

Supply Chain Management

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MGM 660

Lecture 10



Sustainability and the Supply Chain & New trending in Supply Chains

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Course Agenda

Chapter

- 
1. Understand the importance of sustainability in a supply chain.
 2. Discuss the challenge to sustainability posed by the tragedy of the commons.
 3. Describe key dimensions of sustainability for a supply chain.
 4. Understand the role of incentives for successful sustainability efforts.
 5. What's Trending Right Now in Supply Chains
 6. Major Research Themes in Supply-Chain Academia & Practice

Role of Sustainability in a Supply Chain

- *The health and survival* of every supply chain depends on the health of the surrounding world
- Expand the goal of a supply chain beyond the interests of its participants
- *Sustainable development* – development that meets the needs of the present without compromising the ability of future generations to meet their own needs

Role of Sustainability in a Supply Chain

- Focusing on sustainability allows a supply chain to better serve more conscious customers while often improving supply chain performance
- Customers have usually backed up words about the importance of sustainability without a willingness to pay more for sustainable products.
- **Three pillars of sustainable development**
 - Economic sustainability
 - Environmental sustainability
 - Social sustainability
- **Factor categories**
 1. Reducing risk and improving the financial performance of the supply chain
 2. Community pressures and government mandates
 3. Attracting customers that value sustainability

Role of Sustainability in a Supply Chain

- In reality, actions in a supply chain improve both sustainability and supply chain surplus.
- Most effort expended in reducing risk
- Activity slow as actions may require upfront investment
- Barriers to increased focus on sustainability
 - Insufficient return on investment
 - Customers' unwillingness to pay a premium for green products
 - Difficulty evaluating sustainability across a product life cycle

Tragedy of the Commons

- Dilemma arising when the common good does not align perfectly with the good of individual entities
- Every company and supply chain faces the challenge of the tragedy of the commons as it operates in a global environment
- Difficult to imagine a sustainable solution emerging without some intervention

Solutions to this “Tragedy”

- Choose from options that are unlikely to be supported by all of their own free will
- Mutual coercion – social arrangements or mechanisms coerce all participants to behave in a way that helps the common good
 - **Command-and-control approach**
 - Government/regulators set standards
 - **Market mechanisms**
 - Cap-and-trade

Key Pillars of Sustainability

- Measuring performance along all three pillars may be required to evaluate the impact of sustainability-related efforts
- Two fundamental challenges for social and environmental pillars
 - Scope of measurement
 - Absolute or relative measures

- A firm's ability to address issues that are important for its workforce, customers, and society
- Audit and support suppliers
 - Supplier collaboration and capability building strongly associated with social and environmental responsibility performance improvement and lower operating costs
 - Benefits accrue to all customers of the supplier

- **Firm's impact on the environment, including air, land, water, and ecosystems**
 - Resource reduction
 - Emission reduction
 - Product innovation
- **Not all “green” claims are valid**
 - *Greenwashing*

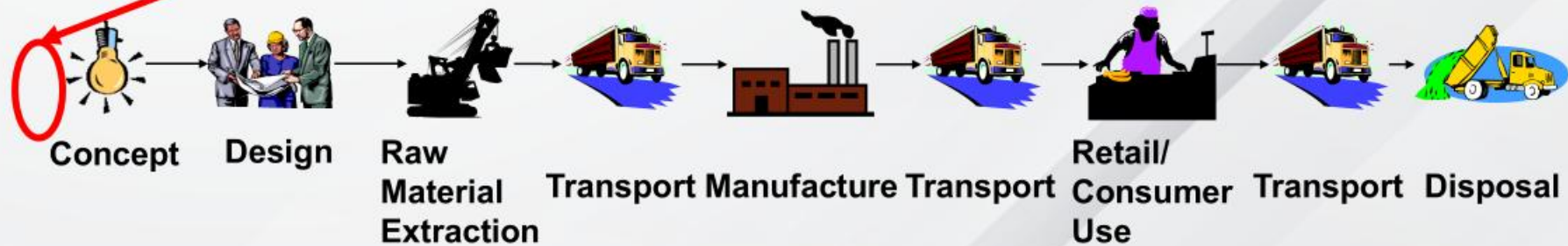
Sustainability and Supply Chain Drivers

- Match pillars with drivers
- Measure environmental impact for each driver along each of the social and environmental categories

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

Supply Chain in the Environmental Life Cycle

Designing the supply chain concurrently with the product is a *supply chain management* best practice.



Typical Supply Chain Scope

Reverse Logistics



**Reverse logistics—
putting the supply chain
into reverse for all flows**

Material flows

- Product returns
- Repairs
- Remanufacture
- Recycling
- Recovery
- Disposal

Payments

- Credits
- Cash refunds
- Rain checks
- Discounts
- Service contract fees

Reverse Logistics

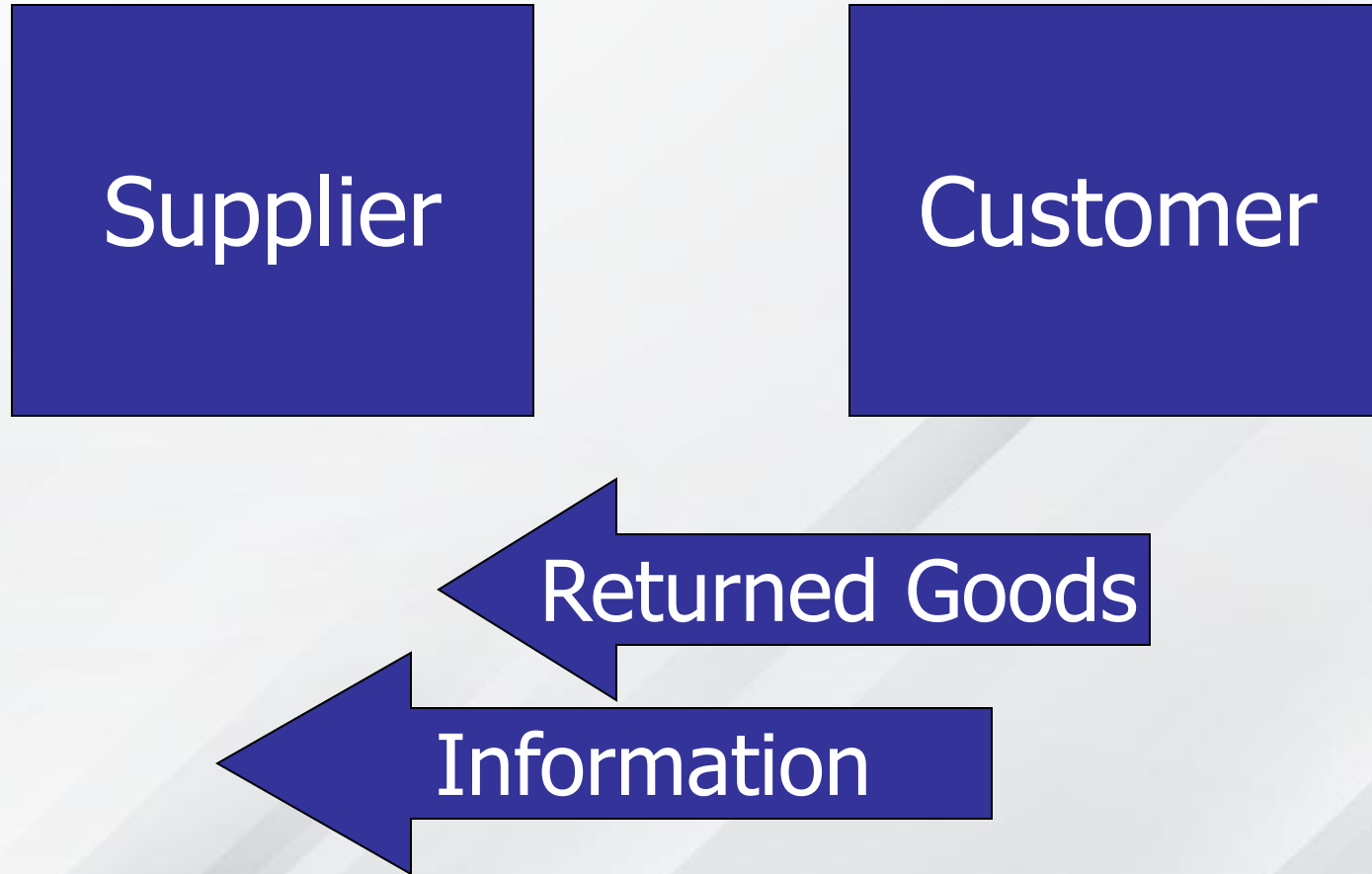
“A complete supply chain dedicated to the reverse flow of products and materials for the purpose of returns, repair, remanufacture, and/or recycling.”

- Can represent major costs to a company
- Amount of goods returned
 - up to 50% in the publishing industry
 - 90% of automotive starter motors or alternators
- Companies are taking responsibility of the return of packaging materials

Reverse Logistics - Information

- Goods are returned to supplier
- Information is also needed
 - reason / approval for the return
 - credit information

Reverse Logistics



- Return and disposal of packaging materials
- Return and disposal of environmentally sensitive materials
 - heavy metals
 - solvents
- Use of reusable (returnable) packaging

Returned Goods

- Quality demands by customers
- Damage or defects
- Excessive inventories
- Seasonal inventories
- Out-of-date inventories
- Remanufacturing or refurbishment

Returned Goods - Disposition

- Returned to inventory
- Refurbished for resale
- Sold into alternate markets
- Disassembled to retrieve components
- Sorted for material recovery



Reverse Logistics

Why have a reverse supply chain?

Aftermarket revenue



Sell recovered metals, etc., from returned products, containers.

Competitive edge



Woo consumers with promise of excellent customer service.

Pressure



Comply with “green” pressure from shareholders, consumers, regulators.

“Green” revenue



Sell into market for “organic,” “natural,” chemical-free, ecologically safe products.

Conscience



Do the right thing.

The reverse logistics hierarchy

Reduce

Reducing resource use is considered to be the most responsible “green” strategy.

Reuse

Design products for reuse of materials and components and with easy upgrades to extend life.

Recycle

Similar to reuse; product materials reprocessed into new products or components.

Recover energy

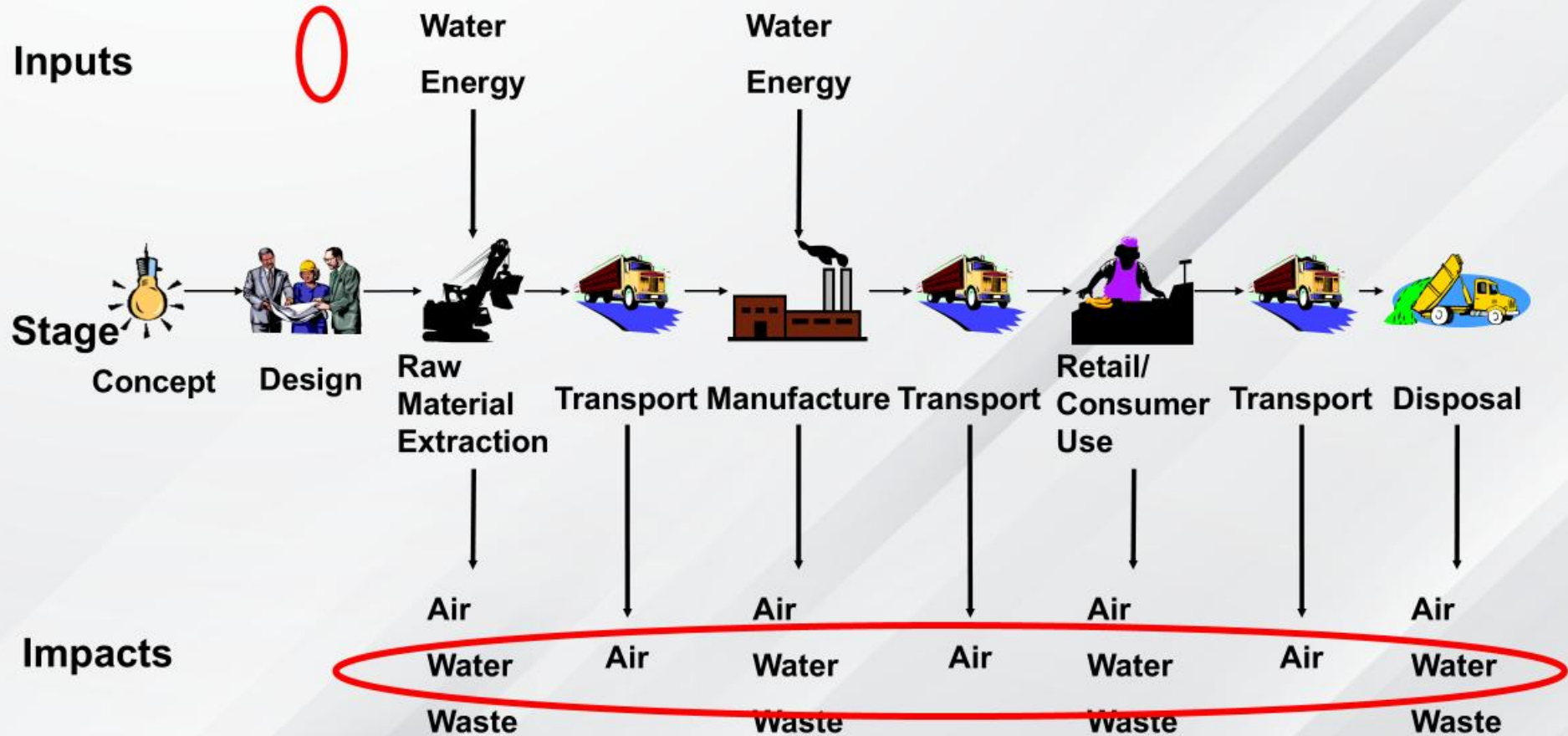
Dispose of product but recover energy in the process; e.g., “trash to energy” plants.

Responsible landfill

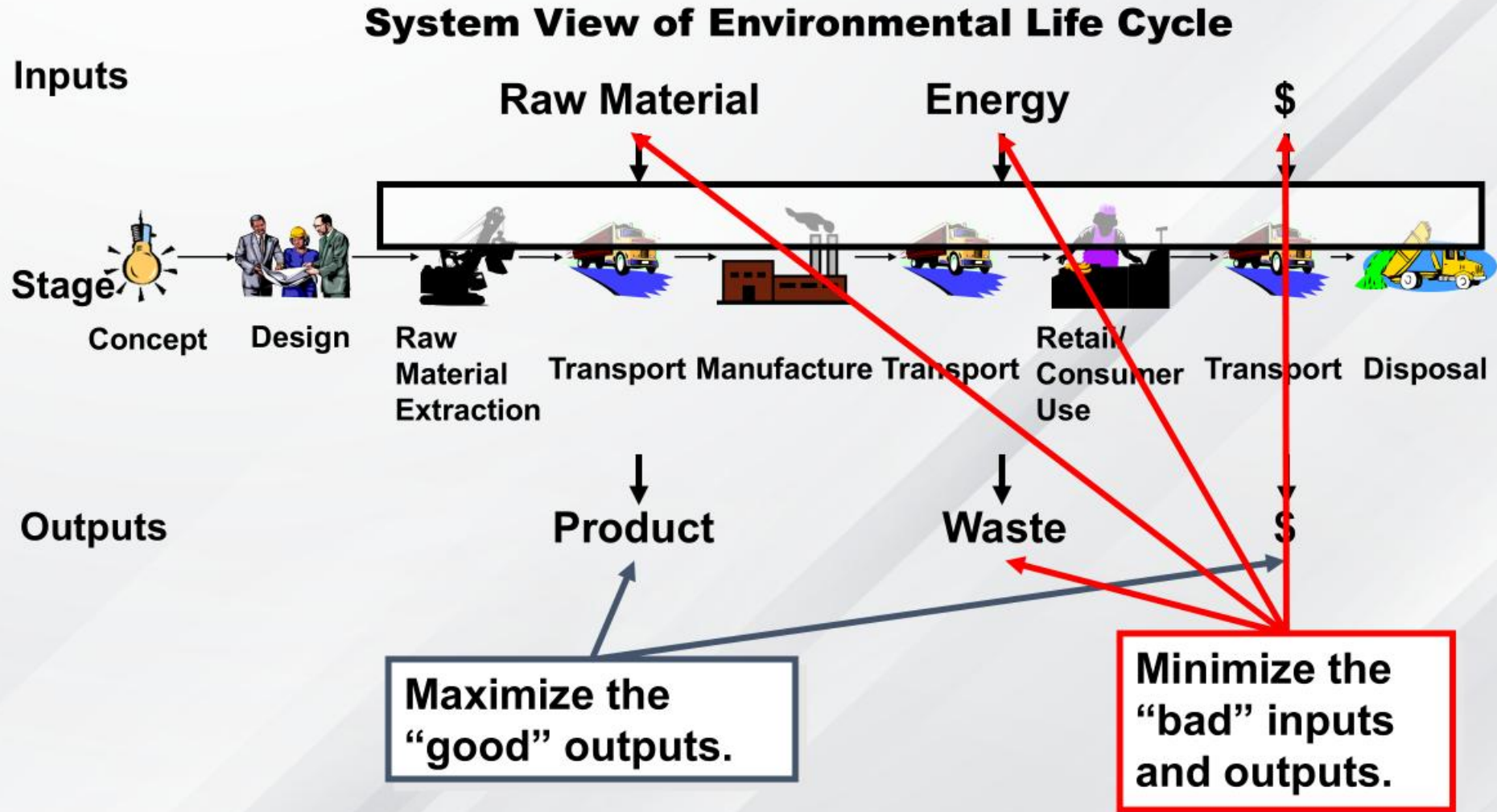
Last resort: Send unusable, unrecyclable materials and components to a responsible landfill.

The environmental impacts of each LC stage are examined for reduction.

Environmental Life Cycle



Evaluating the supply chain as a system leads to life cycle optimization.

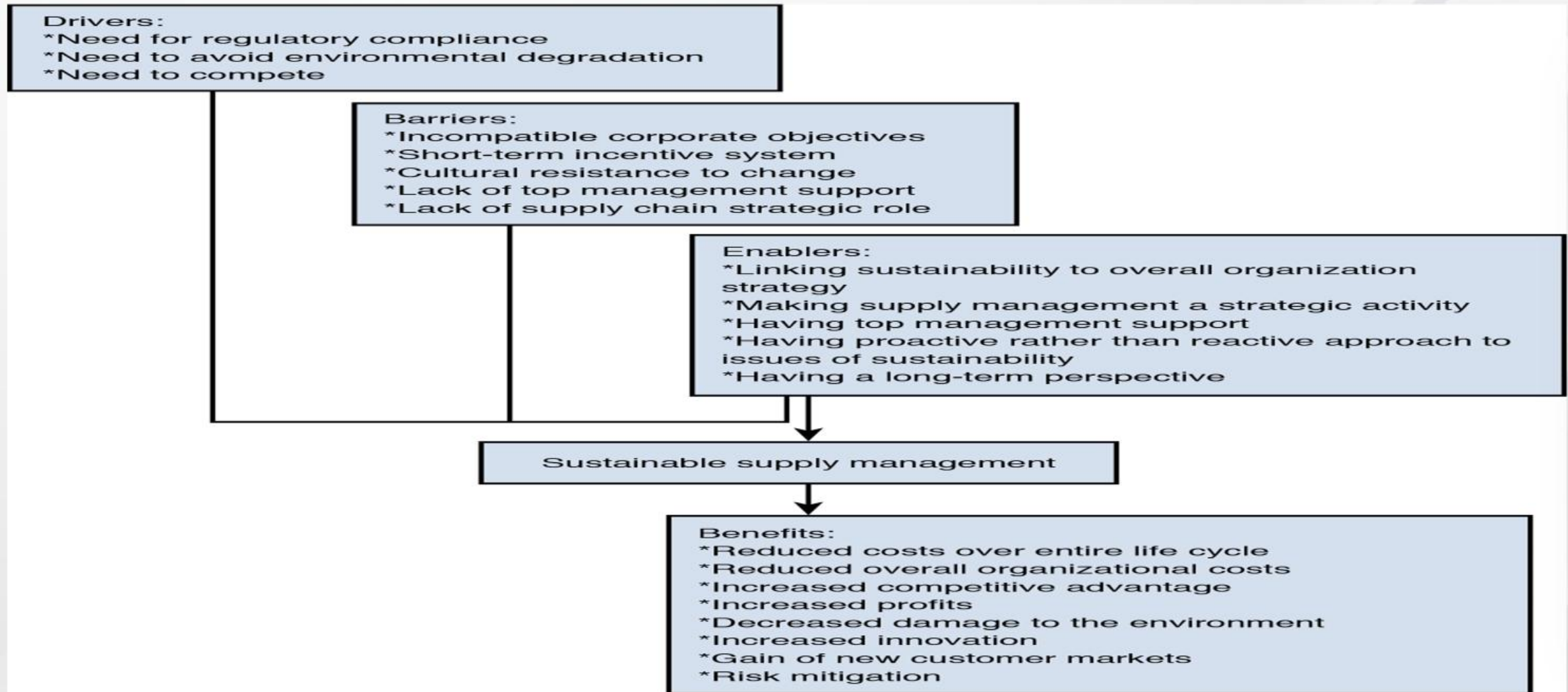


Supply chain design for reverse logistics

- **Reverse flows require their own systems.**
 - **Information flows need worldwide data warehouse.**
 - **Cash flows (credits, etc.) need customer-centered approach.**
 - **Product flows need reverse forecasting, special collection locations, processing centers, and transportation.**
- **Reverse revenues minus reverse expenses can bring profits.**
- **Life cycle design considers the 4 Rs in all phases of product life.**
 - **Design for wise use of resources, reuse of old products.**
 - **Prepare for returns before introduction.**
 - **Develop systems to support continued use, upgrades in maturity.**
 - **Be prepared for end-of-life cycle, especially with dangerous goods.**

The payoffs

- ▶ Lucrative customer service contracts
- ▶ Fewer, or no, costly returns
- ▶ Enhanced customer loyalty and reputation
- ▶ Revenues for materials in product returns
- ▶ More efficient products and logistical tactics
- ▶ New types of jobs
- ▶ More sustainable use of energy and resources
- ▶ Reduction of harmful emissions and pollutants
- ▶ Reduced need for landfills and incinerators



Facilities

- Consumers of energy and water and emitters of waste and green- house gases
- Separate the improvement opportunities into those that generate positive cash flows and those that do not
- Facilities often offer the best opportunity to simultaneously improve the environmental and financial performances through innovation

Inventory

- Most supply chains focus on raw materials, work in process, finished goods
- Inventory in a landfill
- Cost borne collectively by society
- Reduce harmful inventory, unlock unused value
- “Cradle to cradle” design

Transportation

- Improve environmental performance through resource and emission reduction
- Product design can play a significant role

Sourcing

- Greatest social and environmental impact occurs in the extended supply chain
- Impact has grown with increased global sourcing
- Verifying and tracking supplier performance with regard to sustainability a major challenge

- One of the biggest challenges to improved supply chain sustainability
- Absence of standards for measurement and reporting means that some claims of environmental improvement are not verifiable

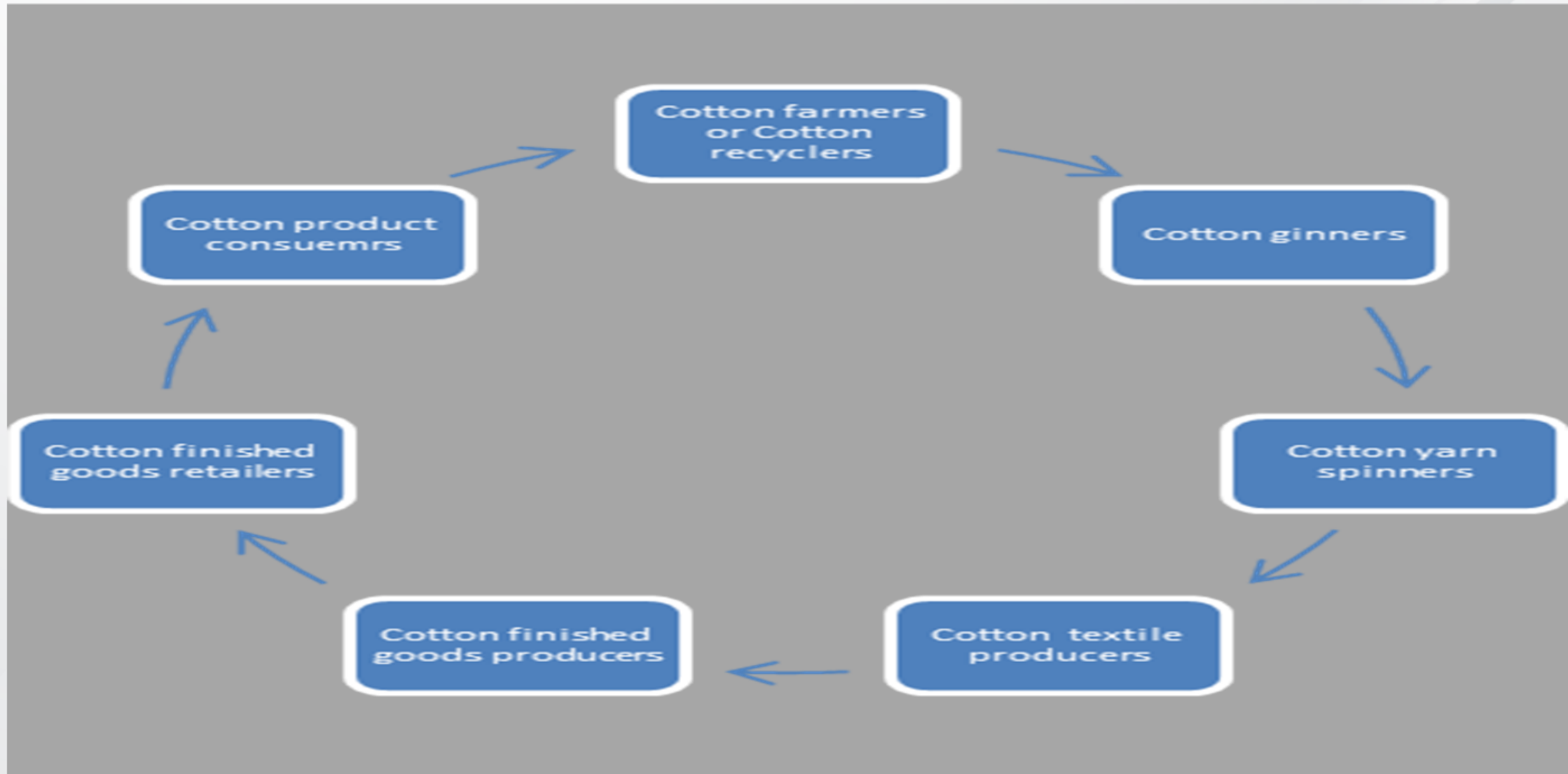
Pricing

- Differential pricing can improve the utilization of assets, leading to resource reduction
 - Delays the need for additional capacity
- Consumption visibility and differential pricing potentially lead to reduce resource consumption
- Biggest challenge is changing the customer's willingness to pay
- Government incentives can encourage customers and firms

Closed-Loop Supply Chains

- Improve sustainability by designing products that use fewer resources and can be recycled and remanufactured
- **Depends on**
 - The incentive to recycle or remanufacture
 - The cost to recycle or remanufacture
- Cannibalization of demand for new products
- Cost of recycling or remanufacturing has a significant impact on the process of recycling

Closed loop of typical cotton products' supply chain



Pricing of Sustainability

- Internalize the “monetary value” of the social or environmental cost
- Incorporate suitable prices for the social and environmental impacts of different actions
- Significant challenges to setting these prices

Pricing Emissions

- Firms will not put sufficient effort into reducing GHGs unless they are “forced” to reduce emissions or required to pay for the social cost of their emission
- **Two approaches**
 - Carbon tax
 - Cap-and-trade system

- **Evaluating pricing mechanisms**

- Cost of administration
- Price volatility
- Emission uncertainty
- New information uncertainty
- Industry competitiveness
- Wealth transfer to energy-exporting countries
- Revenue neutrality

1-Widespread Adoption of AI, Analytics & Automation

- **Artificial intelligence (AI) and machine learning (ML)** are increasingly central to supply-chain planning and decision-making. They're used for demand forecasting, inventory optimization, supplier evaluation, route planning, and more.
- **Predictive and prescriptive analytics** (not just “what happened” but “what will happen / what should we do”) help companies anticipate disruptions or shifts in demand — enabling them to act proactively rather than reactively.
- **Warehouse automation** (robots, autonomous mobile robots, automated storage/retrieval systems) and even autonomous vehicles or drones for last-mile delivery are gaining traction, boosting efficiency, reducing errors, and cutting labor costs.

2- Resilience, Risk Management & Regionalization (Near-/Re-shoring)

- After disruptions from recent global events, many firms are moving away from “just-in-time / lean everywhere” toward more resilient supply-chain models — diversifying suppliers, holding buffer inventory for critical parts, and building redundancies.
- There's a growing trend toward regionalization or near-shoring (using geographically closer or politically stable sourcing partners) to reduce exposure to long-distance shipping risks, geopolitical uncertainties, or port disruptions.
- Flexibility in warehousing and logistics — e.g., pay-per-use or on-demand warehousing — is becoming more common, letting companies scale capacity up/down depending on demand and avoid long-term fixed costs.

3- Real-Time Visibility, IoT & Digital Twins

- Use of IoT devices, smart sensors, GPS trackers, and RFID for real-time shipment and inventory tracking is growing. This gives better visibility across the chain — from raw materials to final delivery — helping forecast delays or detect issues early.
- Some companies are adopting “digital twin” technology: virtual replicas of physical supply-chain networks — allowing simulation of disruptions (weather events, supplier failures, transport delays) so businesses can test and stress-test strategies before real crises hit.

4- Sustainability and ESG Integration

- Environmental, Social, and Governance (ESG) considerations are no longer optional marketing add-ons — they're becoming central to supply-chain planning. Firms are adopting green logistics practices: e.g. optimizing routes to reduce emissions, using renewable-energy transport, green packaging, circular supply-chain models (reuse / recycling / reverse logistics), and waste reduction.
- Especially given rising regulations and consumer demand for ethical products, transparency and traceability in sourcing are becoming more important. That means closer monitoring of supplier practices, emissions, labor conditions, and end-to-end visibility.

5- Customer-Centricity & Logistics Innovation (Faster, Smarter, Customized)

- As consumers increasingly expect faster deliveries (same-day, next-day) and customized service, supply chains are evolving to deliver more quickly and flexibly. This pushes the growth of micro-fulfillment centers (small, automated facilities close to urban areas) to speed up last-mile delivery.
- Integration of IT systems — cloud collaboration, real-time data sharing among suppliers, warehouses, carriers, retailers — is making supply chains more responsive and customer-oriented.

- **AI optimizes inventory management** . This is done by analyzing sales data, supply chain dynamics, and external variables to maintain ideal stock.
- **Demand forecasting**. AI-powered demand forecasting enables companies to predict future demand for products with high accuracy by analyzing a wide range of data sources.
- **Improved warehouse efficiency**. AI, specifically ML models, helps lay out warehouses more efficiently by being able to evaluate the quantity of materials
- **More-timely deliveries**. Manufacturers that assemble products via complex supply chains are especially dependent on timely and well-coordinated deliveries .
- **AI can help make supply chains more sustainable** by optimizing routes and reducing carbon emissions through smart logistics.

الموضوعات البحثية المقترحة

Sustainability, ESG, Circular Economy, and Carbon-Economics (“Carbonomics”)

Resilience & Risk Management under Uncertainty (Climate, Pandemic, Cybersecurity)

AI in warehousing and Logistics

Reshoring, Nearshoring & Geopolitical Risk / Resilience

Last-Mile & Logistics Innovation

Blockchain for Enhanced Transparency and Security in Supply Chain

Strategic sourcing and supplier management in the manufacturing industry

Global Supply Chain Integration

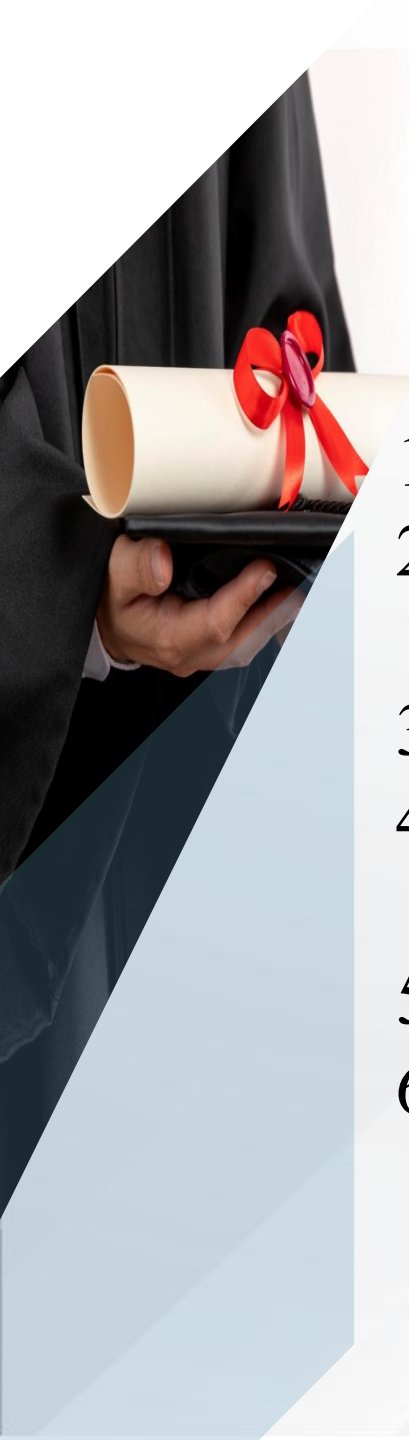
Digital Transformation in Supply Chain Management

Inventory Management and Optimization

E-commerce and Supply Chain Logistics

Supply Chain Disruption and Resilience

Summary of Learning Objectives

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- Supply Chain Council



Thank You