Chapter 7
Distribution Strategies

7.1 Introduction
- Focus on the distribution function.
- Various possible distribution strategies, and the opportunities and challenges associated with these strategies.
- Two fundamental distribution strategies:
  - Items can be directly shipped from the supplier or manufacturer to the retail stores or end customer
  - Use intermediate inventory storage points (typically warehouses and/or distribution centers).

Issues with warehouses
- Manufacturing strategy (make-to-stock vs. make-to-order)
- Number of warehouses
- Inventory policy
- Inventory turnover ratio
- Internal warehouses vs. outside distributor
- Owned by a single firm or by a variety of firms

7.2 Direct Shipment Distribution Strategies
- Advantages:
  - The retailer avoids the expenses of operating a distribution center
  - Lead times are reduced.
- Disadvantages:
  - Risk-pooling effects are negated
  - Manufacturer and distributor transportation costs increase
- Commonly used scenarios:
  - Retail store requires fully loaded trucks
  - Often mandated by powerful retailers
  - Inventories are critical.
  - Manufacturer may be reluctant but may have no choice
  - Prevalent in the grocery industry
    - Lead times are critical because of perishable goods.

7.3 Intermediate Inventory Storage Point Strategies
- Variety of characteristics distinguish different strategies.
- Length of time inventory is stored at warehouses and distribution centers.
- Strategies:
  - Traditional warehousing strategy
    - Distribution centers and warehouses hold stock inventory
    - Provide their downstream customers with inventory as needed.
  - Cross-docking strategy
    - Warehouses and distribution centers serve as transfer points for inventory
    - No inventory is held at these transfer points.
  - Centralized pooling and transshipment strategies
    - May be useful when there is a large variety of different products.

Traditional Warehousing
- Inventory management and risk pooling key factors
- Other factors also play a significant role
  - Centralized vs Decentralized Management
  - Central vs Local Facilities

Centralized vs Decentralized Management
- Decentralized system
  - Each facility identifies its most effective strategy without considering the impact on the other facilities in the supply chain.
  - Leads to local optimization.
- Centralized system
  - Decisions are made at a central location for the entire supply network.
  - Typical objective: minimize the total cost of the system subject to satisfying some service-level requirements.
  - Centralized control leads to global optimization.
  - At least as effective as the decentralized system.
  - Allow use of coordinated strategies
- If system cannot be centralized
  - Often helpful to form partnerships to approach the advantages of a centralized system.
Central vs. Local Facilities

- Centralized facilities:
  - Employ both fewer warehouses and distribution centers
  - Facilities are located further from customers.

- Other factors:
  - Safety stock: Lower safety stock levels with centralized facilities
  - Overhead: Lower total overhead cost with centralized facilities
  - Economies of scale: Greater economies of scale with centralized facilities
  - Lead time: Lead time to market reduced with local facilities
  - Service: Utilization of risk pooling better with centralized
  - Shipment times better with local
  - Transportation costs:
    - Costs between production facilities and warehouses higher with local
    - Costs from warehouses to retailers lesser with local

A Hybrid Decision

- Some products use centralized strategy while others use local strategy
- Not an either or decision
- Varying degrees of centralization and localization due to the varying levels of advantages and disadvantages

Cross-Docking

- Popularized by Wal-Mart
- Warehouses function as inventory coordination points rather than as inventory storage points.
- Goods arriving at warehouses from the manufacturer:
  - are transferred to vehicles serving the retailers
  - are delivered to the retailers as rapidly as possible.
- Goods spend very little time in storage at the warehouse:
  - Often less than 12 hours
  - Limits inventory costs and decreases lead times

Issues with Cross-Docking

- Require a significant start-up investment and are very difficult to manage
- Supply chain partners must be linked with advanced information systems for coordination
- A fast and responsive transportation system is necessary
- Forecasts are critical, necessitating the sharing of information.
- Effective only for large distribution systems
  - Sufficient volume every day to allow shipments of fully loaded trucks from the suppliers to the warehouses.
  - Sufficient demand at retail outlets to receive full truckload quantities

Inventory Pooling – GM Example

- 1,500 Cadillacs parked at a regional distribution center in Orlando
- Await delivery to dealers statewide within 24 hours
- 10% to 11% sales loss because a car is not available...
- Test program expected to:
  - Improve customer service
  - Boost sales of Cadillacs by 10%

Centralized Pooled Systems Perform Better

- For the same inventory level, a centralized system provides:
  - higher service level
  - higher sales
- Push-pull supply chain
  - Moving from a push supply chain
    - Dealers have to order before demand is realized
    - To a push-pull supply chain
    - Dealers pull from regional distribution centers.
- Implications:
  - End consumers will see better customer service
  - More cars are available to them.
Other Factors
- Will GM sell more cars to GM dealers?
  - Total number of cars ordered by dealers will not necessarily increase, even as customer service increases.
- What about the dealers?
  - Dealers have access to more inventory
  - Potentially can sell more.
  - Levels out the playing field between dealers.
  - Small dealers would favor such a system Competitive advantage of large dealers wiped out.

Example of Inventory Pooling
- Two retailers face random demand for a single product.
- No differences between the retailers
- Compare two systems
  - centralized pooled system,
    - retailers together operate a joint inventory facility
    - take items out of the pooled inventory to meet demand.
  - decentralized system
    - each retailer individually orders from the manufacturer to meet demand
- In both systems, inventory is owned by the retailers.

The Two Systems
- FIGURE 7-9: The centralized and decentralized systems
- FIGURE 7-10: Probabilistic demand faced by each retailer

Other Data
- Wholesale price = $80 per unit
- Selling price = $125 per unit
- Salvage value = $20 per unit
- Production cost = $35 per unit

Costs and Profits in the Two Systems
- Decentralized system
  - Each dealer orders 12,000 units
  - Expected profit per dealer = $470,000, Total = $940,000
  - Expected sales = 11,340 units, Total = 22,680 units
  - Manufacturer profit = $1,080,000
- Centralized system
  - Two dealers together will order 26,000 units
  - Total expected profit = $1,009,392
  - Joint expected sales = 24,470 units
  - Manufacturer profit = $1,170,000

Customer Search
- If the customer arrives at a dealer and does not find the item
  - Switches to another dealer
  - Helps the manufacturer sell more products
- Which system is better under customer search?
  - No impact on the centralized system
Impact on Decentralized System

- If a dealer knows that its competitors do not keep enough inventory:
  - this dealer should raise the inventory level to satisfy:
    - its own demand
    - demand of customers who initially approach other dealers with limited inventory.
- If a dealer knows that its competitors has significant inventory:
  - this dealer will reduce the inventory level
  - It is not likely to see customers who switch dealers.
- Dealer’s strategy depends on its competitor’s strategy.
- Dealers may/may not know their competitor strategy:
  - not clear how they decide on their inventory level.
  - not clear about the impact of search on the manufacturer.

Nash Equilibrium (Game Theory)

- If two competitors are making decisions, they have reached Nash equilibrium if they have both made a decision:
  - Both have decided on an amount to order
  - neither can improve their expected profit by changing the order amount if the other dealer doesn’t change his order amount.

Example

- $\alpha$ = percentage of customers that search the system
- Each retailer can determine what their effective demand will be if the other retailer orders a specific amount.
- Based on this information, they can calculate how much they should order given any order by their competitors.
- Best response

Best Response with $\alpha=90\%$

![Retailers' best response](image)

Nash Equilibrium of the System

- Retailer one orders about 20,000 units, retailer two will respond by ordering about 12,000 units
- If this is the case, then retailer one should modify its strategy and reduce the order quantity
- No retailer has an incentive to modify its strategy
- They order amounts associated with the intersection of the two curves.
- Optimal order quantity for each retailer = 13,900 units
- Total expected profit for each retailer = $489,460
- Total expected profit = $978,920
- Total expected sales = 25,208
- Total amount ordered from the manufacturer = 27,800
- Manufacturer’s profit = $1,251,000.

Decentralized and Centralized Systems for Search Level of 90%

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Retailers</th>
<th>Manufacturer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decentralized</td>
<td>978,920</td>
<td>1,251,000</td>
<td>2,229,920</td>
</tr>
<tr>
<td>Centralized</td>
<td>1,006,392</td>
<td>1,170,000</td>
<td>2,176,392</td>
</tr>
</tbody>
</table>

- Centralized system does not dominate the decentralized system.
- Retailers prefer the centralized system
- Manufacturer’s profit is higher in the decentralized system.
As $\alpha$ Increases

- Each retailer’s order quantity and profit increases
- Retailers’ total expected profit will be higher in the centralized pooling system than in the decentralized system.

As $\alpha$ Increases

- With larger $\alpha$
  - retailers will order more in a decentralized system
  - manufacturer will prefer a decentralized system
  - retailers will prefer a centralized system
- With smaller $\alpha$
  - manufacturer will order less in a decentralized system
  - both the retailers and the manufacturer will prefer a centralized pooling system.

Effect of $\alpha$ on Amounts Ordered

Critical Search Level

- Presence of a critical search level
  - manufacturer prefers the centralized system below the level
  - otherwise, manufacturer prefers the decentralized system.
- Manufacturer always prefers a higher search level

How Can the Search Level Be Increased?

- Increase brand loyalty
  - customers will more likely search for a particular brand at another retailer if their first choice does not have the product in inventory.
- Information technology initiatives to increase communication between retailers
  - increases the ease with which customers can search in the system
  - higher likelihood that customers will search in the system

Transshipment

- Shipment of items between different facilities at the same level in the supply chain to meet some immediate need
- Occurs mostly at the retail level
- Can be achieved:
  - with advanced information systems
  - Shipping costs are reasonable
  - Retailers have same owner
Retailers with Different Owners

- May not want to do transshipments
- Distributor Integration strategies may be adopted
- Not clear regarding inventory levels
  - A retailer’s strategy depends on competitors’ strategies

Which Strategy to Adopt?

- Different approaches for different products
- Factors:
  - Customer demand and location
  - Service level
  - Costs => transportation & inventory costs
  - Demand Variability

Summary of the Distribution Strategies

<table>
<thead>
<tr>
<th>Strategy Type</th>
<th>Direct Shipment</th>
<th>Cross-docking</th>
<th>Inventory at Warehouses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real pooling</td>
<td>Takedown cost</td>
<td>Takedown cost</td>
<td></td>
</tr>
<tr>
<td>Transportation cost</td>
<td>Reduced inbound costs</td>
<td>Reduced inbound costs</td>
<td></td>
</tr>
<tr>
<td>Holding costs</td>
<td>No holding costs</td>
<td>No holding costs</td>
<td></td>
</tr>
<tr>
<td>Allocation</td>
<td>Cross-docked</td>
<td>Cross-docked</td>
<td></td>
</tr>
</tbody>
</table>

Summary

- Critical to implement effective distribution strategies regardless of the total level of supply chain integration.
- Strategies:
  - Direct shipping
  - Warehouses or distribution centers
- Related decisions:
  - Should there be many or only a few warehouses or DC’s?
  - Should inventory be held at these locations, or transshipped?
  - As a retailer, does it make sense to participate in a centralized inventory pooling system?
  - What about a transshipment system?