total energy consumption, the rest of energy demand is met from offsite wind turbines. The structure is designed in a way to ensure maximum daylight exposure thereby reducing artificial lighting consumption. The infrastrutcture within the campus is designed to enable water percolation and thereby control storm water runoff thus, contributing towards an increased water table level.

Rajiv Gandhi International Airport (RGIA), Hyderabad is India's 6th busiest airport, which is situated in the downtown of Hyderabad. It has set a benchmark for the green buildings in India. The structure of the airport is designed in a way so as to consume less water, electricity and conserves natural resources. Within the campus of the airport, there is a green belt of 273 hectares with numerous plants.

CII- Sohrabji Godrej Green Business Centre, Hyderabad is an architectural masterpiece. It has set the world's best example of passive architectural design. The CII-Sohrabji Godrej Green Business Center (GBC) was the was the first building outside of the US to be awarded LEED platinum rating at the time of its inauguration. The buildingdoesn't let out any waste and recycles it all within. It can be said that building is literally made up of only recycled materials.

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Infosys Limited, Mysore is located in the city of palaces. This green building is an awe-inspiring structure is the third Infosys building to win a Platinum rating, taking the total Platinum certified building area at Infosys to 780,000 sq ft. The 5 storey structure has been built keeping in mind a holistic approach to sustainability in five key areas, including – Sustainable site development, Water savings, Energy efficiency, Materials selection and Indoor environmental quality. The smart mechanism and efficient equipments lead to 40% of less energy consumption.

Bank Of India, Goa is another worthy example. A world of eco-friendly lights and air-conditioning, intelligent glazing, modern capsule lifts, and indoor fountains – this is what sums of this popular bank in Goa. The building uses Nano Misty Blue, softening colour glass manufactured by Saint Gobin Glass, India for producing the cool effect and saving energy. The glass has solar control and thermal insulation properties. The building is a complete package of modern look of today's bank.

Biodiversity Conservation India Ltd. (BCIL), Bangalore

In 1994, BCIL was established with an aim of creating eco-friendly living habitats, especially in the urban space. It is a wonderful example of smart homes where one can turn lights off using mobile phones. The building has 44 interconnected rainwater percolation wells that lead to a 400,000 litre water tank. The building makes use of central reverse osmosis system to purify water without the use of chemicals. Grey water is directed to the gardens, toilets and for washing cars.

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10.10 GREEN SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION INDUSTRY – RISKS, CHALLENGES & OPPORTUNITIES

Sustainable development in the construction industry has become a necessity. If one looks at the impact of construction industry on environmental protection, the picture is a dismal one. Rapid economic development boosts the construction sector but also leads to shortage of resources, spiraling costs and environmental pollution. China's economic growth is progressing at a blistering pace. The high speed, large scale construction projects in China are causing a severe drain on China's resources and natural environment. What is needed is harmonious development – development that does not cause harm to society and natural environment (Mingqiang & Zuxu, 2011).

The risks for implementation of green supply chain management practices are as many as the challenges. Let us look at a few of them. One of the major risks in implementing green supply chain management practices in construction sector is the involvement of people in the efforts. The concept of green buildings is encouraging but it has to be emphasized that the process for construction of green buildings must follow the tenets of green supply chain management practices. The concept of lean is popular in manufacturing supply chains. It is also being embraced by a few service supply chains. Adoption of lean can reduce waste and lead to reduction in costs. Risk is that stakeholders may not be equally enthusiastic about green measures because they may feel that it is too an esoteric concept or it may involve cost burden. So educating stakeholders is important to achieve success in greening the construction sector.

Transportation of material like debris needs to be done in an environment friendly manner. This will require a major investment of time by construction sector to educate their logistics service providers and contractors and sub contractors. Safe working practices can also lead to environment protection measures – for example if fire protection measures are stringent in a building complex, the risk of fire accidents is minimized and this will involve less wastage of water.

In India, sand from river bed are stolen and used by construction sector. Such unethical practices have caused a slur on the construction sector's image. Most rivers in India run dry due to depleting sand bases from river beds. Other challenges in implementation of green supply chain management practices include (but are not limited to)

- Workers not following rules or understanding practices
- Resistance to change when it comes to new ways of working
- Greater focus on cost reduction to the detriment of environment protection measures

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- Suppliers not willing to change their procurement policies
- Premiums being charged on eco friendly materials more than what is needed
- Logistics providers flouting pollution control norms
- A well-designed layout of a building marred by poor execution
- Inadequate training provided to building workers
- Information asymmetry between suppliers, vendors, equipment suppliers, contractors, builders and architects.
- Insufficient incentives from Governments

However, adoption of green practices in construction sector can also provide opportunities to improve brand image, enhance productivity, reduce cost and enlist greater support from Government in the form of subsidies and reduced taxes. As awareness about green issues is on an upswing, consumers may become more upbeat about purchasing green properties.

In the long run, the industry will face a challenge in terms of making green buildings more affordable. However this is not impossible if one considers the fact that the law of economies of scale can tilt the scales in their favour. Achieving affordable sustainability needs a complete change in the mindset and a unified approach by all stakeholders to achieve this goal. Green supply chain practices need not be expensive. Even small steps taken in this direction will mean a lot for the future generations.

Quality of construction needs to be improved as part of green supply chain management practices. This will ensure that buildings are durable and healthy for a longer duration. For example – a thrust on green plumbing practices will lead to better hygiene.

10.11 SUMMARY

Bleaching coral reefs, rising global temperature and melting ice caps are posing serious threats to sustainability. Green buildings help in saving the Mother Earth. India is one of the few countries spearheading the green building movement worldwide. The number of LEED certified "green buildings" in India is 1883 earning India 3rd place on the list of countries with the most such buildings. Studies say that by 2030, the Indian building stock is expected to reach 100 billion square feet compared to the existing 25 billion square feet.

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Environmental issues are gaining prominence and there is genuine interest in sustainable practices. Sustainable building features will lead to lower operating costs, improved financial performance and efficiency. A review by Rosenberg real estate equity funds of several cost studies found that Green buildings had average energy costs that were 30% less than those of conventional buildings. The dampeners are:

1. Documentation and cost of LEED certification.
2. Higher construction costs
3. Length of required payback period.

As per the research done by Green building market barometer (Turner construction company) the green buildings lower energy costs by 84%, lower operating costs by 68% and lower total life cycle cost by 59% over a 10 year span. A green building uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants as compared to a conventional building. The Green Homes rating system strikes a balance between known established practices and emerging concepts.

Green supply chain management involves use of technology to green the supply chain and reduce pollution. It involves educating all the stakeholders – suppliers, manufacturers, vendors, users. Recycling becomes an important aspect of greening the supply chain. If we are talking of end to end supply chain, then it is vital to look at green supply chain management with the same lens. For example – logistics plays a crucial role in construction sector and so greening the logistics function must form an important agenda.

Construction industry must make optimal use of natural resources, use processes that are environment friendly and take steps to embrace sustainable development. This will help in reducing the production costs, protect the natural environment and improve organizational performance.

Green supply chain management (GSCM) practices can bring economic benefit and sustainability for business organisations. Operations in construction sector are complex and an integrated approach is the best way to reduce waste and improve environmental performance. Environmental legislation, state regulation, need to protect brand image, need to prevent liabilities and a greater awareness about climate changes among populations across the globe are driving the need for green supply chain management practices. These practices are even more important in construction sector as it can reduce waste and improve productivity.

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GSCM can span the entire gamut of activities in construction sector beginning from purchase of eco friendly matters, adopting green operations and building practices, conservation of water, conservation of energy, developing and implementing a green design, recycling of used materials, setting up a rain water harvesting system, promoting greenery within campuses etc. The construction industry must educate all its stakeholders.

The major stumbling block for GSCM in construction industry is the perception that it can be expensive to embrace/adopt GSCM practices. But it need not be so. Solar lamps may need a massive initial capital outlay but in the long run they can bring down the energy costs by a substantial amount. Rather than felling trees, construction industry must look at ways of enhancing the green quotient in their properties.

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11 EXAMPLES OF GREEN SUPPLY CHAINS

Companies that have begun to successfully integrate environmental management practices within their supply chain include Xerox, Daimler Chrysler and IBM. Xerox's Asset Recycle Management Program successfully diverts 90% of all materials and components for its end-of-life photocopiers through reuse, remanufacturing and recycling.Scrap metal from Daimler Chrysler is returned to steel suppliers and recycled.

Lanxess, Germany's fourth largest specialty chemicals company is working on synthesizing and creating chemicals that will go into manufacturing the next generation of automobile tyres. These green tyres will be made of high-performance butyl rubber and will reduce fuel consumption. At Lanxess, they call the technologies behind the making of these products 'green mobility'.

The Body Shop International, Thai Olefin plant, Sun Ace Kakoh Pte Ltd, Sea gate, Philips Domestic Appliances and Personal Care, Nestle India are some of the prominent examples of companies that have successfully implemented green supply chain management.

11.1 CASE STUDY: MAERSK LINE SHIPPING

Shipping industry is highly polluting and this case is about challenges faced by a shipping company called Maersk Line when it tries to innovate as part of its sustainability strategy. The case gives us a clear perspective about the benefits of innovations by a firm to improve its environmental performance and the demerits and uncertainties associated with such efforts.

Shipping industry is known for its adverse impacts on the environment. Exhaust emissions from the heavy fuel oil powering ship engines are the main pollutants. Though shipping is an efficient form of transportation in terms of tonnage of goods that can be carried and in terms of relative costs of transportation, the sheer size of the industry makes the impact of pollution much more severe.

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This case published by Harvard Business School talks about the problems faced by Maersk Shipping Line company in the post- recession phase in 2009 when the economy went for a tail spin. Increasing fuel costs, increased regulatory control by governments in different nations, intensifying competition, commoditization of shipping services are the main problems plaguing all shipping companies. Maersk tries to create a differentiation in terms of enhancing its environmental performance but is the road taken by them a simple one? The challenges faced by Maersk in their green efforts are described in the case in vivid detail.

Sources of environmental pollution

Use of bunker fuel resulted in greater emissions of Sulfur oxides, nitrous oxides and particulate matter that were harmful to the environment. Reduction of sulfur content needed installation of scrubber equipment or switching to lighter fuel oils which were less polluting but were more costly. Other environmental issues were waste water management and life cycle management of vessels and containers.

IMO & EU: Conflicting objectives

As the shipping business has an international orientation, regulation is a challenge. The International Maritime Organization [IMO] was set up to have broader standards for controlling pollution and look at security and safety aspects of international shipping. To address the green house gas emissions, the IMO proposed to include a carbon tax or levy on fuel. It also initiated certain steps outside the purview of the market to attract the problem of environmental pollution at source. This was in the form of an index called as Energy efficiency design index [EEDI]. This was a complex set of design standards by which there would be a reduction in the engine power. This would act as a speed limit on vessels. This would lead to savings in fuel consumption and hence cost savings too. But these standards attracted criticism because if speed is reduced, then there would be delays and this would necessitate increasing the frequency of the vessels which would add to green house gas emissions. Thus, it is apparent that solving one environmental issue could lead to another.

Thus, there were two objectives that were in conflict with each other. The IMO wanted to reduce sulfur content in fuel and design engines with lesser power to conserve fuel. European Union was talking about reducing green house gas emissions. Engines with lesser power would consume less fuel but more trips will be needed to deliver consignments and this would increase the carbon di oxide emissions. The European Union went to the extent to proclaiming that it would regulate carbon di oxide emissions from shipping.

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Maersk Line

The Maersk group was a conglomerate with interests in shipping, oil and gas, departmental stores, supermarkets and banking. The Group's strong balance sheet gave it access to funding and Maersk Line enjoyed purchasing power because the group purchased items like bunker fuel in huge volumes and so got substantial discounts. There was the research department that shared details of technical innovations that could improve the fuel efficiency of the vessels.

Some facts about Maersk Line

- The first shipping company to use standardized shipping containers as early as the '60s which was emulated by competitors in the following years.
- 2012 – Maersk Line had 17% of the world's operating fleet.
- Vessels made 70000 port calls annually to service over 100,000 customers.
- Greater global coverage.
- Vessels – more modern than that of competitors.
- 50% volumes in long term contracts, others – spot contracts.
- 25% of business was with key clients like Walmart, Nike and Tesco (long term contracts).
- Value added services through logistics services: inland intermodal network and feeder connections to smaller ports not serviced by the large container vessels.

Commoditization in the shipping line business affected Maersk Line's bottom line. But Maersk always felt that price was not the only driver. Customers were also looking at schedule reliability, delivery reliability and other aspects of service while making a purchasing decision.

2012: Creating a competitive edge by differentiation

In 2012, Maersk Line addressed three challenges faced by the industry : unreliability, complexity and absence of focus on environmental issues. The firm believed that by focusing on these aspects, it could create a niche in the market and stand apart from competitors.

Reliability: Maersk Line was the industry leader with 80% on-time delivery and in 2011, it decided to raise the target to 95%. As the track record of the shipping industry was poor, customers lowered their expectations from the shipping companies on the reliability front. When the reliability of a shipping company increases, it is beneficial for customers in terms of having to maintain reduced buffer stock in their supply chains. Maersk was a pioneer on many counts; so it was expected that this initiative of the firm to increase reliability would eventually become an industry standard.

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Simplicity: Information flow in the shipping industry was needed to process orders, clear customs and track the cargo. To reduce the excessive paperwork involved, Maersk decided to digitize the process. This allowed customers to easily order and follow their cargo online. Customers would be automatically notified about delays. This allowed Maersk to greatly enhance its levels of customer service.

Maersk's efforts in improving sustainability

The Maersk group launched its sustainability strategy in 2008 with the intent of making it a key driver for improving business profitability. The four themes as part of the strategy were: health and safety, social responsibility and responsible business practices.

Maersk Line's three environmental goals:

1. To become the global leader in low-carbon shipping
2. To take the company and the industry towards zero Sulphur oxide emissions.
3. To reduce the impact on the marine environment.

The company believed that by integrating the strategy across the Group they would succeed in de-commoditization of the business, create a competitive edge in the market and charge higher price premiums. The expectation was that environmental performance of an organisation would eventually become an order qualifier for a customer to place the orders. This would lead to growth of Maersk Line's business.

Slow steaming initiative

In 2007, Maersk Line was the first operator to introduce slow steaming where vessels sailed at less than the full engine load. Thereafter this became an industry standard. Maersk Line also shared its technical learnings with all the players in the industry.

Slow steaming reduced carbon di oxide emissions and fuel consumption. It also provided scope for absorbing spare vessel capacity. This also increased reliability of service. But the drawback was that slow steaming involved costs of additional vessels that were added to maintain departure schedules. It also increased shipping time. Maersk made attempts to overcome this problem by reducing in-port time and decreasing port calls on certain trade routes.

But the challenge was – how would this strategy sustain once container demand pucked up or if fuel prices fell or if competition began to ship at normal speeds again to improve speed of delivery.

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Other efforts by Maersk Line

The company optimized operations by providing data that would help captains adjust speeds and routes and providing fuel consumption benchmarks for the ship crew to follow. Fuel efficiency was linked to the compensation of the ship captains. Though low sulphur fuel was expensive, the company initiated steps to procure it and in the long term drive the industry towards zero sulphur emissions. The Hong Kong port eventually took a cue from the efforts of Maersk Line and made the fuel switch from high sulphur to low sulphur fuel mandatory.

The company also took steps to install chemical free water technology across 100% of its own fleet and dispose waste in a safe manner. It had tie ups with research institutions to stimulate marine research efforts.

To further demonstrate their commitment to the sustainability strategy, Maersk Line improved the technical design of shipping vessels such that the vessels were designed with their end-of-life in mind. These vessels reduced carbon di oxide emissions and enhanced fuel efficiency. These vessels had a large capacity. But the problem was that these large vessels would stretch the capacity of the terminals. For example – India's sea ports could not handle such vessels and that was a limitation.

If the entire industry started investing in such large vessels without a proper due diligence it could be a significant risk. The company planned for technological retrofitting of its existing fleet to reduce energy consumption and carbon di oxide emissions. Even they sought to scrap their vessels in an environmentally responsible manner though at most times it resulted in losses for the firm. Maersk Line started doing trial tests using biofuels again as part of their commitment towards sustainability strategy. It was the only shipping company to have done so.

It was clear to Maersk Line that in the future customers would assign greater weight age to environmental performance of the shipping companies while selecting them. So, in a sense, Maersk Line was doing the right thing. Companies like Unilever added environmental performance of their suppliers as one of the important criteria in the supplier performance score card. Sensing that educating customers about their green efforts was important, Maersk Line started telling customers how their carbon foot print was improving year on year and how customers could demand the same from other carriers. To cite a cliché, Maersk Line was looking at one more industry standard.

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But the challenge was that during times of economic recession when companies were worried about bottomlines, the sustainability efforts get relegated to the side lines. Though the company's sustainability efforts helped the company save fuel and money, it wasn't really able to create a unique niche for itself. Either competitors followed their strategy or information asymmetry between customers and shipping firms diluted Maersk Line's green efforts.

The important question that stared at Maersk Line was: Can the firm's sustainability agenda translate into greater share of business by creating a unique differentiation in the market? Was the company's integrated focus on sustainability really their core competence?

The Final Word

This case is interesting because it has presented the challenges faced by a contemporary business firm in attempting to incorporate sustainability as part of their business agenda. Maersk Line has done all that was possible to make its integrated sustainability focus its core competence but at the same time, the company has faced many challenges on this front.

The important lessons that were learnt from this case are delineated below:

1. Shipping industry though cheaper and efficient also has the reputation of being most polluting.
2. Maersk Line got benefits because it was part of a conglomerate group that led to cost advantages.
3. Maersk Line has been the pioneer in the market when it comes to innovations aimed at improving the environmental performance in the market,
4. The strength of Maersk Line in implementing the innovations has been derived because it is part of a conglomerate.
5. At times, there is ambivalence about Maersk Line's intentions. On one hand, Maersk Line wants to decommoditize the shipping line business. On the other hand, it wants to work towards creating an industry benchmark with every innovation undertaken by it. These two goals seem to be conflicting with each other.
6. The case is also a vivid reminder that implementation of green efforts is riddled with complexity and can be nettlesome. Bottlenecks can hobble the implementation efforts. Solving one environmental problem could lead to the creation of another problem. For instance, Maersk wanted to reduce sulfur emissions by modifying engine design. But there was concern that this would lead to increased vessel trips which would increase the green house gas emissions.
7. During recessionary times, the sustainability agenda takes a beating and companies deflect their attention towards improving their bottomline.

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8. The case proves that intelligent innovations that are focused on improving levels of customer service can also be rewarding to an organisation. But the progress can be hampered by information asymmetry between the business that is steering the innovations and the customers.
9. Consistent below average performance by a business will lead a customer to lower his expectations and reduce the threshold benchmark itself – especially when it is viewed as an industry trend.
10. Finally, the goals of an individual company to take mileage out of their environmental efforts (creating a niche in the market) and goals of the entire industry to reduce the adverse impacts of their actions on the environment can be at loggerheads with each other.

11.2 CASE STUDY: THERMAX INDIA

Thermax India is a company based in Pune, India. The company had diversified extensively and in 1998 their business was hit by slowdown. Based on an angry letter from a shareholder, Anu Aga who was at the helm of this engineering company decided to rejig the business. The company decided to exit all non-core businesses. They decided to focus on what they knew the best. In about 12 years, the company's turnover increased from INR 500 crores to INR 6000 crores. Thermax decided to focus on the energy and environment segments. Even during tough times, the company chose to continue with their efforts to fuel the innovation drive that they had initiated. The company was in the capital goods business and during a slowdown, doing business was definitely a risky proposition. The company then set a target – by 2015, it wanted 30% of its total turnover to come from international markets and 15% from services. Company is now on track in delivering this goal.

In their international business efforts, Thermax chose "selective internationalization". This meant that Thermax would look only at certain key markets. The company started focusing on China, South East Asia, Middle East, South America and Africa. The company had to consider the negative impact on the environment in these markets as energy consumption increased. As a global player in the sustainability business, Thermax believes in practicing what it preaches. The headquarters of Thermax in Pune is a LEED certified green building and the company has increased its efforts to develop alternative sources of energy as part of its portfolio. For example, Thermax uses tea and coffee grounds along with coconut husks as supplementary fuel at a dairy in South East Asia. Such green efforts have really helped Thermax grow its business.

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12 THE FUTURE OF GREEN SUPPLY CHAINS

Green Supply Chain Management (GSCM) is an emerging discipline where research has commenced only around the mid 90's. Though the literature survey reveals that a lot of areas in GSCM have been researched, there is ample scope for future research to address the unanswered research questions. At present there is more focus in the following areas of GSCM – correlation between different functions and GSCM, performance measurement of GSCM, embedding environmental strategy in manufacturing strategy, selection of green suppliers as part of green purchasing, linking organizational theories with GSCM to explain how the concept can find greater acceptance by management and other stakeholders. There is lot of focus also on Reverse Logistics.

Despite many research papers on performance management of GSCM, there is no clear cut standard emerging that can be applied across industries. The elements of performance measurement are ambiguous. The use of information technology, data sharing, managing the information asymmetry are other areas for future research.

The synergies between Lean manufacturing and GSCM, ISO 14000 standards and GSCM are being explored. However, there is a need to manage the conflicts between Lean and Green and so a suitable mechanism for trade-off has to be worked out.

Environmentalism has been characterized as one of the most significant forces shaping the economy and an important issue in contemporary business management. Environmental impact of business activities has become a key issue due to growing public awareness of environmental conservation, increasing need for sustainable development and introduction of environmental legislations and regulations in developed countries. For countries like China and India that are becoming global manufacturing hubs, greening the business has become even more necessary than before.

Awareness about environment and the issues surrounding it is growing globally. Global corporations and multi national corporations are becoming more vigilant around these issues. General Motors, Toyota, Walmart, Xerox, Sony, IBM, Dell, HP have started procuring products from suppliers that do not contain any substance that is prohibited by law (Agrawal 2010, p. 341). A wave of green supply chain is being created because downstream suppliers are persuading upstream suppliers to go green.

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Sustainability has replaced cost, value and speed as the dominant topic of discussion among purchasing and supply professionals. Rising fuel prices and globalization are challenges for an efficient, streamlined supply chain. More agility in supply chains will lead to better response to customer demand. Future supply chains have to be designed from the customer backwards.

Though green supply chain management has gained momentum in the last few years, there was traction in this area as early as the 1990s. General Motors started its green supply chain efforts in the '90s. GM created a supplier advisory board that included a select group of Tier 1 suppliers. GM lacked resources to visit all its suppliers and conduct on-site workshops. It began working with the Environmental Protection Agency to form a nonprofit organization that helps automotive equipment manufacturers engage all levels of their supply chains in the development of common sense approaches to reduce environmental impact. GM also identifies activities that can support its suppliers to become environment friendly. The approach is more collaborative.

The smaller suppliers welcomed this exposure that could make their business more sustainable. These efforts also resulted in savings of billions of dollars. Some of GM's suppliers were able to reduce their consumption of hazardous chemicals and also reduce the generation of solid waste. A green suppliers network has been created. This means that such efforts can be extrapolated to include other industries besides automotive.

Green supply chain management concept falls into the following buckets

a) Design of products
b) Sourcing of materials (in bound logistics)
c) Manufacturing
d) Delivery of final product to customers (out bound logistics)
e) End of life management of the product after its useful life

The future of green supply chains indeed looks promising. Green supply chain combines environmental aspects in value creation. It is not just about complying with the environment. Firms have now been forced to look at green supply chains as a collaborative way of doing business that can also generate revenue. It is not considered a liability where a business has to comply with the regulations or the law of the land. Companies are now realizing that enhancement of productivity, improving supplier relations, driving innovation, adopting technology, waste management, recycling – all these need not run as parallel tracks. These efforts can be integrated under the umbrella of green supply chain management.

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Growing levels of awareness and deeper penetration of Internet has made community issues far more relevant than they were before. Hindustan Lever was forced to stop its production when there was a revolt against mercury contamination of natural river water sources in Kodaikanal, Tamil Nadu, India. Coke has faced immense resistance from local communities in Kerala and Rajasthan when its manufacturing activities resulted in depletion of ground water tables. So, no firm can take the local communities where its business operates for granted.

Serendipity has worked wonders for business firms when they attempted to innovate and in the process realized that innovation excellence has made them greener. Green supply chain programs have motivated employees, enhanced the quality of life and sustainability of environmental efforts. There is a greater alignment of business policies with environmental efforts.

Fig. 12.2 Different approaches to green supply chain management

And these problems can be a plethora of items including a level of uncertainty regarding: **market position, stakeholders concerns,** and **change.**

But briefly lets examine firms as far downstream the value chain as we can go.

Manufacturers and suppliers will fear that by operating along green supply chain practices they could become too expensive compared to their competition (Lo, 2014). Consider a market where there are 5 firms producing aluminum, if you choose to implement a closed-loop supply chain to reduce waste and create re-manufactured products, you might out price yourself compared to your competition.

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Downstream firms aren't the only firms that feel uncertainty towards implementing a green supply chain management strategy. Upstream firms such as retailers might fear they can over price their products and consumers will no longer be interested in purchasing.

Although there is definitely a better chance of implementing green supply chain practices with consumer facing firms due to an increasing importance in eco-friendly practices.

Yet out-pricing yourself isn't the only uncertain aspect consumer-facing firms can face. Supply chain managers also need to consider uncertainty towards change as well as uncertainty towards stakeholder positions.

\The likelihood of implementing green supply chains can be diminished when employees running the supply chain are adverse to change. For example, perhaps they've been using paper purchasing processes and they're only comfortable faxing invoices between departments.

Although the firm can easily save money by installing an e-procurement software to reduce paper waste and increase purchase tracking; the firm cannot easily continue with e-procurement software because employees can be intimidated by change.

There are also issues of stakeholder positions. In some cases, stakeholders are only interested in improving profits and that would mean vying away from more expensive green supply chain practices. However this could work in the favor of a supply chain manager if a stakeholder is adamant about eco-friendly practices.

There are tons of issues to discuss regarding implementing a green supply chain management strategy. There are also quite a few benefits of implementing green supply chain management strategy.

The most immediate benefit that should be considered when evaluating the implementation of green practices involves reducing waste. A common example within supply chain literature involves food processing.

Consider bread. Well there are multiple steps that are required towards retailing a loaf of bread. Well with a closed supply chain loop, the wasted grains/bran/damaged bread/etc. can be re-manufactured into other products. For example, the bran that results while producing flour is often re-used for bran-based products. Or the damaged bread can be retailed as animal feed. The steps in a closed loop supply chain add value by increasing possible revenue streams, but it does also add costs.

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Green supply chains will continue to grow in importance. The best possible outcome is one where all supply chains can reduce waste, improve profits, and become more eco-friendly. There is evidence that green supply chain practices can create the aforementioned outcomes. However without properly evaluating all possible outcomes, implementing green practices can lead to disaster.

Critical Issues in Greening the Supply Chain

The more corporations around the globe focus on sustainability, the more they realize that their greatest challenges and opportunities often lie outside their own offices and manufacturing plants. To make a truly significant lifecycle leap, large companies have to work on greening their supply chains.

Underlying the relatively easy steps some companies are taking to green their supply chains are a few core principles. These best practices can accomplish a great deal of good for the environment in the near term. But, sooner rather than later, executives will have to look beyond the low-hanging fruit and find long-term solutions to make companies truly sustainable.

For some companies, it's easier to write an optimistic sustainability report than it is to thoroughly green its operations and those of its suppliers. Obstacles include consumer unwillingness to pay a premium for environmentally friendly products, the complexity of modern supply chains and the huge capital investment often required. But increasingly, strong regulation, real opportunities to save money by reducing waste and the need to maintain a positive brand image are pushing corporations to thoroughly revamp their operations.

The Greening of Supply Chain Information Systems

Many of the largest and best global corporations are still using spreadsheets to handle environmental data. To make their supply chains truly sustainable, companies need information systems that merge environmental and economic data, and make the results available to all stakeholders within and outside the company. The challenge is daunting, but progress is being made on many fronts.

Greening the Supply Chain: Driving Transportation Reform

Transportation is only an estimated 4% of the global supply chain, but it's one of the ripest areas for reform. Combining trips, switching to alternative fuels and fuel-efficient shipping, reducing wasteful product returns, and reusing material rather than sending it to landfills are just a few of the options available. Savvy companies are setting ambitious energy use and greenhouse gas reduction targets.

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To summarise

No company can afford to ignore environmental issues more so as these are related to their licence to operate. Businesses can't switch on the sustainability light just because competitors are doing it. Today consumers are demanding their pound of flesh in terms of sustainability efforts by organizations. Green issues will become hygiene factors in the days to come.

The Indian Government has introduced Corporate Social Responsibility (CSR) as a compulsory agenda for large enterprises (who meet certain criteria in terms of turnover or profits) in the Companies Act, 2013. Environmental efforts of organizations cannot afford to be mere rhetoric. They have to be supplemented by action. Generic approaches to environmental management are not enough. Sustainability strategies have to be firmly entrenched in the business model. If a firm's green strategies are not aligned with the overall business strategies, precious resources can be wasted.

It is important for organizations to prioritize activities so that green efforts can be profitable for the bottom line. A company can have a plethora of options to choose from and these may also need investments. It is essential that the right choices are made in line with the company's overall strategy.

Renato J Orsato, Senior Research Fellow at INSEAD offers four competitive green strategies. This can help managers optimize their economic return on investments. These strategies are delineated below:

- Eco efficiency
- Beyond compliance leadership
- Eco-branding
- Environmental cost leadership

The eco-efficiency strategy is about doing more with less/ and lower environmental impact. This kind of lean thinking can lead to break through innovations and efficient resource utilization. Companies have to go beyond what compliance dictates. They have to do much more than what their competitors are doing. This is termed as 'beyond compliance' leadership. Eco-branding is all about sourcing a point of differentiation based on ecological characteristics of certain products. Environmental cost leadership is all about selling products with good environmental performance but also having a competitive pricing strategy. These strategies can work independently of each other. Very few companies have been able to link the environmental qualities of their products with their processes, resulting in a corporate-wide eco-differentiation. Some companies have become so pervasive in their approach that green has become part of their core brand values. It would be a good idea to link a firm's core competency with the green efforts.

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If an automotive company wants to implement ISO 14001 it is a good strategy as all car makers are doing it. But the question to be asked is – Is this enough? A true breakthrough can happen when companies innovate to create a unique offer for their customers at a price that is far lower than their competitors. This calls for a different way of thinking.

There was a time when any discussion about sustainability or green supply chains was linked with increased cost and loss of efficiency. But now there are opportunities to green your supply chain at lower cost. Green is not about recycling and disposal. P&G and Walmart decided to reduce the size of plastic bottles used for liquid detergent by reducing the water content of the liquid to make it more concentrated. Customers resisted at first. They thought that the same price was being charged for less product. But P&G was able to convince customers that they would achieve the same results with 50% less of the liquid detergent. So in a sense the value proposition to the customers had increased. The impact was dramatic.

Transportation is frequently a critical part of a sustainability effort since it has the potential of leaving such a large carbon footprint. Various transportation strategies that are both cost efficient and ecologically sound can be used to mitigate this challenge.

SUSTAINABILITY IS BECOMING AN IMPORTANT DRIVER OF BUSINESS AGENDA.

THERE IS NEED FOR BREAK-THROUGH INNOVATIVE APPROACH TO SUSTAIN GREEN EFFORTS SO THAT THEY CAN CREATE ECONOMIC ADVANTAGES FOR THE BUSINESS.

BUSINESSES ARE REALISING THAT GREEN EFFORTS CAN LEAD TO GREATER REWARDS FOR BUSINESS IN THE LONG RUN.

FIRMS HAVE TO MAKE THE RIGHT CHOICE WHILE INVESTING IN GREEN EFFORTS.

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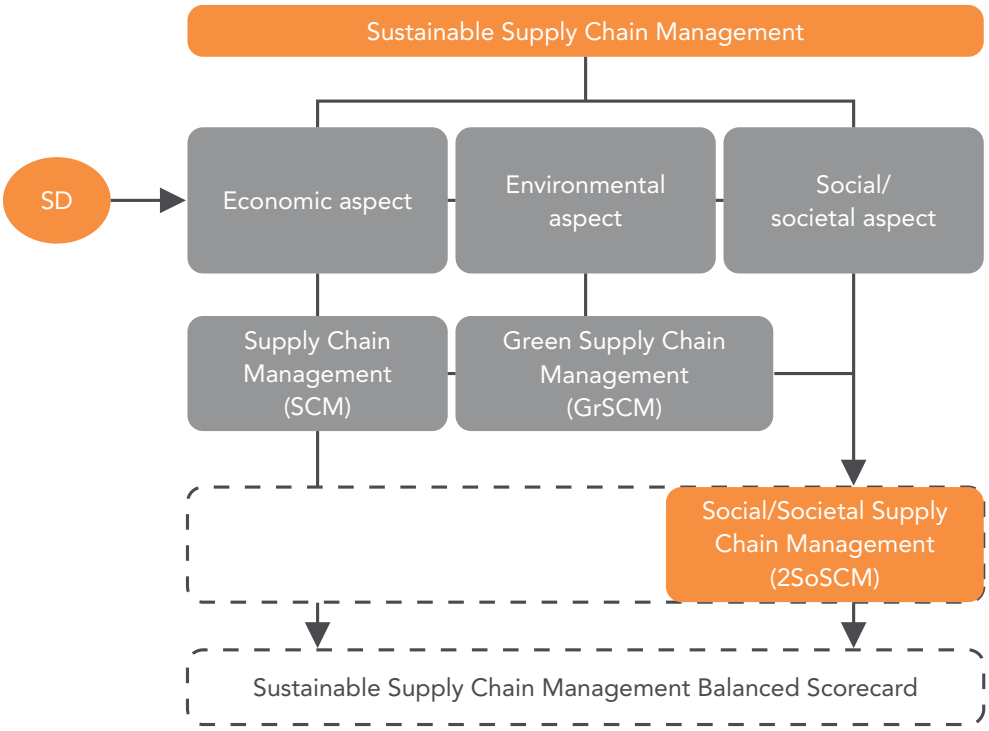

Figure: Components of sustainable supply chain management: Adapted from the book: Sustainable supply chain management by Joelle Morana (Wiley publications, 2013)

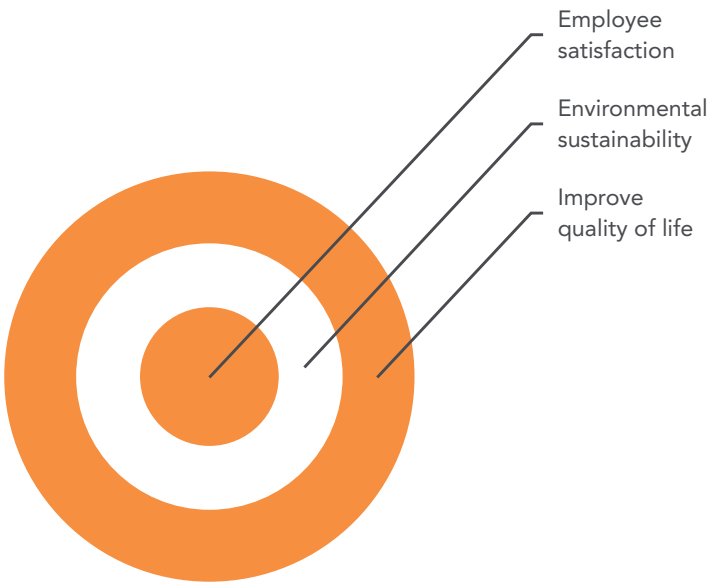

Fig. 12.1 Green Supply Chain Programmes

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Future of Green Supply Chains

It is important to identify the relation between a company's core competences and its long term sustainability. Future research could reflect on green supply chains and sustainability from a Resource based view (RBV) – how firms with valuable, rare, inimitable and non substitutable resources have a greater potential for achievement of sustainability.

Absorptive capacity is the firm's ability to recognize the value of new information, assimilate it and apply it to commercial ends. To be innovative, an organization has to develop its absorptive capacity. It can be interesting to correlate a firm's absorptive capacity with success in implementing green supply chain management practices.

More research is needed for greening along the entire supply chain. Greening the different phases of supply chain will lead to an integrated green supply chain leading to improved economic performance. A demonstrable link between GSCM and economic performance and competitiveness is necessary. Green supply chain management has to be proactive strategic approach instead of a reactive regulatory approach.

Green sustainable supply chain defined as the process of using environmental friendly inputs and transforming the inputs through change agents – whose by products can improve or be recycled within the existing environment. Sustainability can be a competitive advantage. How to include suppliers in the GSCM agenda in a way which can increase the firm's competitive advantage and also improve operational, economic, environmental performance will continue to a challenge in the future.

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ENDNOTES

1. Environmental management system.

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