Chapter 4

Designing the Distribution Network in a Supply Chain

After this discussion, you should be able to understand:

- The role of distribution in a supply chain
- The key factors influencing distribution network design
- The design options for a distribution network
- Assessment of the value, the strengths and weaknesses of various distribution options
- Distribution networks in practice
- Summary thinking questions

Borders & Amazon.com …

AMAZON.com
- The world largest on-line book store
- Deliver time : about a week
- Warehouse: 5
- Inventory turnover: 12

BORDERS
- The large book store with on-line store
- Deliver time : within one day
- Warehouse: 400
- Inventory turnover: 2

More stories: Dell, HP, Gateway – same industry, different distribution networks
7- Eleven and Wal-Mart – both highly profitable, different networks

The choice of distribution network can be used to achieve a variety of supply chain objectives raging from low cost to high responsiveness

GM case:

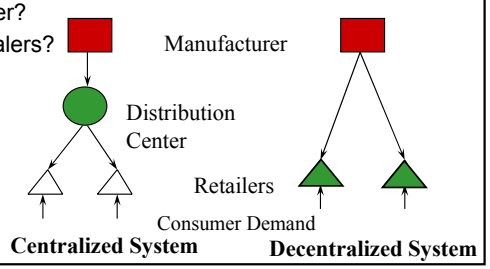
- In 1994, General Motors was planning to test a program in Florida to reduce the amount of time Cadillac buyers must wait for new cars

- *Under the program, which begins in mid-September, about 1,500 Cadillacs will be parked at a regional distribution center in Orlando, Fla, to await delivery to dealers statewide within 24 hours….GM hopes improving customer service will boost sales of Cadillacs…Research shows we lose 10% to 11% of sales because the car is not available… GM says the test program will increase Cadillac sales by 10%.*

–The Wall Street Journal, August 1994

GM - Cadillac Distribution Systems

- What is GM trying to achieve?
  - Centralized distribution system performs better than a decentralized system
  - For the same inventory level, centralized system provides higher service level, and hence higher sales
    - » The Risk Pooling Concept
- Is the centralized system a better system?
  - Better for the manufacturer?
  - Better for the retailers/dealers?



- **Compaq computer estimates it lost $500 million to $1 billion in sales in 1995 because its laptops and desktops were not available when and where customers were ready to buy them.**

  Boeing Aircraft, one of America's leading capital goods producers, was forced to announce writedowns of $2.6 billion in October 1997.
  The reason? "Raw material shortages, internal and supplier parts shortages…". (Wall Street Journal, Oct. 23, 1997)

Questions:

- *What the role of distribution networks?*
- *What are the optional networks?*
- *How to evaluate a network?*
- *Value of each system?*

The Role of Distribution in the Supply Chain

- ***Distribution***:
  the steps taken to move and store a product from the supplier stage to the customer stage in a supply chain
  - Distribution related costs form about 10.5% of the US economy, and about 20% of manufacturing cost
  - directly affects cost and the customer experience and therefore drives profitability
  - long term effect to the company
  - Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness

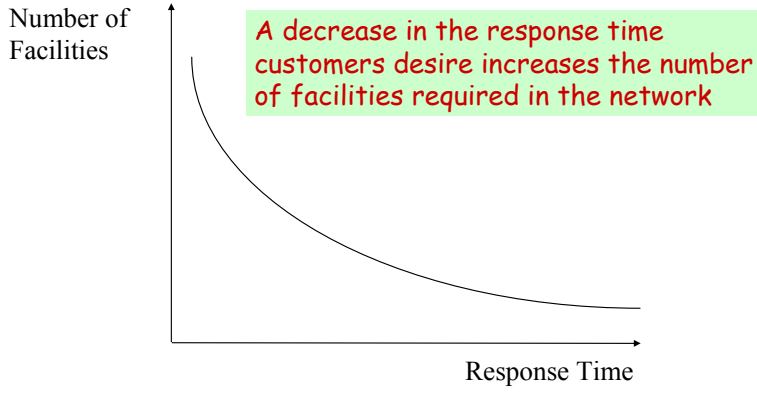
Factors Influencing Distribution Network Design

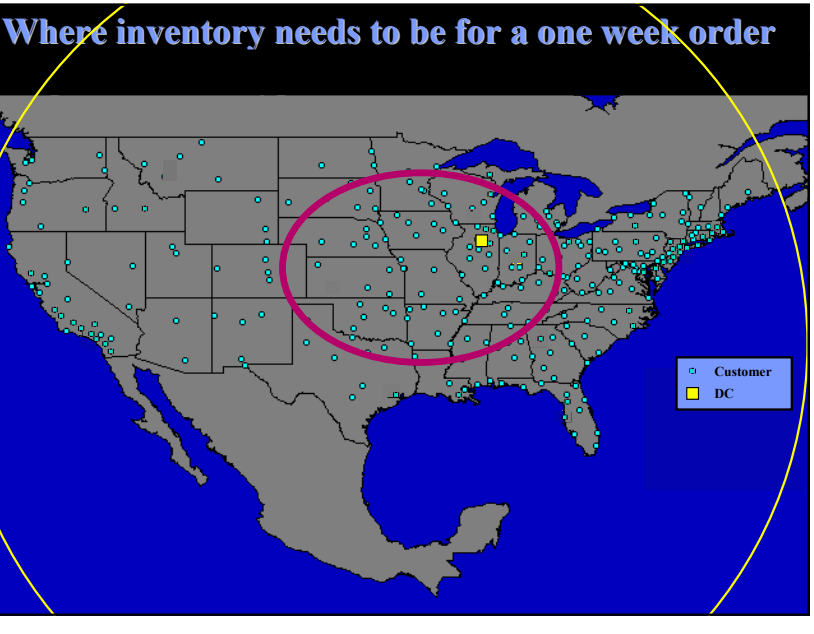
- Distribution network performance evaluated along two dimensions at the highest level:
  - Customer needs that are met
  - Cost of meeting customer needs
- Distribution network design options must therefore be compared according to their impact on customer service and the cost to provide this level of service

Factors Influencing Distribution Network Design

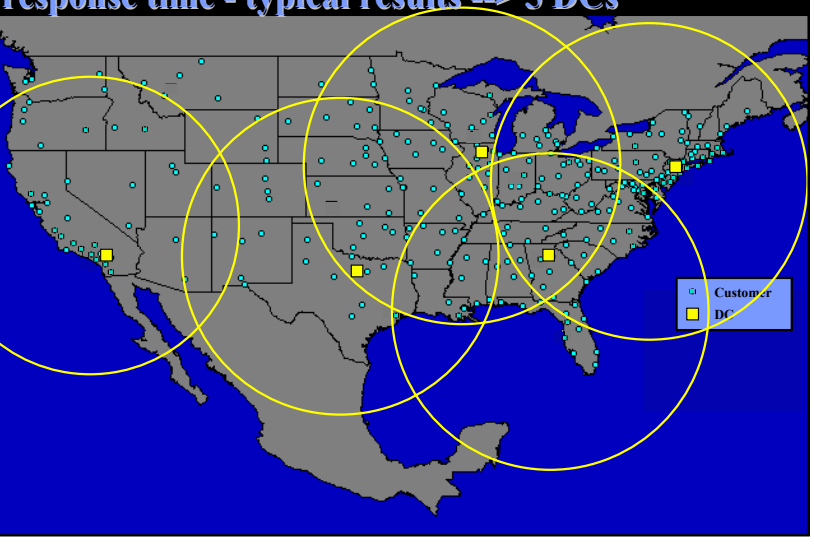
- Key customer needs or the elements of customer service influenced by network structure:
  - Response time
  - Product variety
  - Product availability
  - Customer experience
  - Order visibility
  - Returnability …
- Supply chain costs affected by network structure:
  - Inventories
  - Transportation
  - Facilities and handling
  - Information …

Service Time and Number of Facilities

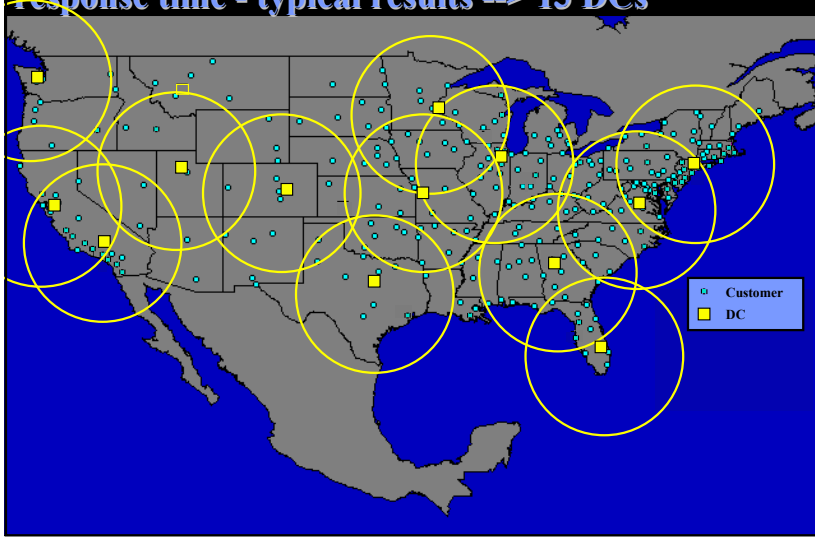




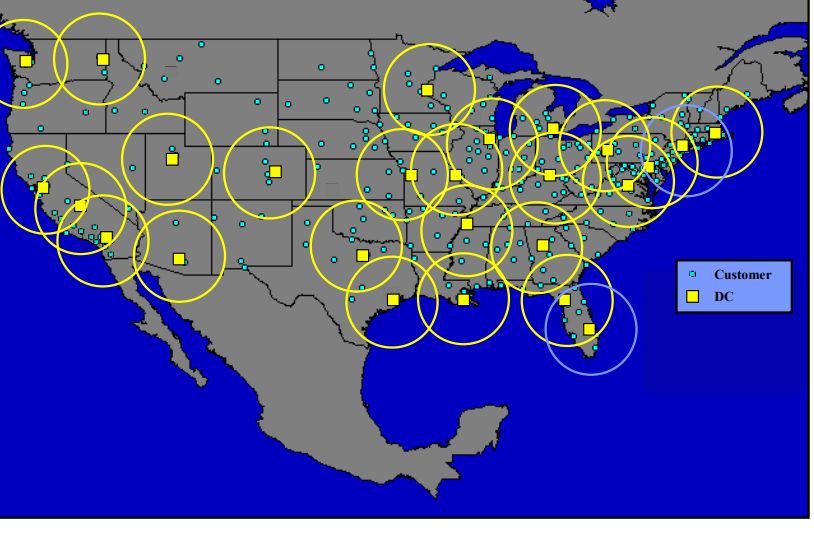
Where inventory needs to be for a 3 day order response time - typical results --> 5 DCs



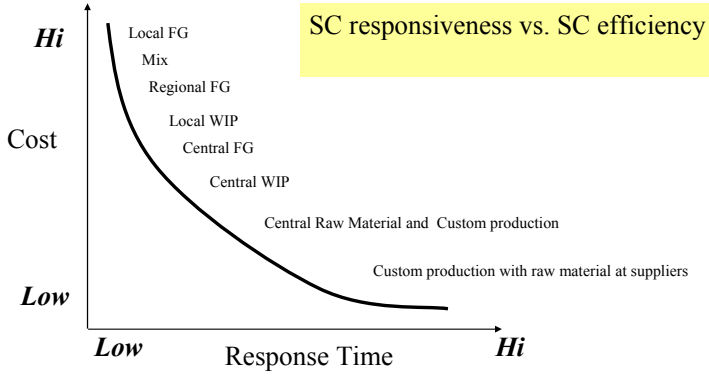
Where inventory needs to be for a next day order response time - typical results --> 13 DCs



Where inventory needs to be for a same day / next day order response time - typical results --> 26 DCs

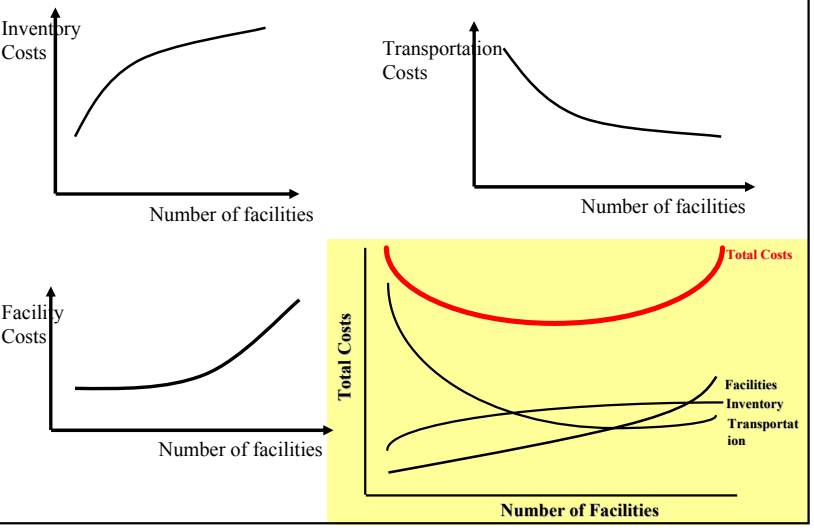


The Cost-Response Time Frontier

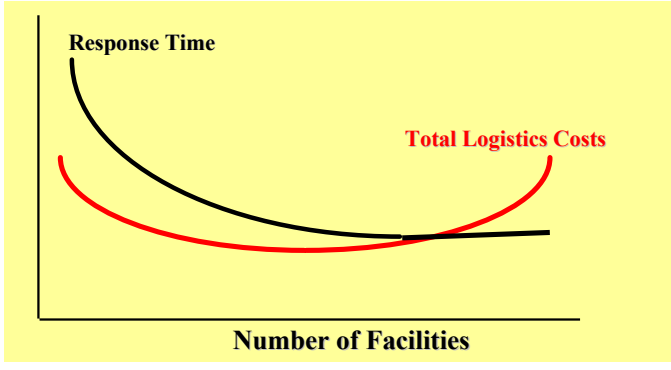


SC responsiveness vs. SC efficiency

Logistics Costs and Number of Facilities



Variation in Logistics Costs and Response Time with Number of Facilities



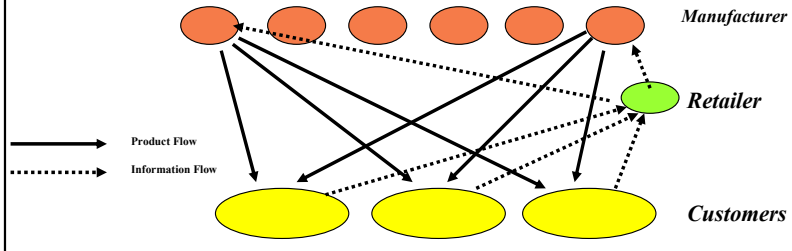
Critical decision: How to optimize the distribution network to achieve a satisfactory customer service standard with the minimum possible cost?

Design Options for a Distribution Network

- Manufacturer Storage with Direct Shipping
- Manufacturer Storage with Direct Shipping and In-Transit Merge
- Distributor Storage with Carrier Delivery
- Distributor Storage with Last Mile Delivery
- Manufacturer or Distributor Storage with Consumer Pickup
- Retail Storage with Consumer Pickup
- Selecting a Distribution Network Design
- ….

Manufacturer Storage with Direct Shipping

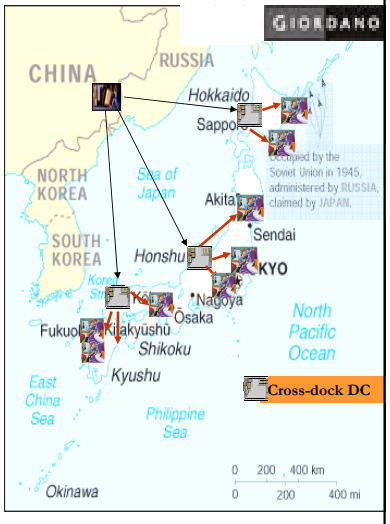
(Fig. 4.6)



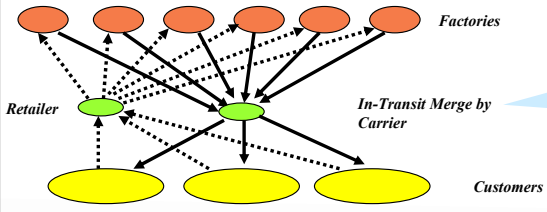
- Retailers carry no inventories. The ownership of inventories is at manufacturers
- Example networks: eBags, Gateway, Nordstrom.com (for slow moving items) and W.W.Grainger
- Advantages:
  - Aggregate demand and centralized inventory, which is good for high-value, low demand items with unpredictable demand.
  - -- Manufacturer can postpone the customization till the order is placed
- Response time is large. Transportation (outbound) cost is high. And so is for information infrastructure.

Giordano (Hong Kong)

- Distribution strategy to its Japan market changes.
- Old strategy: Products sent from China to Tokyo warehouse, then distributed to retailing stores.
- New strategy: Send products from China to retailing stores directly through cross-docking at Narita airport, using airplane.
- Tradeoff between warehouse cost and transportation cost. (about the same)
  - Distribution time and sales increased (due to the most updated information)



In-Transit Merge Network (Fig. 4.7)



Combines pieces of the order from different locations so the customer gets a single delivery

TABLE 4.2 Performance Characteristics of In-Transit Merge

Cost Factor	*Performance*
Inventory	Similar to drop-shipping.
Transportation	Somewhat lower transportation costs than drop-shipping.
Facilities and handling	Handling costs higher than drop-shipping at carrier; receiving costs lower at customer.
Information	Investment is somewhat higher than for drop-shipping.
Service Factor	*Performance*
Response time	Similar to drop-shipping; may be marginally higher.
Product variety	Similar to drop-shipping.
Product availability	Similar to drop-shipping.
Customer experience	Better than drop-shipping because a single delivery has to be received.
Order visibility	Similar to drop-shipping.
Returnability	Similar to drop-shipping.

DELL SONY

Distributor Storage with Carrier Delivery (Fig. 4.8)

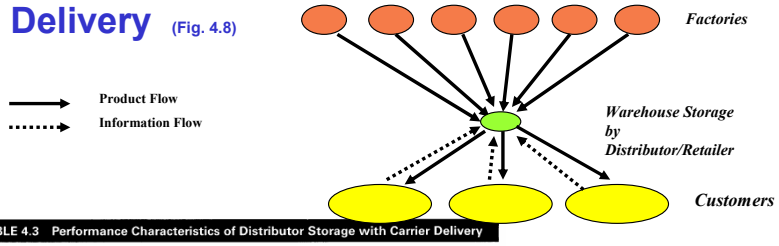


TABLE 4.3 Performance Characteristics of Distributor Storage with Carrier Delivery

Cost Factor	*Performance*
Inventory	Higher than manufacturer storage. Difference is not large for faster moving items.
Transportation	Lower than manufacturer storage. Reduction is highest for faster moving items.
Facilities and handling	Somewhat higher than manufacturer storage. The difference can be large for slow-moving items.
Information	Simpler infrastructure compared to manufacturer storage.
Service Factor	*Performance*
Response time	Faster than manufacturer storage.
Product variety	Lower than manufacturer storage.
Product availability	Higher cost to provide the same level of availability as manufacturer storage.
Customer experience	Better than manufacturer storage with drop-shipping.
Order visibility	Easier than manufacturer storage.
Returnability	Easier than manufacturer storage.

Distributor Storage with Last Mile Delivery (Fig. 4.9)

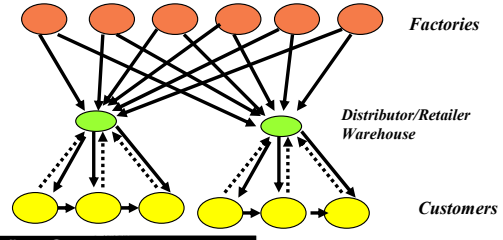


TABLE 4.4 Performance Characteristics of Distributor Storage with Last Mile Delivery

Cost Factor	*Performance*
Inventory	Higher than distributor storage with package carrier delivery.
Transportation	Very high cost given minimal scale economies. Higher than any other distribution option.
Facilities and handling	Facility costs higher than manufacturer storage or distributor storage with package carrier delivery, but lower than a chain of retail stores.
Information	Similar to distributor storage with package carrier delivery.
Service Factor	*Performance*
Response time	Very quick. Same day to next day delivery.
Product variety	Somewhat less than distributor storage with package carrier delivery but larger than retail stores.
Product availability	More expensive to provide availability than any other option except retail stores.
Customer experience	Very good, particularly for bulky items.
Order traceability	Less of an issue and easier to implement than manufacturer storage or distributor storage with package carrier delivery.
Returnability	Easier to implement than other options. Harder and more expensive than a retail network.

Manufacturer or Distributor Storage with Customer Pickup (Fig. 4.10)

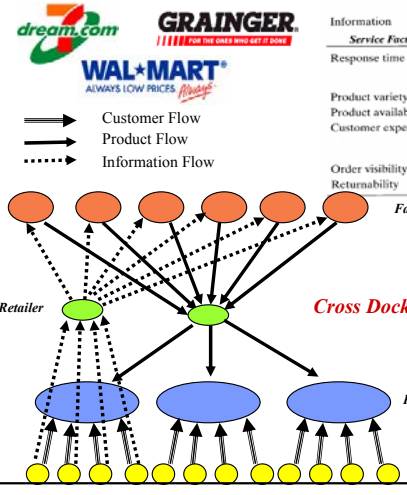


TABLE 4.5 Performance Characteristics of Network with Consumer Pickup Sites

Cost Factor	Performance
Inventory	Can match any other option depending on the location of inventory.
Transportation	Lower than the use of package carriers, especially if using an existing delivery network.
Facilities and handling	Facility costs can be very high if new facilities have to be built. Costs are lower if existing facilities are used. The increase in handling cost at the pickup site can be significant.
Information	Significant investment in infrastructure required.
Service Factor	**Performance**
Response time	Similar to package carrier delivery with manufacturer or distributor storage. Same day delivery possible for items stored locally at pickup site.
Product variety	Similar to other manufacturer or distributor storage options.
Product availability	Similar to other manufacturer or distributor storage options.
Customer experience	Lower than other options because of the lack of home delivery. In areas with high density of population loss of convenience may be small.
Order visibility	Difficult but essential.
Returnability	Somewhat easier given that pickup location can handle returns.

A distribution strategy in which the stores
or other points are supplied by central warehouse that act as coordinators of the supply process and as transshipment
points for incoming orders from outside vendors.

Questions to be answered:

- How many and where the cross-docking points needed?
- Is cross-docking strategies better than traditional strategy?
- How should it be implemented?

What accounts for Wal-Mart's remarkable success?

- In 1979, Kmart was the king of the retail industry with 1891 stores and average revenues per store of $7.25 million
- At that time Wal-Mart was a small niche retailer in the South with only 229 stores and average revenues about half of those Kmart stores.
- Ten years later, Wal-Mart transformed itself; it has the highest sales per square foot, inventory turnover and operating profit of any discount retailer. Today Wal-Mart is the largest and highest profit retailer in the world.
- The starting point was a relentless focus on satisfying customer needs; Wal-Mart goal was simply to provide customers access to goods when and where they want them and to develop cost structures that enable competitive pricing
- The key to achieving this goal was to make the way the company replenished inventory the centerpiece of its strategy.
- This was obtained by using a logistics technique known as **cross-docking**. Here goods are continuously delivered to Wal-Mart's warehouses where they are dispatched to stores without ever sitting in inventory.
- This strategy reduced Wal-Mart's cost of sales significantly and made it possible to offer everyday low prices to their customers.

Characteristics of Cross-Docking:

- Goods spend at most 48 hours in the warehouse,
- Avoids inventory and handling costs,
- Wal-Mart delivers about 85% of its goods through its warehouse system, compared to about 50% for Kmart,
- Stores trigger orders for products.
- Very difficult to manage,
- Requires linking Wal-Mart's distribution centers, suppliers and stores to guarantee that any order is processed and executed in a matter of hours,
- Wal-Mart operates a private satellite-communications system that sends point-of-sale data to all its vendors allowing them to have a clear vision of sales at the stores
- Need a fast and responsive transportation system:
- Wal-Mart has a dedicated fleet of 2000 truck that serve their 19 warehouses
- This allows them to
  - ship goods from warehouses to stores in less than 48 hours
  - replenish stores twice a week on average.

Comparative Performance of Delivery Network Designs (Table 4.7)

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor storage with last mile delivery	Manufacturer storage with pickup
Response Time	1	4	4	3	2	4
Product Variety	4	1	1	2	3	1
Product Availability	4	1	1	2	3	1
Customer Experience	5	4	3	2	1	5
Order Visibility	1	5	4	3	2	6
Returnability	1	5	5	4	3	2
Inventory	4	1	1	2	3	1
Transportation	1	4	3	2	5	1
Facility & Handling	6	1	2	3	4	5
Information	1	4	4	3	2	5

Linking Product Characteristics and Customer Preferences to Network Design

	Retail Storage with Customer Pickup	Manufacturer Storage with Direct Shipping	Manufacturer Storage with In-Transit Merge	Distributor Storage with Package Carrier Delivery	Distributor storage with last mile delivery	Manufacturer storage with pickup
High demand product	+2	-2	-1	0	+1	-1
Medium demand product	+1	-1	0	+1	0	0
Low demand product	-1	+1	0	+1	-1	+1
Very low demand product	-2	+2	+1	0	-2	+1
Many product sources	+1	-1	-1	+2	+1	0
High product value	-1	+2	+1	+1	0	-2
Quick desired response	+2	-2	-2	-1	+1	-2
High product variety	-1	+2	0	+1	0	+2
Low customer effort	-2	+1	+2	+2	+2	-1

Distribution Networks in Practice

- The key factors to be considered when designing the distribution network: customer needs to be met, and the cost of meeting these needs
- **The ownership structure** of the distribution network can have as big as an impact as **the type of physical flows** in distribution network
- The choice of a distribution network has very long-term consequences
- Consider whether an exclusive distribution strategy is advantageous. A hybrid distribution network is often the optimal choice
- Product, price, commoditization, and criticality have an impact on the type of distribution system preferred by customers

Think Questions:

- What roles do distribution play in the supply chain?
- What are the key factors to be considered when designing the distribution network?
- What are the strengths and weaknesses of various distribution options?
- What types of distribution networks are typically best suited for commodity items? Why?
- What types of networks are best suited to highly differentiated products?
- What are some examples of very effective distribution networks?