Ecosystem Aware
Global Supply Chain Management

Green Supply Chain Ecosystem Analysis

Meet the Present needs without compromising the Future

N. Viswanadham
Indian Institute of Science
Bangalore- 560012
n.viswanadham@gmail.com

ISBN 978-981-4508-16-2
World Scientific

Ecosystem Aware
Global Supply Chain Management

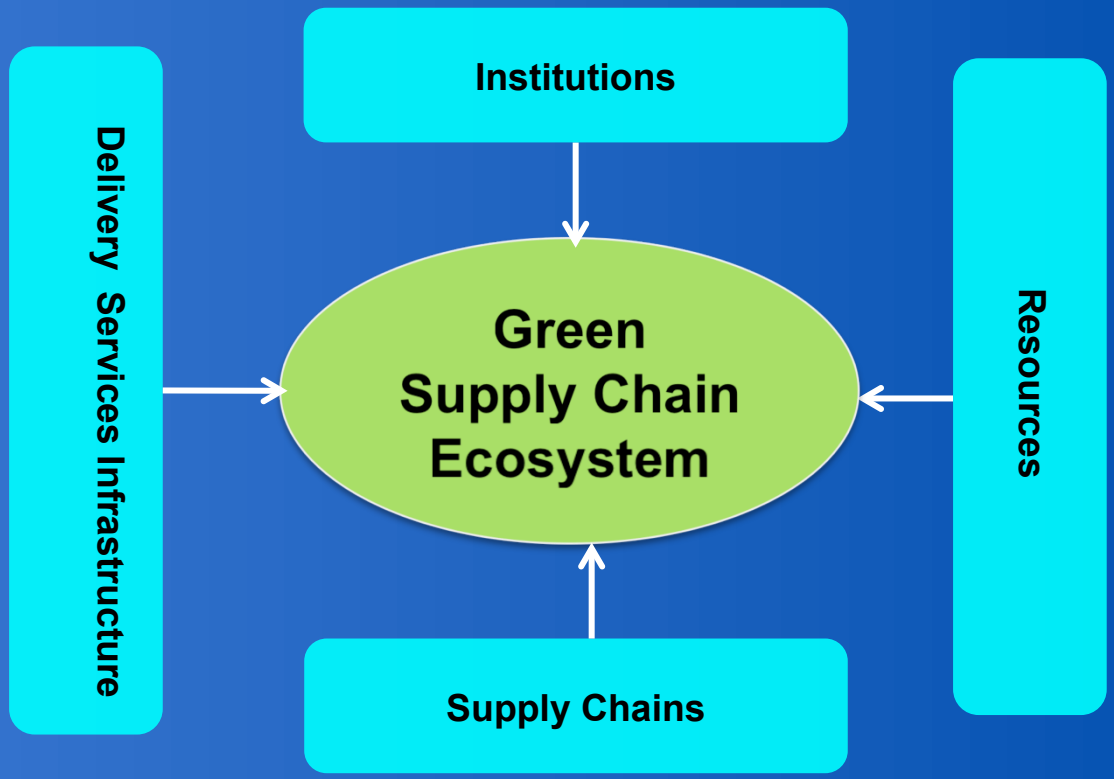
Contents

- The Green Supply Chain Ecosystem
  - The Forward-Backward Supply chains
  - Delivery Infrastructure
  - Institutions
  - Resources
  - Talent
- GRIP Framework
  - Performance
  - Innovation
  - Risk
  - Governance
- Conclusions

The Green Supply Chain Ecosystem

Ecosystem Aware
Global Supply Chain Management

The Green Supply Chain Ecosystem

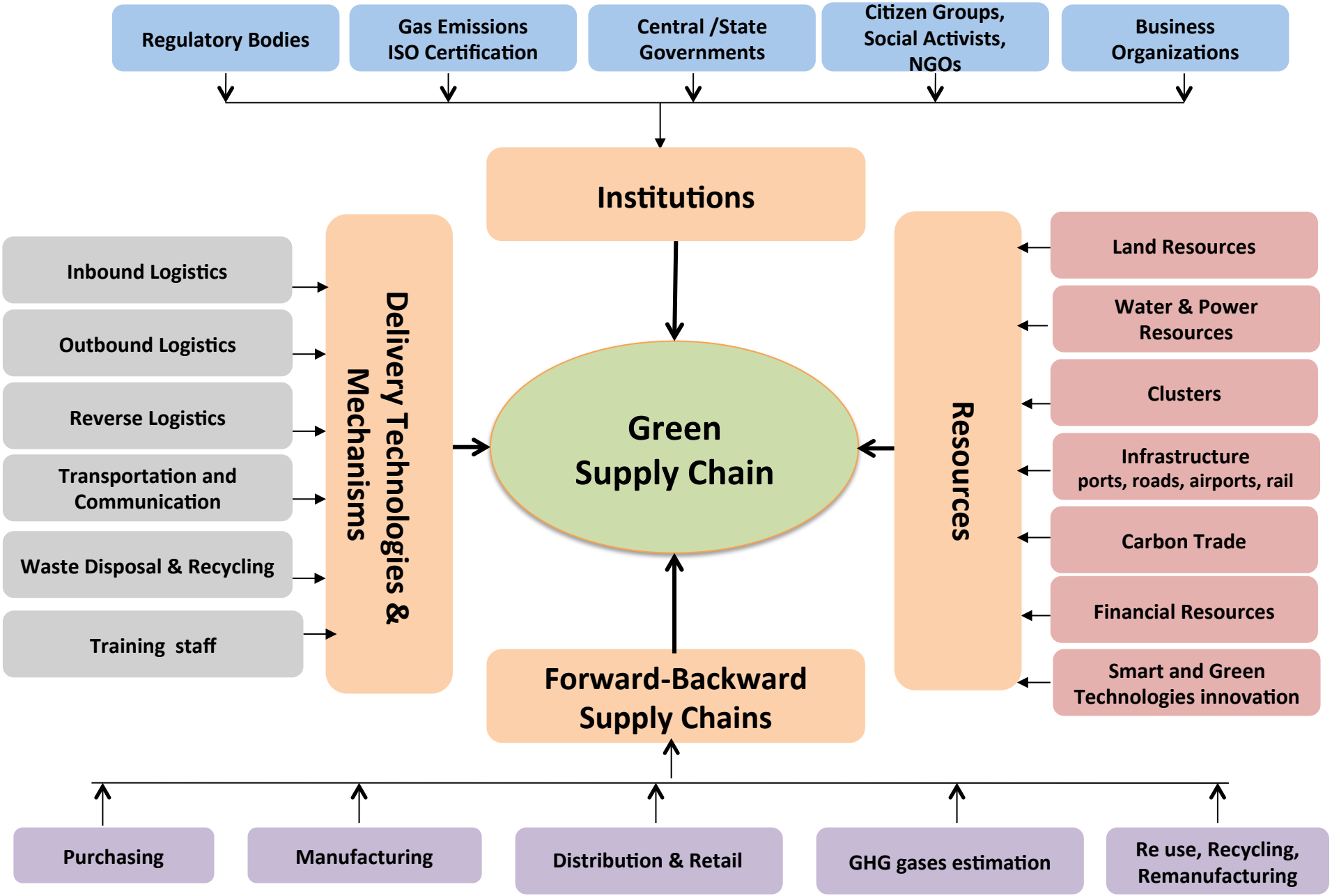


Co-Evolution, Risk Propagation

Ecosystem Aware
Global Supply Chain Management

The Ecosystem Framework for GSCN

- Forward-Backward Supply chains
- Governmental & Social Institutions
- Resources including Human, Natural, Financial and Industrial (Clusters)
- Delivery Services


Regulatory Bodies
Gas Emissions ISO Certification
Central /State Governments
Citizen Groups, Social Activists, NGOs
Business Organizations
Institutions
Inbound Logistics
Outbound Logistics
Reverse Logistics
Transportation and Communication
Waste Disposal & Recycling
Training staff
Delivery Technologies & Mechanisms
Green Supply Chain
Resources
Land Resources
Water & Power Resources
Clusters
Infrastructure ports, roads, airports, rail
Carbon Trade
Financial Resources
Smart and Green Technologies innovation
Forward-Backward Supply Chains
Purchasing
Manufacturing
Distribution & Retail
GHG gases estimation
Re use, Recycling, Remanufacturing

The Forward-Backward Supply chains

The Forward – Reverse Supply Chain

- Green Supply Chain Management (GSCM) = Green Purchasing + Green Manufacturing + Green Distribution + Repair+ Re-Use + Re-Manufacturing +Re-Cycling.
- The forward-reverse supply chain has dual objective
  - Forward Supply Chain optimizes cost and performance of all processes from product design to customer delivery
  - Backward supply chain optimizes the environmental performance of the Forward Supply Chain

Re-features in Supply Chain Design

- **Recycling:** Collecting used products, disassembling into like materials (metal, plastic, glass, etc.) & processing them.
- **Re-use:** Collecting used products from the field, and selling them at reduced prices.
- **Remanufacturing:** Collecting used products, repair & test for quality, before **Re-Use**
- Materials and Components recovered from used products re-enter the same forward supply chain along with the new materials or components.

Green Business Processes

- Green Procurement : Acquisition of products and services that minimize environmental impacts over their life cycle of manufacturing, transportation, use and recycling or disposal.
- Green Manufacturing: Production processes using efficient inputs, energy-efficient technologies that generate little waste or pollution & have low environmental impact
- In-bound Logistics : Freight Consolidation, The transport mode selection. Rail and barge use energy more efficiently than road haulage or air cargo
- Outbound logistics : Criteria for green logistics such as Fewer shipments, less handling, shorter movements, more direct routes, and better space utilization tradeoff with delivery time, responsiveness, quality and cost.

Ecosystem Aware
Global Supply Chain Management

Green Procurement

Adding Environmental Aspects To Price & Performance When Making Purchasing Decisions

- Purchasing includes vendor selection, material selection, outsourcing, negotiation, buying, delivery scheduling, inventory and materials management, and to some extent, involvement in design
- Green procurement is the selection and acquisition of products and services that minimize negative environmental impacts over their life cycle of manufacturing, transportation, use and recycling or disposal.
- Examples of environmentally preferable characteristics include
  - Products and services that conserve energy and water
  - Minimize generation of waste and releases of pollutants
  - Products made from recycled materials and that can be reused or recycled
  - Energy from renewable resources such as bio fuels, solar & wind
  - Alternate fuel vehicles
  - Products using alternatives to hazardous or toxic chemicals, radioactive materials and bio hazardous agents

In-bound Logistics

- The just-in-time (JIT) practice is to lessen the amount of inventory by delivering in small batches. Less warehousing but more fuel consumption and traffic congestion.
- Freight Consolidation: Full load freight delivery may lead to longer lead times but environmentally preferable.
- Mode Selection: The transport mode decision affects traffic congestion and air pollution both directly and indirectly.
  - Rail and barge use energy more efficiently than road haulage or air cargo. Flexibility, timing and speed are tradeoffs to environmental & cost factors.

Green Manufacturing

- **Production processes** should use highly efficient inputs, energy-efficient technologies that have relatively low environmental impact and generate little waste or pollution.
- **Quality control** at vendor site and before processing of all inputs and concentration on high percentage of recyclability and recoverability
- It can lead to lower costs, reduced environmental safety expenses, and improved corporate image.

Distribution & Outbound logistics

- **Outbound logistics** is movement of Finished products from production line to the consumer.
- Typical outbound logistics decisions include direct shipping or hub-and-spoke, central warehouse or distributed network, intermodal or single mode, and third party services or private fleet.
- **Outbound logistics Criteria that support environmental planning** include fewer shipments, less handling, shorter movements, more direct routes, and better space utilization.
  - But, each of these issues tradeoff with delivery time, responsiveness, quality and cost.

Delivery Infrastructure

Reverse Logistics

- Reverse logistics is the process of retrieving the product from the end consumer and includes collection, sorting, re-processing, redistribution, and disposal.
- Reverse logistics competency that does not exist in most OEMs or 3PLs. Outsourcing is common.
- The stronger the pooling ability held by the third party over the manufacturer in reverse logistics, the more suitable it is for the third party to manage the reverse supply chain.

Reverse Logistics

- Reverse distribution costs may be higher than moving the product from producer to consumer.
  - Returned goods flows are difficult to forecast & cannot be transported, stored and handled in the same manner as in the forward channel. Most logistics companies are ill-equipped to handle reverse product movement.
  - Tools and models for disassembly scheduling, planning and control are still in their infancy

Reverse Logistics: Auto, Aero, Computer

- Car manufacturers to invest and manage their reverse supply chain, managing thousands of different parts across hundreds of car models.
  - Automotive manufacturers face steep competition, and low profit margins (less than 5%).
  - The spare parts market enjoys a much higher margin and a source of high profits .
- Aircrafts enjoy a high profit from the limited competition and Boeing and Airbus have technological advantage. The manufacturers pass the spare parts management to 3PLs.
- In the consumer electronics sector, demand for refurbished computers is growing. They are sold at cheaper prices by all the leading brands. Reverse logistics is outsourced

Institutions

Institutions Role in the Green Supply Chain

- Environmental legislations : Clean Air Act, the Clean Water Act, the Toxic Substances Act, Comprehensive Environmental Response, Compensation, and Liability Act were adopted in several countries.
- Legislation on products, energy usage motivate GSN research
- ISO 14000 series provide guidelines and standards towards ecologically sustainable business practices
- The price of emissions can include taxes, tax credits, and subsidies directly related to emissions and indirect emissions pricing such as fuel charges.

Resources

Resources

- Industries influence the environment in the eight major stress categories: **use of raw materials, energy, water, land, atmospheric emissions, water effluents, production of solid waste, and other releases.**
- Use of land in competition with other activities, such as agriculture; Use of virgin land (forests, wetlands and coastal), biodiversity loss.
- Massive use of non-renewable natural resources, Pollution during the transportation and manufacturing ; Consumption of water and pollution of water reserves; Generation of waste ; High energy consumption in product making & usage
- Cradle to Grave or Cradle to Cradle protocols

Carbon markets

- Carbon markets use cap and trade scheme, which have four basic components
  - Governments set a cap on the total volume emissions of a pollutant
  - These allowances are distributed for free or sold to firms.
  - The allowances can then be traded in the carbon market. Firms that would face high costs to reduce their emissions will buy allowances from firms with lower costs, thus reducing the total costs of emissions reductions.
  - Emissions are monitored and reported, and at the end of the accounting year
- **The largest carbon market is the European Union Emissions Trading Scheme**

Ecosystem Aware
Global Supply Chain Management

Talent

Talent

- The transition to a greener economy has enormous potential, to create both direct & indirect employment(millions of jobs)
- **Green restructuring:** Training workers and enterprises to move from declining to growing sectors and occupations.
  - Increase in wind or solar power, and decline in the production and use of fossil fuels.
- **New occupations :** Provision of training courses Emerging occupations.
  - Scientists and Engineers , Technicians (Solar), Management of Energy efficiency & Waste in Buildings

Olga Strietska-Ilina, Christine Hofmann, Mercedes Durán Haro, Shin young Jeon, Skills for Green Jobs A Global View: Synthesis Report Based on 21 Country Studies, Skills and Employability Department, International Labor Organization, Geneva

Talent

- **Greening existing jobs**:
  - In the automotive industry, workers across a range of jobs from engineering design to the assembly line will have to work with new fuel efficient technologies.
  - Farmers will have to adjust to more severe drought conditions, requiring them to learn how to grow new crops or new methods for producing the same crops
- All three sources of change alter the skill profiles of occupations & thus training needs

Olga Strietska-Ilina, Christine Hofmann, Mercedes Durán Haro, Shin young Jeon, Skills for Green Jobs A Global View: Synthesis Report Based on 21 Country Studies, Skills and Employability Department, International Labor Organization, Geneva

Competitive GSCNs

Supply chains which integrate **economic, social and environmental concerns are more difficult to replicate,** particularly if suppliers devote asset-specific investments to engage in the design of products and processes that use low resources, carbon friendly energy sources, care for disassembly and reuse activities of their customers and developed higher levels of trust.

- But ……