Managing Transportation in a Supply Chain
Sections 4.3, 4.4 and 4.5
Section 4.3: Design Options for Distribution
4.3.1: Drop-Shipping or Direct Shipping to Consumer

- Products are shipped **directly** to the consumer from the manufacturer
- Manufacturer often uses **package carriers** for delivery
- Retailer is an information collector:
  - It picks consumer orders from customers and passes them to the manufacturers
  - It does not hold product inventory, rather it is purely for order generation (naturally or via promotions, ads)
- E.g.: Medical equipment salespeople can be considered as retailers. Dell, Nordstrom catalogues
Drop shipping for
High-value and low, unpredictable demand items

◆ All consumers’ needs for a particular product is satisfied from a manufacturer:
  All finished goods inventory for a product reside at one manufacturer. Finished goods inventory is **aggregated** over different consumers.
  – Aggregated demand often has smaller standard deviation than the sum of the standard deviations of the individual demands in the aggregation because extremes cancel out.

◆ Manufacturers **postpone** customization of products until an order is placed.
  Component and sub-assembly inventory is **aggregated** over different products.

◆ A wide range of products can be provided at a low cost due to postponement.
  – e.g. Dell uses postponement very effectively.

◆ Direct shipment simplifies retailers’ functions but complicates manufacturers’. Can manufacturer’s handle shipping units one by one to the consumers?
  Manufacturers and retailers must coordinate their actions using an integrated information systems.

◆ **Product returns** are harder to handle.

◆ **Response times** to consumer orders are longer with direct shipping.

◆ **Direct shipping** increases shipment costs.
How to reduce shipment costs for moderate demand?

4.3.2: In-Transit Merge

- The distribution network is too extensive with direct shipping and no economies of scale in transportation costs can be achieved.
- Consider merging shipments at Mergers. Shipments to Mergers are larger so economies of scale is achieved.
- Mergers increase facility costs.
- Mergers can be done within trucks: Cross-docking becomes useful.
- Response time may go up.
- Example:
  - Furniture retailers merge couches and coffee tables produced by different manufacturers
  - Dell merges a Dell PC with a Sony flat screen
How to reduce transportation costs/response times?

4.3.3: Distributor Storage with Carrier Delivery

- Keep finished goods inventory at a **warehouse** which ships to consumers using carriers.
- Shipments from manufacturers to warehouses are in TL or LTL to exploit **economies of scale**.
- Warehouses are physically closer to consumers which leads to
  - Shorter order fulfillment time
  - Shorter distance to cover with package carriers for outbound shipment.
- With respect to In-Transit Merge
  - Inventory aggregation is less because inventory is pushed to warehouses
  - Higher inventory costs
  - Facility costs are higher
- **Easier to run.** Warehouse meets the demands so infrequent orders from manufacturers to warehouses.
- **Less information** to keep track of. Only warehouses need real time demand/order status information.
- **Example:** Amazon
How to provide more delivery service?

4.3.4: Distributor Storage with Last Mile Delivery

- Very similar to Distributor Storage with Carrier Delivery except that the warehouse delivers to the consumers using Milk Runs.
- Transportation costs go up because warehouses are not as effective as package carriers in aggregating loads to have economies of scale.
- Warehouse may need to own a trucking fleet so the physical infrastructure costs are higher. Products must be flowing fast to justify the infrastructure.
- The cost for drivers and load handlers are high. Last mile delivery can be a sound option if labor costs are relatively small with respect to the premium consumers are willing to pay for home delivery.
- Response times are shorter
  - Warehouses are located closer to consumers
  - A private fleet of trucks can deliver faster than package carriers.
- Home delivery is high customer service; appreciated by the customers for bulky products, e.g. a washer.
- Consumer must pay for delivery costs.
  - Peapod charged $9.95/delivery
  - Delivery costs can depend on the time of the day
- Example: Milk delivery, Grocery delivery
How to reduce eliminate consumer’s delivery cost?

4.3.5: Manufacturer or Distributor Storage with Consumer Pickup

- If consumers are willing to pick up the products easily, let them do so. Otherwise, they would be charged for the delivery costs.
- This is very similar to Last Mile Delivery except that the consumers come to pick up sites (warehouse, retailer) to get the products.
- Order tracking is crucial. Consumers must be alerted when their order is ready for pick up. Once a consumer arrives at the pick up site, the products must be quickly located.
- Significant amount of information is required to run.
- Example: 7dream.com of Japanese 7-Eleven
  - Check it out but it is in Japanese
How to push products closer to consumers?

4.3.5: Retail Storage with Consumer Pickup

- Consumers can also pick up from retailers. This is the most common form of shopping.
- This is very similar to consumer pick up from warehouses except that now the consumers go to retailers which are closer to consumers and more conveniently located for pick ups.
- No order tracking necessary. If the product is available at the retailer, the consumer buys. Otherwise goes to another retailer.
- Example: All the retail stores. Wal-Mart, Albertson’s, Van Heusen Shirts, JCPenny.
## Performance: 1 is good

<table>
<thead>
<tr>
<th>Service</th>
<th>Pickup from Retailer</th>
<th>Drop Shipping</th>
<th>In-Transit Merge</th>
<th>Package Carrier Delivery</th>
<th>Last Mile Delivery</th>
<th>Pickup from Warehouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Time</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Product Variety</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Product Availability</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Customer Experience</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Order Visibility</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Returnability</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Inventory</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Transportation</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Facility &amp; Handling</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Information</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>
What value do distributors add to SCs?

- **Economies of scale in inbound transportation costs** to distributors by combining shipments of several products coming from the same manufacturer.
- **Economies of scale in outbound transportation costs** from distributor to retailers by combining shipments coming from several manufacturers and going to the same retailer.
- Inventory aggregation at the distributor as opposed to individual retailer inventories
- Smoothes out orders coming from retailers and going to manufacturers. This is a side effect of combining shipments.
- Distributors provide a compromise strategy, for keeping inventories in the SCs, between
  - Storage at the manufacturer with direct shipments
    » Low inventory cost but high transportation cost
  - Storage at the retailer with customer pickups
    » High inventory cost but low transportation cost
- By specializing on distribution, distributors do a better job in logistics of shipments:
  - On time deliveries
  - Breaking bulk shipments, e.g., kitting
  - Shipment tracking
E-Business and the Distribution Network

◆ Impact of E-Business on Customer Service
  - Faster
    » Response to customer orders
    » New product introductions
    » Modifications of Product portfolios, pricing, promotions
    » Revenue collection
  - Product variety
    » Number of products
  - Product availability
    » Number of products in the storage
      ◆ Improved Information and Aggregation Potential
  - Customer experience
    » Ease (+); After-hours-shopping (+); Distant-shopping (+);
    » Order visibility (-) for the customer.
  - Profit can increase with the removal of the distributors
E-Business and the Distribution Network

- Impact of E-Business on Cost
  - Inventory
    » Improved Information and Aggregation Potential
  - Facilities
    » Facility costs
    » Operating costs
      ♦ Simplification of order taking
      ♦ Increased handling of products
  - Transportation
    » Increased the outbound transportation costs
  - Information
    » Increased demand visibility
    » Increased supplier visibility

- Using E-Business: Dell, Amazon, Peapod, Grainger
13.5: Tradeoffs in Transportation Design

- Transportation, facility, and inventory cost tradeoff
  - Choice of transportation mode
  - Inventory aggregation

- Transportation cost and responsiveness tradeoff
  - Temporal aggregation
    » leads to economies of scale
    » decreases responsiveness
Temporal aggregation: Extremes cancel out

Day 1 Load:

Day 2 Load:

2 trucks at the end of each day (one truck half-full)
or 3 trucks at the end of the 2nd day (both trucks full)?
13.6: Tailored Transportation

- By product characteristics: life cycle, spoilage.
- By customer density and distance
  - High density, short distance: private fleet, milk runs
    » Milkman, 7-Eleven Japan
  - Low density, high distance: package carrier
    » Amazon
- By customer size
  - Various frequencies of deliveries
  - Delivery on Even days to Retailers L and H , on Odd days to Retailer H
- By value and volume
  - If High value, use fast transportation; semiconductor chips
  - If High volume, can afford to disaggregate inventories that is use several warehouses; Wal-Mart DCs
  - If High cube (very heavy), locate next to the source (mining industry).
Routing and Scheduling in Transportation

Use frequency decomposition

◆ Clustering
  – Assignment of trucks to demand points (retailers)
    » Saving matrix method
    » Generalized assignment method

◆ Routing
  – Sequencing demand points; improvement of an existing one
  – Trucks use these sequences to visit demand points

◆ Scheduling
  – Exact time of visits/loading and unloading

Clustering of Chinese Cities based on 2015 GDP
Is your emerging-market strategy local enough?
McKinsey Quarterly, April 2011
Classification: Vehicle Routing Problems

- **Demand uncertainty**
  - Repair operations, spare parts demand for Xerox machines
- **The nature of operations:** pick up / load
- **Planning periods:** Single vs. Multiple
  - In multiple periods, initial configuration of where trucks are every period can be different.
- **Static vs. Dynamic**, to the extent real time info used
  - Wireless technologies can help
  - After all what are RFID (Radio Frequency ID) tags for?
- **Fleet capacity, known?** Strategic vs Operational.
- **Delivery** time windows.
  - I want
    - my paper in the morning
    - my pizza in the night
- **Objective:** transportation costs, inventory costs, crew costs
Summary

- Distribution network design
- Clustering and Sequencing

For more take “OPRE 6370: Logistics and Distribution” offered every Fall semester.