Closing the Loop in Supply Chains

Regulatory and Business Aspects

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Waste Generation
Traditional Supply Chains

Extraction → Production → Distribution → Consumption → Disposal
Extraction → Production → Distribution → Consumption → Recycling
Remanufacturing → Reuse → Refurbishing

Closed-Loop Supply Chains

CLOSING THE LOOP!
Extended Producer Responsibility

- Post-consumer waste + Environmental concerns ➟ EPR regulations
- **Principle**: Polluter pays!
- **Possible tools**: Collection and recycling targets

- **Objectives**:
  - Reduce environmental impact
  - Create design incentives
States with EPR Laws

Product Categories
- Auto Switches
- Batteries
- Carpets
- Cell Phones
- Electronics
- Fluorescent Lighting
- Mercury Thermostats
- Paint
- Pesticide Containers
- Mattresses

Source: Product Stewardship Institute, Inc. (2013)

Number of Product Categories Covered by EPR Law
- Zero
- One
- Two
- Three
- Four
- Five
- Six
- Seven

* Other laws authorizing agencies to require EPR, including Framework laws
WA Implementation

- Washington Materials Management and Financing Authority
- A state-run standard recycling plan
- Total volume of electronics collected: 157 M pounds

A sample of 50 collection points in WA

Major processors in WA
WA Implementation: Product Flow

Consumers

Collectors

Consolidators

Processors

Authority

electronic products

used electronics

valuable parts/materials

other parts/materials

Downstream Recyclers & Brokers

RECYCLING
WA Implementation: Financial Flow

Consumers → Collectors → Authority → Consolidators → Processors

Manufacturers

Pay or be paid

Electronic products → used electronics

Pay

Valuable parts/materials

Other parts/materials

Downstream Recyclers & Brokers

Recycling
WA Implementation

- Elements of EPR Legislation
  - The environmental objective of landfill diversion
  - Central government run entity
  - Assignment of financial responsibility to the producers
Research Questions

• How to model the interactions between the stakeholders?
• How to allocate the costs to producers?
• Who should have the financial and operational responsibility?
• .....
Research Aspects

- **Methods:**
  - LP
  - Game Theory

- **Challenges:**
  - Understand the perspectives and objectives of stakeholders
  - Develop tractable and representative mathematical models

- **Goals:**
  - Effective and efficient business and environmental outcomes
Business Aspects

- **Reuse**
- **Refurbish**: Minor cleaning, part replacement
- **Remanufacture**: Using a mix of used and new products to make products
- **Recycle**: Processing used materials and remaking them into the same material
HP Product Returns Management

- Over 50,000 unit returns ➟ $157 M revenue lost and $50 M handling cost

- **Reasons for returns:**
  - 40% Not compatible with needs
  - 28% Installation problems
  - 20% Defective product
  - 12% Convenience (Better price elsewhere, rumors etc.)

- **Approach:** Develop a comprehensive strategy
  - Reduce the losses due to the returns
  - Recover maximum value from returns
  - Develop competitive advantage
HP Product Returns Management

- **Goals:**
  - To minimize the returns
  - To reduce the cost of handling the returns

- **What has been done:**
  - Started centralized reverse-logistics system
  - Developed decision models for evaluating the used products

- **What to do next?**
  - Change the return policy
  - Create demand for the remanufactured product
Kodak Single-Use Cameras

- Two-stage program:
  1. New designs facilitating the reuse of parts and components
  2. Forced agreements for returning the used cameras to Kodak
IBM Global Asset Recovery

- App. 4% of IBM’s revenue and 11% of IBM’s pre-tax profit (2006)
- Annual collection volume > 1M machines
- 85% are utilized, refurbished and resold
- More than $1.6 billion pre-owned equipment was sold in 2006.
- End-of-life + Waste processed > 50,000 metric tones, only 1.25% to landfill
Take-Aways

• Possible to reach **WIN-WIN** outcomes for the environment and businesses

• We are part of these system!

*What can we do?*
THANK YOU!

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