

# Sustainable Supply Chain Management: Application areas and practices

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## Agenda

- Green procurement and supplier collaboration
- Green and reverse logistics
- Global and multitier relationships

## **Green purchasing**

Green purchasing is defined as an environmentally friendly initiative that enables the purchased products/materials to meet the environmental requirements of the buying firm.

The environmental requirements may include the reduction of waste emissions and resource consumption.

The aim of green purchasing is to minimize the harmful environmental impacts over a product's whole life cycle of manufacturing, transportation, use, reuse, recycling, remanufacturing, and disposal.

With consumers' environmental awareness, increasingly buying firms have integrated environmental aspects alongside traditional business and organizational dimensions, such as cost, quality, delivery, technology, and culture, when making procurement decisions.

Sustainable purchasing takes into account also the social responsibility aspects such as workers conditions and rights.

## **Drivers for Green Purchasing**

Internal drivers:

1) Top management support: top management support has been frequently viewed as a significant driver in environmental programs often in line with founder's ideals and views; 2) Middle managers' support: middle managers are key actors in any important projects, and they normally are familiar with the operational issues of the buying companies; the ideas and conceptions of middle managers can influence buyers to adopt green purchasing strategies; 3) Employees' support: employees are often the initiators of proactive environmental.

External drivers:

There are three main clusters of external pressures: (1) regulatory pressures by government; (2) industrial norms often set by industrial professional organizations; and (3) benchmarking and competitor analysis in the same or similar industries.

## Green Purchasing Strategies

There are two basic green purchasing strategies:

*Source reduction*, referring to recycling (on-site and off-site), reuse, and source changes and control;

*Waste elimination*, referring to biodegrading, scrapping or dumping, and nontoxic incineration.

Green purchasing strategies can be grouped into two categories:

*Monitoring strategies (reactive)*, referring to the monitoring of supplier's environmental compliance (products and processes), such as environmental product labeling and environmental audits.

*Collaboration strategies (proactive)*, referring to joint efforts with suppliers to improve suppliers' environmental performance, including the joint development of cleaner product processes and ecological products, to influence legislation in cooperation with suppliers

These strategies require long-term strategic engagement, including: early involvement by the supplier and customer, building trust, incorporating linkages among levels of management and functions, early involvement of suppliers in the design of product and process, joint teams and problem solving, and a focus on value rather than cost.

## Green Purchasing Strategies



## Green Purchasing Monitoring Strategies

- **Product Stewardship:**  
Buying companies take responsibility for reducing the negative environmental impact of products at all stages of the life cycle, involving the suppliers in waste management and in resource consumption reduction throughout the whole supply chain, often through LCA and eco-design.
- **Supplier Collaboration in Design:**  
Suppliers are incorporated into the design of new products/processes so to reduce the quantity of supplied components, control the cost of green products, and avoid problems dealing with the green image they uphold. However not all suppliers will be willing to incorporate new strategies into their current production. Industrial environmental standards.

## Green Purchasing Monitoring Strategies

- **Educating Suppliers on Environmental Issues:**  
Buying companies educate and train suppliers about the environmental issues in order to improve suppliers' environmental performance. This includes learning how to elicit economic benefits from improved environmental performance.
- **Joint Development of Clean Production with Suppliers:**  
Buying companies can help suppliers to improve suppliers' production efficiency and to reduce resource consumption and waste emissions. The joint development of clean production programs with suppliers calls for buying firms and suppliers to implement a broad range of activities, including joint environmental summits for both parties to share environmental and technical skills and know-how, along with joint applied research to explore alternative clean technologies and processes.
- **Influencing Legislation in Cooperation with Suppliers**  
Buying companies can cooperate with suppliers to influence governmental regulations by setting industrial environmental standards.

## Green Purchasing and Performance Measurement

It is difficult to measure green purchasing performance because complex interorganizational issues need to be considered, often dealing with nonstandardized data, poor technological integration, geographical and cultural differences. It requires a structured approach



## Green Purchasing and Performance Measurement

- Step 1: Establishment of a Green Purchasing Project Team

Suitable managers and employees, from different departments within the buying company, who are responsible for green purchasing performance measurement should be assigned. The departments may include purchasing, environmental protection, production, and R&D. Departments in supplier organizations may also be considered for further validation and acceptance of the measures and metrics developed at later stages.

- Step 2: Well Balanced Performance Measurement Goals Determined

The level and diversity of performance measures are heavily impacted by the goal of an organization. Both qualitative and quantitative objectives should be simultaneously considered. A time frame needs to be determined when planning goal achievement. The performance goals may be part of a cooperative agreement between a buyer and supplier. The balance should include at least environmental and economic dimensions. Social dimensions may be added if the broader sustainability aspects are to be considered.

## **Green Purchasing and Performance Measurement**

- **Step 3: Determination of Methods and Tools for Performance Measurement**

The determination of tools may impact the metrics selected since various supporting tools may be able to incorporate different metrics. For example, tangible, easy to measure metrics may be more appropriate for some financial and economic models, whereas integrating qualitative metrics becomes more difficult. Tools might be specific to green such as the vendor profile analysis (VPA) or be more general, such as the balanced scorecard (BSC) that considers organizational performance from four perspectives: customers, internal efficiency (process), innovation and learning activities (learning and growth), and the financial perspective.

## **Green Purchasing and Performance Measurement**

- **Step 4: Development of Environmental Performance Indicators:**

The choice of metrics relies on the environmental strategy of a buyer's organization. For example, buyers with a reactive environmental strategy may pay attention to whether suppliers comply with environmental regulations, and the amount of regulated emissions or hazardous wastes disposal would be critical performance indicators. Buyers with a proactive environmental strategy may not only focus on suppliers' performance indicators for regulation compliance but also require suppliers to provide detailed information related to the greenness of products and processes.

- **Step 5: Developing a Green Purchasing Performance Measurement System**

Regular reviews of the measurement system should be conducted, and any necessary adaption and adjustments should be made swiftly. A performance measurement system may be automated but can only focus on a series of activities that relate to organizational policy and strategy.

## Defining Green Supplier Development

Green supplier development can be defined as collaborative efforts by a buyer to help suppliers reduce their negative environmental impact and improve their environmental performance.

Supplier development is regarded as a long-term cooperative effort by a buying company to increase its suppliers' capabilities and performance. Many suppliers in developing countries, where a very large percentage of suppliers exist, have very limited resources or technological capabilities to address environmental problems.

Green supplier development and collaborative practices have a positive impact on improving environmental performance as:

- green supplier development can promote buyers and suppliers working together and establish better relationships among the partners;
- green supplier development can help buyers and suppliers understand the strengths and weakness of both parties.

## Green Supplier Development Practices

Green supplier development practices includes:

- Management and Organizational Practices:**

Management and organizational practices focus on nontechnical, less investment-oriented activities that emphasize managerial practices and processes. The focus is on setting up and supporting organizational and managerial structures to aid in green supplier development.

- Green Knowledge Transfer and Communication**

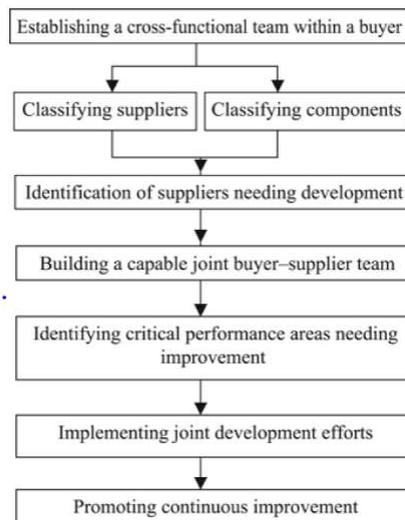
Access to knowledge and expertise is lacking among many suppliers, especially smaller suppliers. Larger and resource-rich suppliers who have gained knowledge and expertise related to environmental issues may be able to share this with other suppliers. The knowledge may be specific to a particular product or asset of the buying firm, or it may be more general.

## Green Supplier Development Practices

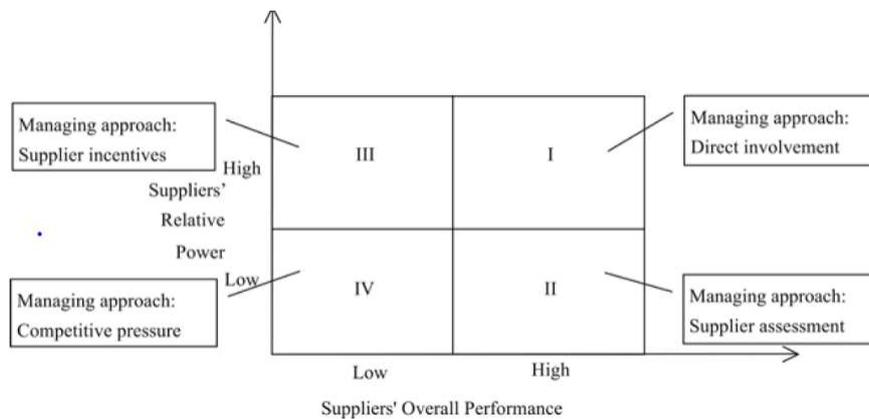
- **Investment and Resource Transfer**

Sharing financial and capital resources make the largest portion of these types of supplier development. By investing in suppliers and other stakeholder social and environmental initiatives, organizations are making an investment that has economic payoffs. That includes various types of investments—not only direct investments in supplier activities but also paying premiums for exceptional products that are environmentally sound and have high quality.

## Green Supplier Development Process model



## Supplier Classification Model



## Suppliers' relative power

In a buyer–supplier relationship, the dominance of a powerful buyer often has important implications for green programs because of their influence on suppliers. A different situation characterizes the opposite situation.

The main buyer dependence factors are:

- logistical indispensability,
- need for supplier's technological expertise,
- availability of alternative suppliers,
- buyer's switching cost.

The main supplier dependence factors are :

- financial magnitude,
- need for buyer's technological expertise,
- availability of alternative buyers,
- supplier's switching cost.

## Suppliers' overall performance

Suppliers' overall performance considers operational and environmental criteria.

Positive environmental performance does not mean simultaneous positive economic and operational performance and vice versa.

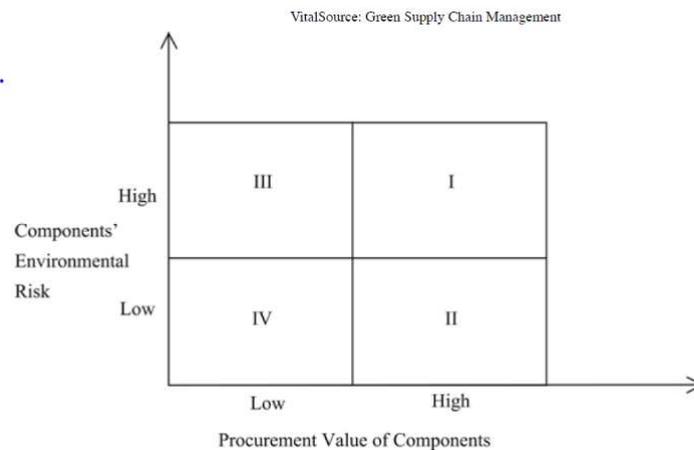
Supplier's environmental performance needs to be balanced with the other factors.

Since the economic and environmental criteria may be numerous, knockout (KO) criteria (criteria that must absolutely be met in the eyes of buyers) can be involved in the overall performance evaluation process.

## Implementing Joint Development Efforts

- Quadrant I: *direct involvement*, maintaining long-term partnerships with suppliers and providing them with the necessary favorable conditions and resource support.
- Quadrant II: *supplier assessment*, evaluating suppliers' specific performance and capabilities and providing feedback to them.
- Quadrant III: *providing incentives*, motivating them with increased volumes or with a preferred supplier status. In case suppliers do not collaborate, buyers may cultivate substitutes or internalize the production, especially in case of single sourcing.
- Quadrant IV: *competitive pressure*, cutting out problematic suppliers, while recruiting suppliers with qualified environmental performance.

## Components classification model



## Classifying Purchased Components

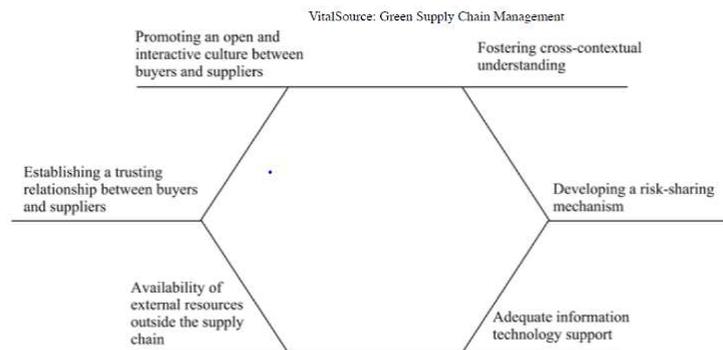
A matrix method, similar to the method of classifying suppliers, can also be applied in clustering and classifying purchased components.

The established cross-functional team is responsible for assessing current purchased goods and components based on environmental risk and procurement value.

The determination of environmental risks should include concerns for ethics codes, investors, NGOs, local governments, and the community.

Components, having high environmental risks and high procurement value, should be given special attention and can be identified as potential improvement areas.

## Enablers of green Supplier Development



## Enablers for Implementing Green Supplier Development

**Promoting an Open and Interactive Culture Between Buyers and Suppliers:** buyers and suppliers often have different understandings of environmental issues when seeking to implement a green supplier development practice. The establishment of an open and interactive culture between buyers and suppliers helps to reach a common understanding of supplier improvement goals and to exchange the necessary information to frontline employees in both parties.

**Fostering Cross-Contextual Understanding:** buyers may arrange employees with cross-contextual knowledge and skills to participate in a GSDP in order to facilitate a better understanding of the cultural, social, political, and economic circumstances of suppliers in foreign countries. A better cross-contextual understanding on the part of the two parties can achieve minimal communication bias and greatly enable the implementation of GSDPs.

## Enablers for Implementing Green Supplier Development

***Establishing a Trusting Relationship Between Buyers and Suppliers:*** trust can lead to more knowledge exchange and interfirm learning between buyers and suppliers because trust creates a belief that information sharing increases not only the size of the pie but also everyone's share of it. Trust-relationship-building activities should occur before investing in supplier development practices. Trust based on goodwill can increase the chances of effective interfirm learning by encouraging a higher level of involvement, open commitment, and a reduction of the risk of exploitation.

***Developing a Risk-Sharing Mechanism:*** small suppliers are risk averse since a failure of a GSDP may cause financial loss that small suppliers cannot tolerate. Buyer needs to provide some guarantee that the suppliers' costs in the green program can be paid off. The suppliers' increased cost of improving environmental performance should be allowed to be passed on as the price of components/materials increases.

## Enablers for Implementing Green Supplier Development

***Adequate Information Technology Support:*** through information technology the buyer can achieve more information exchange, more efficient coordination, and increased responsiveness. Information technology (e.g., request for quotation [RFQ], electronic transmission of purchase orders, electronic transmission of advanced shipment notification, electronic notification of changes) can promote information transparency and enhance the collaboration level between two parties. electronic data interchange (EDI) have been identified to have significant impacts on buyer.

***Availability of External Resources Outside the Supply Chain:*** small and medium-sized suppliers normally do not have enough capabilities of meeting buyers' environmental requirements. In many cases, the role of external resources outside the supply chain is essential. Support from several public- and private-sector sources is key in order to improve their environmental capabilities. External resources such as governments, academic institutions, and universities can play a significant role in enabling a green supplier development practice

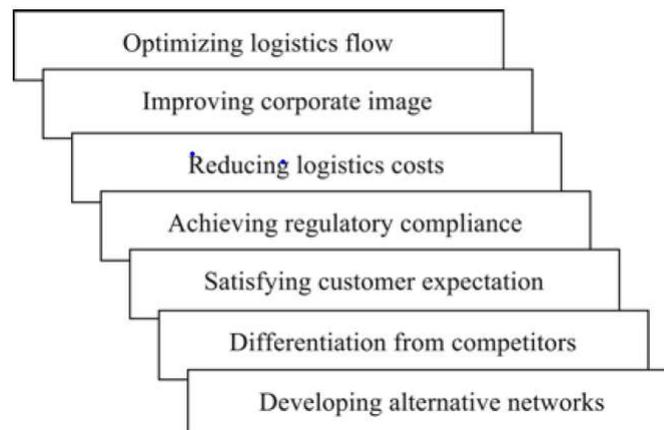
## Green Logistics

Green logistics is an “environmentally responsible logistics”. Its activities involve the delivery of materials/parts, the parts/materials inventory, the primary products inventory, the distribution of primary products, and the sale of products to customers along the supply chain.

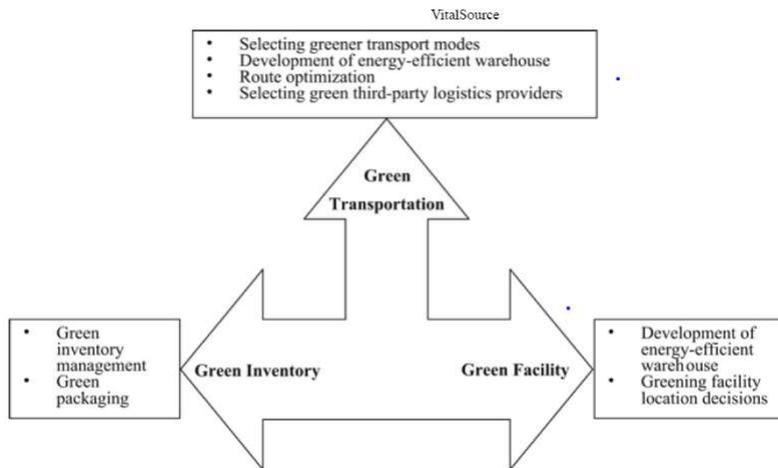
Due to packaging’s influence on logistics management, dealing with packaging is considered part of the green logistics tasks.

Spare parts may also be an issue for greening logistics activities, and their greater uncertainty in demand makes it more difficult to manage them efficiently and in an environmentally sound way.

## Main drivers of green logistics



## Green transportation and logistics practices



## Attributes for green transport modes evaluation and selection

Categories	Attributes
Economic characteristics	Price, maintenance cost, running cost, driving range, traffic safety, loading capacity, information technology
Governmental policies	Compliance with energy-based government regulations, compliance with emission-based government requirements, the use of hazardous substances (RoHS), the use of volatile organic compounds (VOCs), government subsidies or incentives for greener equipment
Pollution emissions	GHG emissions rate, noise pollution rate, solid or water waste generation, other air pollutants (e.g. NO <sub>x</sub> , VOCs, CO, particulates, toxics)
Energy and resources	Fossil fuel usage rate, renewable energy use, energy saving
Infrastructure	Market availability of the mode, availability of fuels, availability of fuel delivery outlets
Recycling	Compliance with WEEE, recycling costs, recyclability rate, dismantling and reuse possibility, recycled materials usage

Source: Adapted from Bai et al. (2015).

## **Environmental Benefits of Blockchain Technology**

Blockchain information can be used to trace the movement of products in the value chain.

Proof of distance travelled and the mode of transportation used can be embedded in the data associated with a particular product or material. This movement and the type of transportation used can be used to evaluate such factors as the carbon footprint of the transported item.

The information is also verified and certified, and it can occur at any of the points along the supply chain. The circular aspect of the green supply chain can help in the logistics of the material throughout its life cycle even after usage.

Knowing where products are and knowing their characteristics can help trace the product throughout its product life cycle.

## **Green Third-Party Logistics Providers**

Third-party logistics providers have made significant efforts to reduce the negative environmental impact of their logistics offerings through:

- (1) environmentally friendly facility location,
- (2) the use of green energy and green transport modes/equipment,
- (3) energy-efficient lighting system,
- (4) energy-efficient materials-handling equipment,
- (5) green packaging system
- (6) waste management system.

## Green Packaging

Packaging includes:

packaging directly in contact with products, typically disposable;

packaging that helps the storing, transferring, and delivery of products (like trays, buckets, containers, and cans), potentially reusable.

Green packaging can incorporate the 3R principles (reduce, reuse, and recycle). The packages should be reduced as much as possible, made lightweight, and use fewer materials. Thin, lightweight, and firm packages could be encouraged and mandated. Less packaging may mean less overall and waste material, lower expense, lowered transportation costs and emissions, and less space for storage of materials.

Reused containers and trays can also significantly reduce the generation of waste. However reusable packaging can lead to round-trip transportation and more cleaning work.

The rapid development of e-commerce has caused packaging systems to cause large amounts of solid waste.

## Defining Reverse Logistics

Reverse logistics is “the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal”.

Reverse Logistics includes the activities of reducing materials and resources consumption in forward supply chains, reverse distribution, and the recycling of materials and products, avoiding landfill or incineration for used products.

Reverse Logistics is often initiated in response to regulatory and consumer pressures.

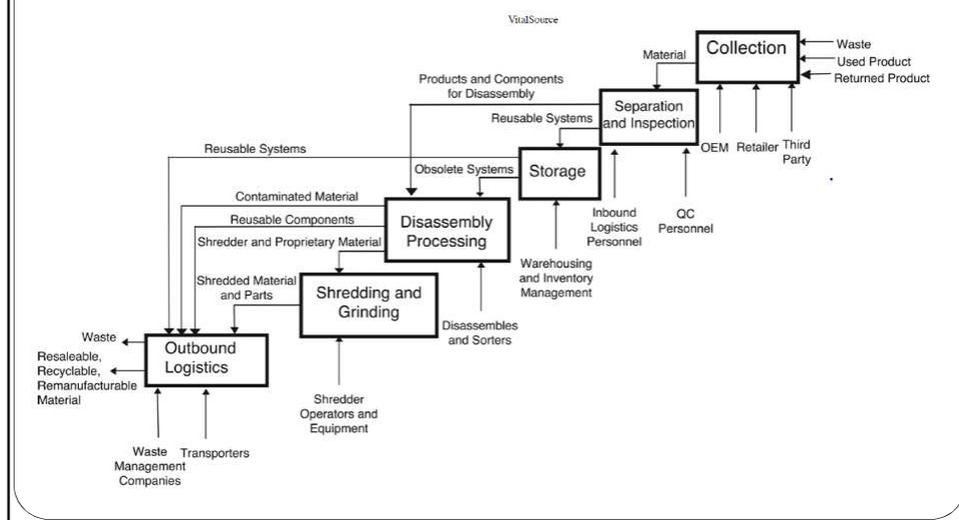
Reverse Logistics increases the complexity of business operations since the firm may serve in the two roles of supplier in forward logistics process and consumer in a reverse logistics process.

## Reverse Logistics goal

Reverse Logistics has the goal to allow the company to:

- *Reducing*: the source reduction of raw materials and other resources and energy.
- *Reuse*: the process of collecting used products and directly using them, without additional processing.
- *Recycling*: the process of collecting used products and processing them into recycled products, where the functionality of the original materials is lost.
- *Remanufacturing*: the process of collecting end-of-life products or parts and repairing or replacing broken parts with new ones, where the functionality of the original products is retained.

## Schematic of various reverse logistics activities



## Legislative Pressures

Governments worldwide are enacting more stringent environmental regulations which force manufacturers and producers to be responsible for the collection and handling of their products at the end of its useful life.

For packaging, environmental regulations, such as the European Directive on Packaging and Packaging Waste (94/62/EC), attempt to reduce the impact of packaging on the environment. For hazardous waste, under the EC 2005 Hazardous Waste Directive (91/689/EEC), hazardous waste producers in the List of Waste (formerly the European Waste Catalogue) must register with the Environment Agency before they can move material from their premises.

For the Waste Electrical and Electronic Equipment (WEEE), a UE Directive was approved on February 13, 2003, in the European Union. WEEE materials and components normally contain serious hazardous materials like bromated flame retardants (BFR), lead, heavy metals, and plastics. Electronics production also utilizes rare-earth natural resources such as gold.

Producers of WEEE are required to take responsibility for the collection, treatment, and recycling of end-of-life products, which involves financing the collection and appropriate treatment of waste equipment, as well as meeting specific targets for recycling and recovery. The Directive required collection schemes for consumers to return their WEEE free of charge.

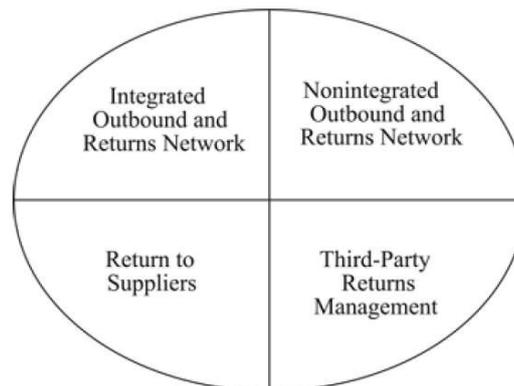
## Advantages from Reverse Logistics

**Economic Gains:** economic savings, both direct and indirect, can be achieved as used products are reused or remanufactured. Direct economic benefits include the profits from reduced materials use and recovery programs. RL focuses primarily on the return of recyclable or reusable products and materials into the forward supply chain.

**Environmental Consciousness of Consumers and Producers:** consumers are becoming increasingly aware of environmental problems and, all things being equal, prefer greener products. The green product market has expanded in recent years. Subsequently, recognizing the increasing market for environmentally friendly products, companies have observed the need to implement RL practices to produce remanufactured and green products.

**Customer Services:** the quantity of returned products has increased significantly. This increase has resulted in a focus on customer satisfaction by retailers and producers. A liberal returns policy has been recognized as an important strategy for maintaining satisfied customers. As consumers shift from in-store and retail channels to more nonstore purchasing (e.g., buying on the Internet), requirements for returns shifts from in-store returns to direct returns, whether to the dealer or to the manufacturer.

## Reverse Logistics networks



## Reverse Logistics Network Design (1)

**Integrated Outbound and Returns Network:** retailers use their own existing logistics network. The fleets and vehicles are owned by the retailers, and returned products are normally distributed to their existing regional distribution centers. The gatekeeper responsibility, including collecting, sorting, checking, and handling, lies with the retailers. This type of network is proper when the returned products have large volumes, and the delivery frequency is high.

**Nonintegrated Outbound and Returns Network:** retailers develop a new network for dealing with returned products instead of using their existing forward logistics system. A new, separate returns center is often built by retailers to undertake gatekeeper activities. Returned products differing in volume (generally low volume) are a characteristic that make this type of network appropriate.

## Reverse Logistics Network Design (2)

**Third-Party Returns Management:** retailers outsource their gatekeeper functions to a third-party contractor. Normally, the third-party organizations have better expertise in and understanding of RL, enabling an efficient management of returned products. The third-party organization, often having contracts with many other retailers and producers, can make good use of scale advantages of returned products and maximize the potential of reuse and remanufacturing. Advanced technologies relating to RL can also be easily adopted. Fourth-party logistics providers, undertaking “business process outsourcing” to fully provide comprehensive forward and reverse supply chain solutions, have also arisen to achieve optimization of forward and reverse logistics.

**Return to Suppliers:** returned products are directly transited to suppliers, and the gatekeeper responsibilities lie mainly with suppliers. The energy consumption and transport cost may be high since the returned goods have to move to widely scattered individual suppliers. Additional sorting, assessing, and handling may incur a greater number of transportation tasks and activities.

## The Circular Economy

The Circular Economy can be defined as an economic model wherein resourcing, purchasing, production, and reprocessing are designed to maximize environmental performance and human well-being, with a shift from the traditional open-ended economic system to the circular economic system.

The Circular Economy principles can be adopted at:

- the micro level, e.g. green firms;
- the meso level, e.g., eco-industrial parks;
- the macro level, e.g., cities, provinces, regions.

The Circular Economy has as its basis closed-loop supply chains and reverse logistics.

## Globalization drivers in a Green Supply Chain Perspective

- *Market drivers*: if there are increasing demands for green products or services, increasing market segments for green products, or more channels for green services and products in some regions of the world, then there is reason to enter those global markets.
- *Cost drivers*: cost pressure increases cause organizations to locate facilities in, find suppliers in, or outsource to various regions of the world. Locating in areas with sustainable fishing might be a greener and more resilient supply chain practice that allows for lower costs over the long run.
- *Competitive drivers*: a competitive greening perspective occurs for organizations in industries which seek to cut into carbon emissions by using inseting along its supply chain in developing countries. This inseting process may include international locations covered by international agreements that will help them improve image, supply chain resilience, and other competitive factors

## Globalization drivers in a Green Supply Chain Perspective

- *Technology drivers*: green technology that is cheap and affordable can be a driver for organizations to purchase from various regions, as in the case of proprietary recovery processes for the precious metals that exist in electronic equipment.
- *Government drivers*: some locations are considered eco-industrial zones, and companies with certain industrial symbiotic (waste of one company becoming input for another company) may wish to locate in some of these regions due to government incentives. A more maleficent, contra-greening reason may be to locate in a certain region of the world with fewer environmental regulations.
- *Macroeconomic drivers*: common macroeconomic tools used in some regions of the world are greenhouse gas trading systems. In this case, companies may wish to locate in regions of the world where these systems occur due to some form of cost or revenue advantage.

## Cultural Boundaries in Global Green SCM

**Cultural boundaries** are the unwritten rules of acting and behaving set by culture, where social values may differ. Organizations, countries, and regions can all differ in terms of culture. Crossing boundaries and the heterogeneity of cultures play a role in environmental perceptions and perspectives.

Cultural influence boundaries have been determined by national boundaries, certain regions of the world would have similar cultural expectations. Nations in Europe, such as Germany and France, would have similar expectations that would probably be different from nations in Asia, such as China and Vietnam.

Even within nations, various areas may have similar or different cultural contexts and greening beliefs. For example, in the United States, the East Coast and West Coast cultures, although far apart, may be more similar than those that are geographically closer.

From a green supply chain perspective, understanding the culture of the company or the region is important for whether certain greening practices and perspectives will encounter barriers or enablers.

## Economic and Informational Boundaries

**Economic boundaries** impacts on the extent to which an entity in a supply chain has control over the costs and concerns the financial benefits that a supply chain entity may achieve from savings or additional revenue generated from greening supply chains and flows.

If extended producer responsibility is a GSCM strategy to be adopted by firms, then the boundary can easily get to global network levels.

**Informational boundaries** can be defined by the accuracy, completeness, reliability, and availability of information. Data and its transformation to information constitute a major driver of decisions. Access to and the availability of data make up a virtual boundary that is met by many entities at all levels.

A very important boundary element for the supply chain is the point at which life cycle analysis information is no longer reliable. An LCA assumes that the information is available through the whole life cycle of a product, but this is not always the case. Thus, an artificial boundary may need to be set depending on how far and deep the information is for an LCA.

## Legal and Political Boundaries

**Legal boundaries** may overlap greatly with political boundaries but may not necessarily follow them directly. Laws may occur at various levels, whether local, regional, national, or international.

The legal boundary impacts on whether organizations and supply chains may not be responsible for some environmental legal issues such as the so-called deep pocket activities of those seeking damages in courts. For example, the inappropriate use of chemicals that can cause environmental and health damage at downstream stages of the supply chain, rather than immediately upon the manufacture of the chemical, may cause the chemical manufacturer to be liable.

**Political boundaries** are built around regulations and institutional norms and rules that may vary across political boundaries. Environmental regulations can be diverse, ranging from mandatory required regulations that all organizations have to meet to particular voluntary regulations targeted to a specific industry.

At a global supply chain level, one of the related political regulatory policies emanates from a so-called race to the bottom—the pollution haven hypothesis perspective. In this case, companies may outsource or offshore to locations with weak environmental regulations or enforcement.

## Organizational and Proximal Boundaries

**Organizational boundaries** can occur at many levels, including departments, business units, functional areas, facilities, joint ventures, corporate entities, or supply chain. An organization's "sphere of control" is not always clear, given that power, trust, resource dependency, and asset specificity can all relate to control. The organizational boundary comes into play on greening topics such as LCA, product stewardship, and general green supply chain practices.

**Proximal boundaries** relate to physical and geographical boundaries and distances. Physical and geographical location considerations can be greatly affected by this dimension. For example, the environmental and economic costs of transporting materials over large distances may constrain some locations from being selected, and what can be monitored and investigated in a supply chain could be limited by physical characteristics.

In the diffusion of greening standards along a supply chain, distance has been found to be a significant factor. Larger distances typically mean fewer and weaker relationships between buyers and suppliers or sub-suppliers.

## Technological and Temporal Boundaries

**Technological boundaries** may occur due to limitations of technology in being able to solve a particular problem related to environmental burdens from supply chain operations and activities.

So-called *best available technology* policies associated with emissions management technology and regulations are an example of a policy-based technological boundary. Organizations should seek out the best available technology on the market, not requiring that organizations seek to push the envelope on technology to address environmental issues. The feasibility of many environmental improvement efforts are technology based.

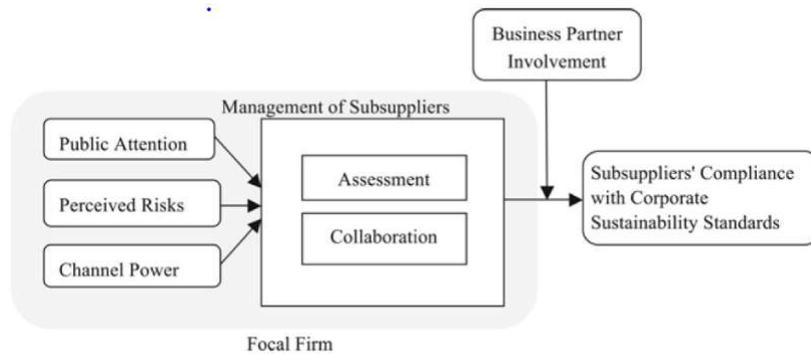
**Temporal boundaries** are relevant . Sometimes environmental concerns are very immediate, on almost a minute-to-minute basis—a very tight boundary. In other cases, the impact of an environmentally adverse action may not be felt for years or generations. For example, climate change is relatively slow and not immediate.

The temporal boundary of the decisions and solutions along the supply chain may be shorter or longer term depending on the crisis and situation. What might not be a problem in the short run (global warming) may be a problem in the long run.

## Green Multitier Supplier Management

- **Direct approaches:** a focal company establishes a direct relationship with subsuppliers. Industries which have strict components quality and service requirements for lower-tier suppliers, a focal company (end product maker) often selects and certifies critical subsuppliers. A requirement by the focal company is that its direct suppliers use the certified subsuppliers
- **Indirect approaches:** a focal company influences subsuppliers' sustainable practices through other suppliers, normally direct suppliers. The direct approach may be very costly especially when the number of subsuppliers is very large. In practice most focal companies would rely on their direct suppliers to manage subsuppliers' green and sustainability performance.
- **Working with third parties:** the focal company collaborates with third parties to monitor subsuppliers. These third parties can include industry associations, NGOs, government agencies, or competitors. Using third parties, the focal company can shift some responsibilities and have an unbiased source of information and support. Third parties may have significant public influence or reputation or be part of a certification scheme. With third parties, the focal company can build legitimacy and receive support to buffer risks and criticisms from poor environmentally performing subsuppliers.

## Relationships between focal firm and subsupplier compliance



## Enablers for Implementing Green Multitier Supplier Management

***Trust between a focal company and direct suppliers.*** Trust between a focal company and its first-tier, direct suppliers is important for the initiation of green supplier management programs. Direct supplier trust is needed in helping focal companies monitor lower-tier suppliers. Sometimes the indirect relationship is the only way that focal companies can work with subsuppliers; without the trust of suppliers, the focal company–subsupplier linkage is very tenuous.

***Amount of buyer power over direct suppliers.*** Power is a governance and resources dependency set of relationships. With greater power, companies can potentially exert greater moral influence on the weaker party and provide a ripple effect down the entire supply chain. Suppliers may not be willing to take on increased tasks originating from supervising their own suppliers. A greater differential in power dynamics favoring the focal company makes it easier for them to pressure direct suppliers.

## Enablers for Implementing Green Multitier Supplier Management

***Robust understanding of supply chains by a focal company.*** It is difficult to implement a GSM practice successfully for a focal company without a robust understanding of, involvement in, and knowledge of their own upstream members. Part of this understanding is knowing their “sphere of influence”. This understanding is necessary to help determine the type of relationship to try to develop with subsuppliers.

***Willingness to provide human resource support to suppliers.*** Most upstream supply chain members are likely to be SMEs (small to medium-sized enterprises), and they often face the challenge of insufficient human resources and expertise, especially at the initiation of a Green Multitier Supplier Management program. Focal company may provide the necessary human resource support and expertise.

***Top managers’ committed support from a focal company.*** Top management support has been frequently identified as an important factor in green supply chain management programs, and it is not surprising that this enabler appears throughout most internal and external green supplier management programs. Top management support from a focal company indicates the willingness of the focal company to invest resources in Green Multitier Supplier Management.

## Enablers for Implementing Green Multitier Supplier Management

***Willingness to provide financial resource support to suppliers.*** Financial resources are important tangible resources to build capability and, further, to improve environmental performance. Financial resources are important elements of green supplier development programs. There are a number of cases where firms have invested with suppliers and their subsuppliers through incentives.

***Willingness to provide necessary physical assets support to suppliers.*** The focal company green supplier development programs may target to invest in capital equipment and other physical assets in their suppliers. Physical assets, such as pollution treatment devices and facilities, are tangible resources that are necessary for developing green capabilities and can improve the environmental performance of suppliers and build capacities to share with their suppliers. If a focal company is willing to provide the necessary physical assets support, the programme has a better opportunity to succeed.

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***Trust between first-tier and second-tier suppliers.*** Similar to the relationship between the focal company and the first-tier supplier, trust between the first-tier supplier and second-tier supplier is critical for the success of the program. If the second-tier supplier treats its customer (the first-tier supplier) as a trusting partner, the second-tier supplier is expected to more likely be involved in the GSM program.

***Low risk of supplier bypassing.*** The risk of supplier bypassing is a disinter-mediation risk, where the focal company terminates the business with the first-tier supplier and starts to purchase products directly from the second-tier supplier. A guaranteed long-term partnership, trust, and sincere communication between the focal company and the first-tier supplier may mitigate these first-tier supplier concerns.

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***Supply chain members that are geographically close to one another.*** The geographical locations of supply chain members are important because close proximity creates the convenience of facilitating training programs, periodic monitoring, auditing, and lessened transportation costs. Close geographical proximity makes the logistics of actually implementing GSM practices and programs easier for the focal company.

***Willingness of first-tier supplier to share second-tier suppliers' information with the focal company.*** Suppliers are not typically considered a key environmental sustainability driver by focal companies, but integration and cooperation with them through information sharing can result in environmental improvement and competitive advantage for the focal company. The collaborative willingness of the first-tier supplier to provide their suppliers' information is sensitive for a number of reasons, including trust and competitiveness. Focal companies often rely on their first-tier suppliers' sharing information on their own suppliers.

## **Subsupplier auditing for Green Multitier Supplier Management**

Auditing in the GSM is complex. The complexities arise from the “who”, “where”, and “when” of the auditing. The auditors may be a variety of stake-holders, and third-party auditing plays a large role. Environmental and sustainable auditing may also include external, internal, and mixed auditing. The amount of effort and type of auditing used is very much dependent on a variety of stakeholder pressures and, as mentioned in the previous section, on contingent factors.

Audits are not static documents with checklists. They evolve over time and, in fact, if used from a continuous improvement perspective, may require incorporating new elements and eliminating older elements.

The number and timing of audits play a significant role in whether GSM partners wish to be involved and what relationships are best. A number of factors in the contingency framework, as previously discussed, may come into play, ranging from criticality of materials to distance apart in the supply chain.

## **Raising Awareness for Green Practices in Subsuppliers**

Subsupplier adoption of green practices may come as the result of the customers' customer pressures. Subsuppliers need to be aware that they are part of the GSM. Involvement and relationships through conferences, workshops, and direct input from the upstream supply chain are needed.

Raising awareness is important since many subsuppliers may believe that, because of their “smallness”, they do not impact the society and environment. Even when they do believe that they have some impact, they consider their impact to be insignificant or rather small. Their combined impact, however, is rarely highlighted and shared with subsuppliers.

Convincing second- and third-tier subsuppliers requires some determination of the benefits. Rewards awareness could be targeted and may include strengthening relationships with buyers, building trust, access to new customers, potential opportunities to move to higher tiers, global market access, all of which in turn might justify certification costs.

## **Transformation into a Greener Subsupplier**

Subsuppliers need to build the internal capacity required to support sustainable initiatives and the managerial capacity that will lead to a change in culture.

A firm needs to make an initial investment to acquire and internalize sustainability knowledge and then it needs further support training and development. Developing the necessary financial and technical capacity is important.

A management approach that integrates sustainability into the overall management of a subsupplier is viewed as an essential tool for incorporating sustainability into strategy. Having managers go through training to raise awareness and knowledge is necessary. Hiring consultants and/or experts is another approach for building management capacity.

Company mind-set, culture, and subcultures are key elements that can help determine subsupplier response to greening efforts. Firms may need to unlearn and accept that their responsibilities to the environment go beyond economic and legal responsibilities and extend down the supply chain.

## **Maintaining a Green Multitier Supplier Management**

Performance metrics, feedback loops, and programs selection all play a continuous role in maintaining a GSM.

Performance metrics are very multidimensional and may require explication and adjustment as the GSM matures and evolves. Maturity matrices for sub-supplier management are needed and do not exist.

Forming what the long term goals are and measuring progress are critical to maintaining an effective GSM program. Some of these activities are described in other chapters.

Feedback loops mean that forms of communication and open communication are needed to determine the issues that go beyond the numbers of performance measurement. Sharing of information and benchmarking can help subsuppliers see how well they are doing with respect to peer groups. Open discussion on performance and measures is needed. Having a GSM performance measurement and database is necessary in this case.