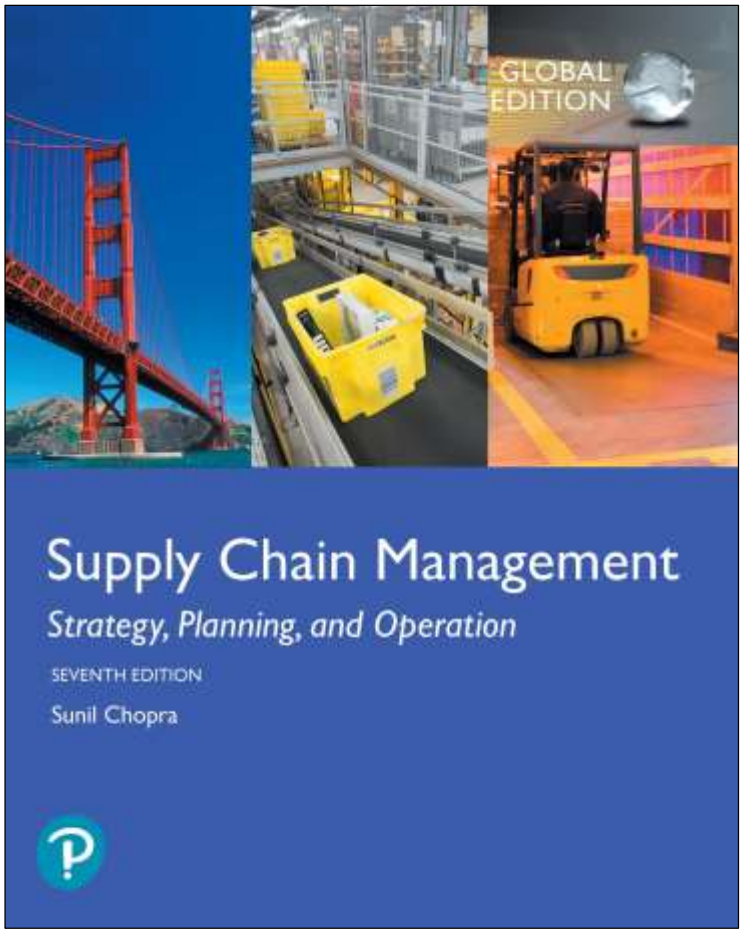
Supply Chain Management: Strategy, Planning, and Operation

Seventh Edition, Global Edition



Chapter 4

Designing Distribution Networks and Applications to Omni-Channel Retailing

Pearson

Learning Objectives

4.1 Identify the key factors to be considered when designing a distribution network.

4.2 Discuss the strengths and weaknesses of various distribution options.

4.3 Describe how omni-channel retail may be structured to be both cost effective and responsive to customer needs.

Distribution Network Design 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
- Drives profitability by directly affecting supply chain cost and the customer value
- Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness

Factors Affecting Distribution Network Design (1 of 3)

- Distribution network performance evaluated along two dimensions
  1. Value provided to the customer
  2. Cost of meeting customer needs
- Evaluate the impact on customer service and cost for different distribution network options
- Profitability of the delivery network determined by revenue from met customer needs and network costs

Factors Affecting Distribution Network Design (2 of 3)

- Elements of customer service influenced by network structure:
  - Response time
  - Product variety
  - Product availability
  - Customer experience
  - Time to market
  - Order visibility
  - Returnability

Factors Affecting Distribution Network Design (3 of 3)

- Supply chain costs affected by network structure:
  - Inventories
  - Transportation
  - Facilities
  - Information

Desired Response Time and Number of Facilities

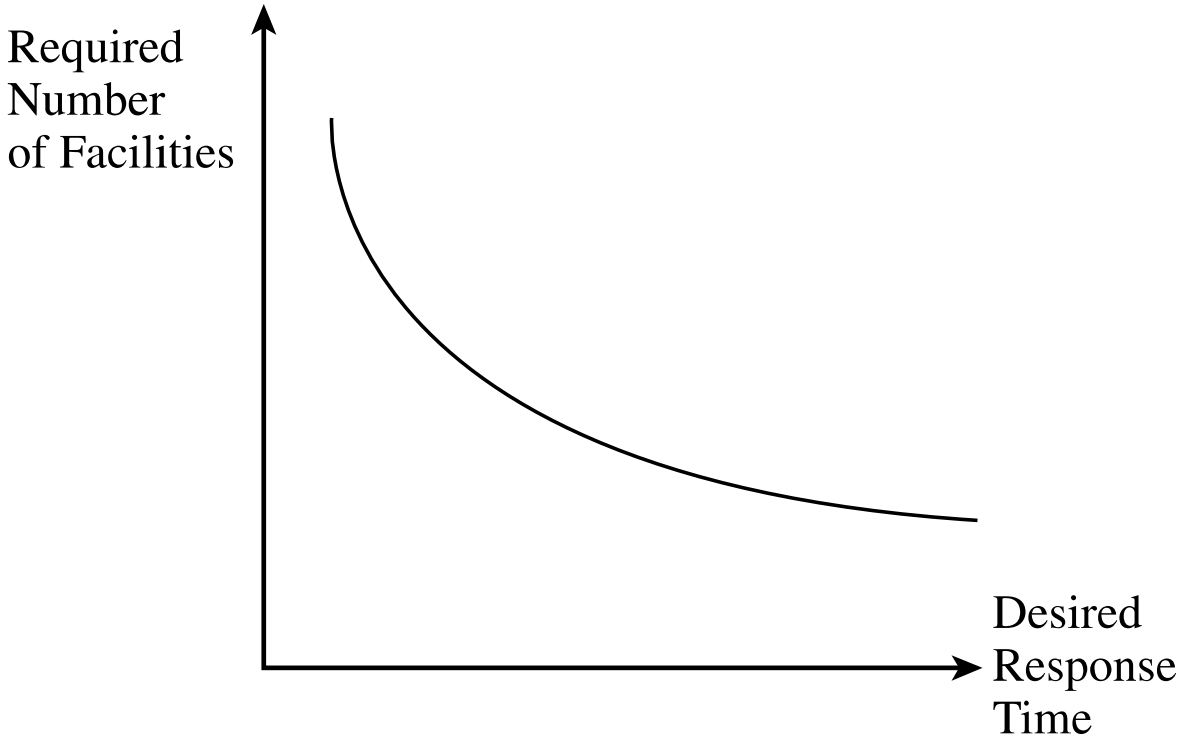


Figure 4-1 Relationship Between Desired Response Time and Number of Facilities

Inventory Costs and Number of Facilities

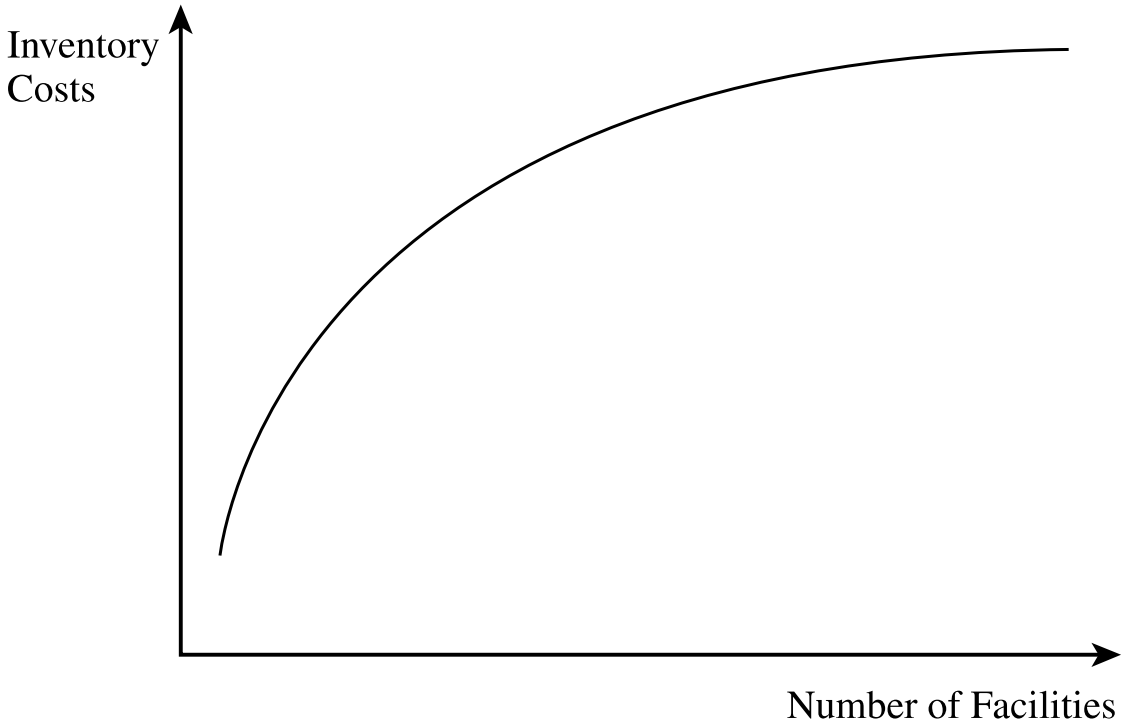


Figure 4-2 Relationship Between Number of Facilities and Inventory Costs

Transportation Costs and Number of Facilities

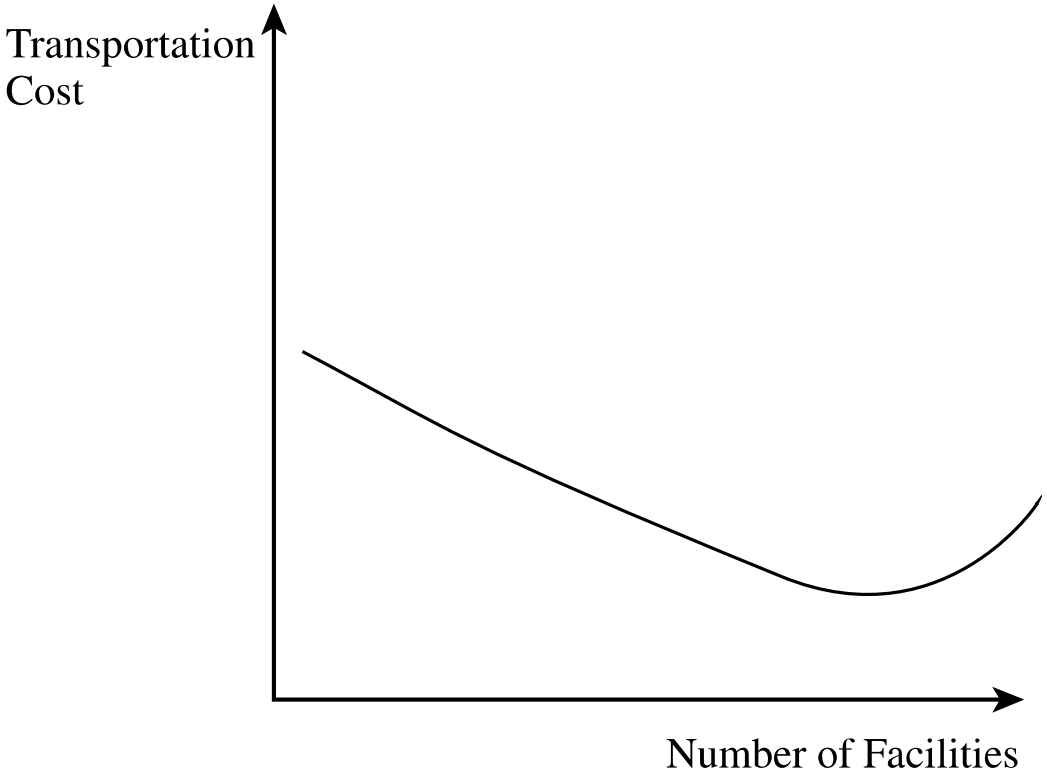


Figure 4-3 Relationship Between Number of Facilities and Transportation Cost

Facility Costs and Number of Facilities

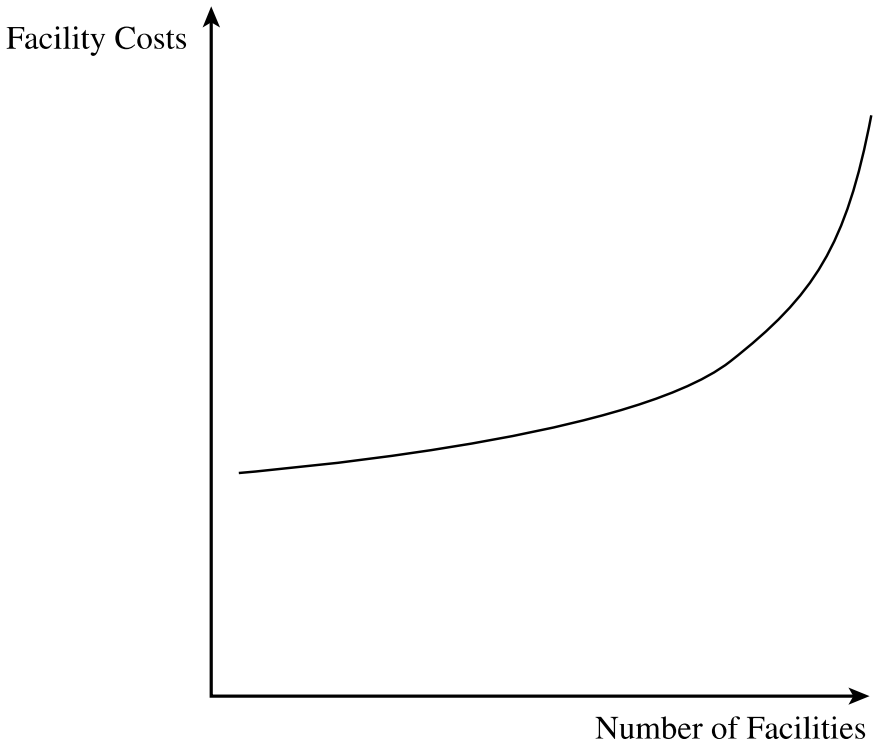


Figure 4-4 Relationship Between Number of Facilities and Facility Costs

Logistics Cost, Response Time, and Number of Facilities

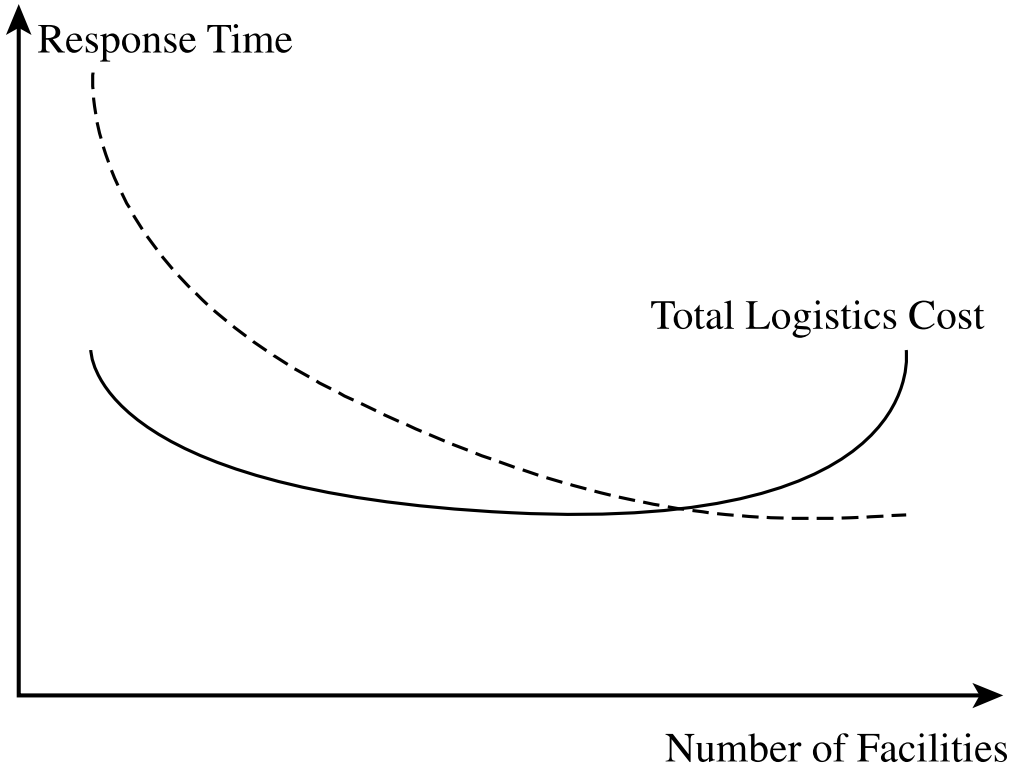


Figure 4-5 Variation in Logistics Cost and Response Time with Number of Facilities

Summary of Learning Objective 1

A manager must consider the customer needs to be met and the cost of meeting these needs when designing the distribution network. Some key customer needs to be considered include response time, product variety/availability, convenience, order visibility, and returnability. Important costs that managers must consider include inventory, transportation, facilities and handling, and information. Increasing the number of facilities decreases the response time and transportation cost but increases inventory and facility cost.

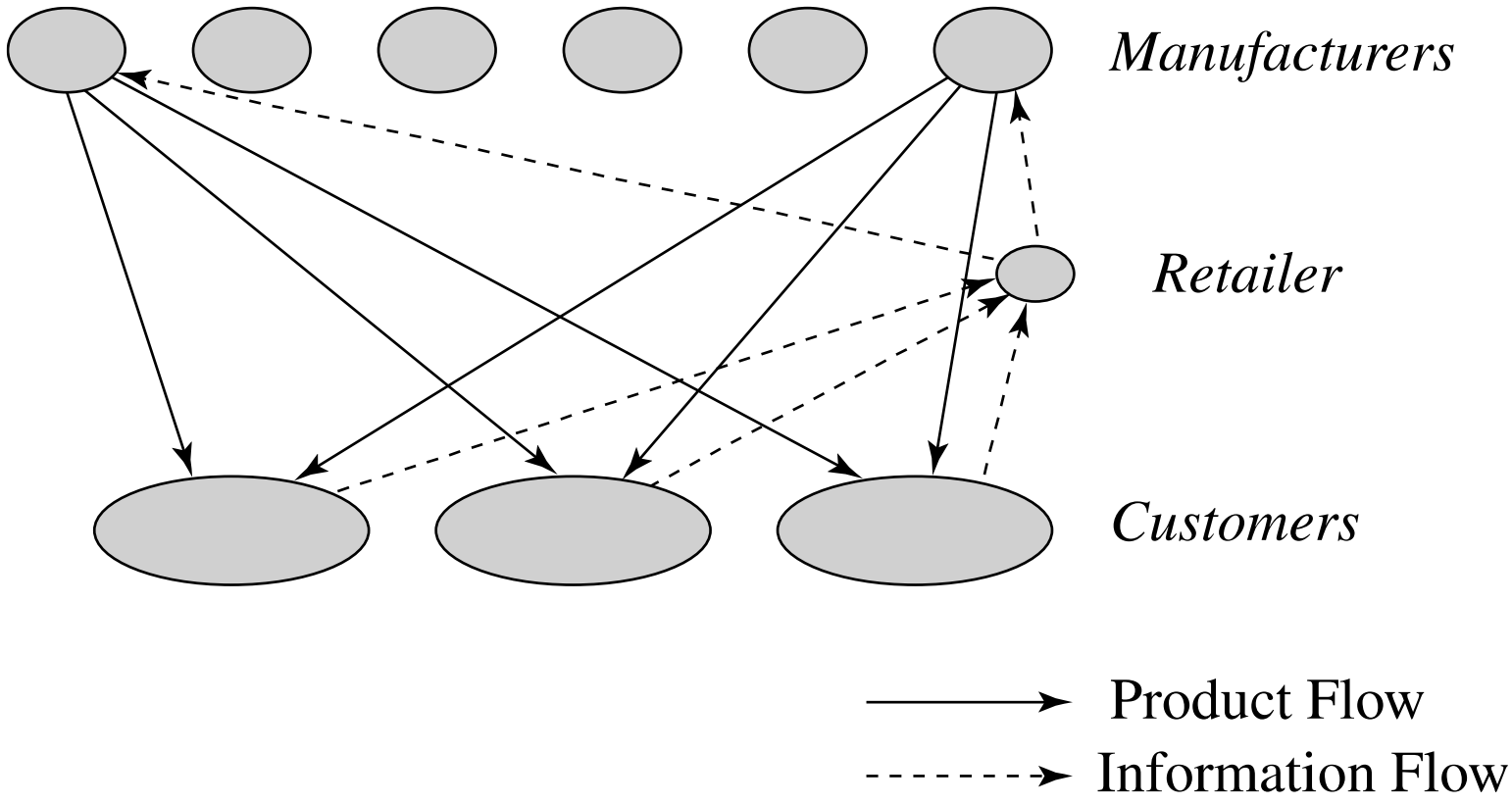
Design Options for a Distribution Network (1 of 2)

- Distribution network choices from the manufacturer to the end consumer
- Two key decisions
  1. Will product be delivered to the customer location or picked up from a prearranged site?
  2. Will product flow through an intermediary (or intermediate location)?

Design Options for a Distribution Network (2 of 2)

- One of six designs may be used
  1. Manufacturer storage with direct shipping
  2. Manufacturer storage with direct shipping and in-transit merge
  3. Distributor storage with carrier delivery
  4. Distributor storage with last-mile delivery
  5. Manufacturer/distributor storage with customer pickup
  6. Retail storage with customer pickup

Figure 4-6 Manufacturer Storage with Direct Shipping



Manufacturer Storage with Direct Shipping Network (1 of 2)

Table 4-1 Performance Characteristics of Manufacturer Storage with Direct Shipping Network

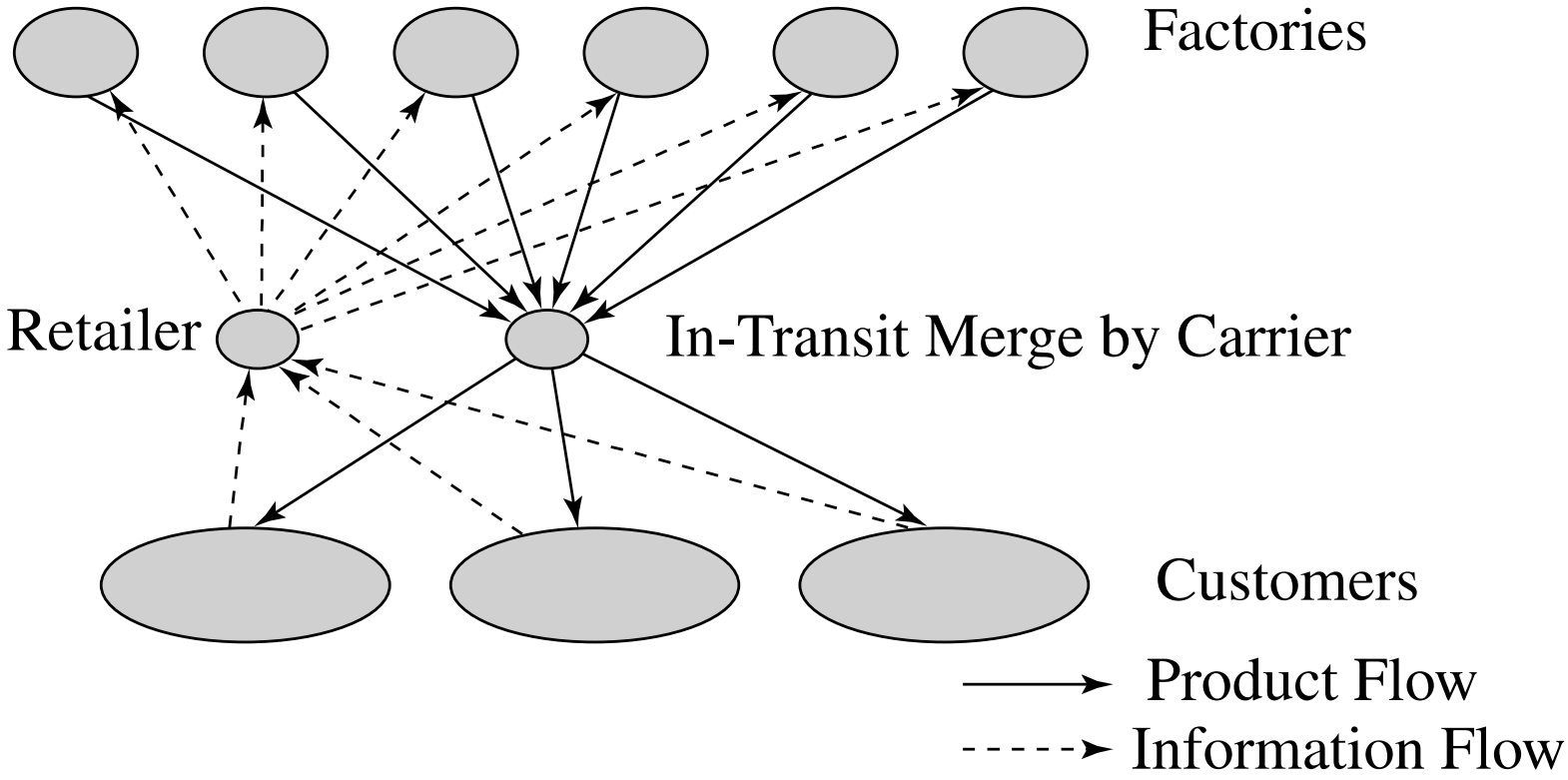
Cost Factor	Performance
Inventory	Lower costs because of aggregation. Benefits of aggregation are highest for low-demand, high-value items. Benefits are large if product customization can be postponed at the manufacturer.
Transportation	Higher transportation costs because of increased distance and disaggregate shipping.
Facilities and handling	Lower facility costs because of aggregation. Some saving on handling costs if manufacturer can manage small shipments or ship from production line.
Information	Significant investment in information infrastructure to integrate manufacturer and retailer.

Manufacturer Storage with Direct Shipping Network (2 of 2)

Table 4-1 [Continued]

Service Factor	Performance
Response time	Long response time of one to two weeks because of increased distance and two stages for order processing. Response time may vary by product, thus complicating receiving.
Product variety	Easy to provide a high level of variety.
Product availability	Easy to provide a high level of product availability because of aggregation at manufacturer.
Customer experience	Good in terms of home delivery but can suffer if order from several manufacturers is sent as partial shipments.
Time to market	Fast, with the product available as soon as the first unit is produced.
Order visibility	More difficult but also more important from a customer service perspective.
Returnability	Expensive and difficult to implement.

Figure 4-7 In-Transit Merge Network



In-Transit Merge (1 of 2)

Table 4-2 Performance Characteristics of In-Transit Merge

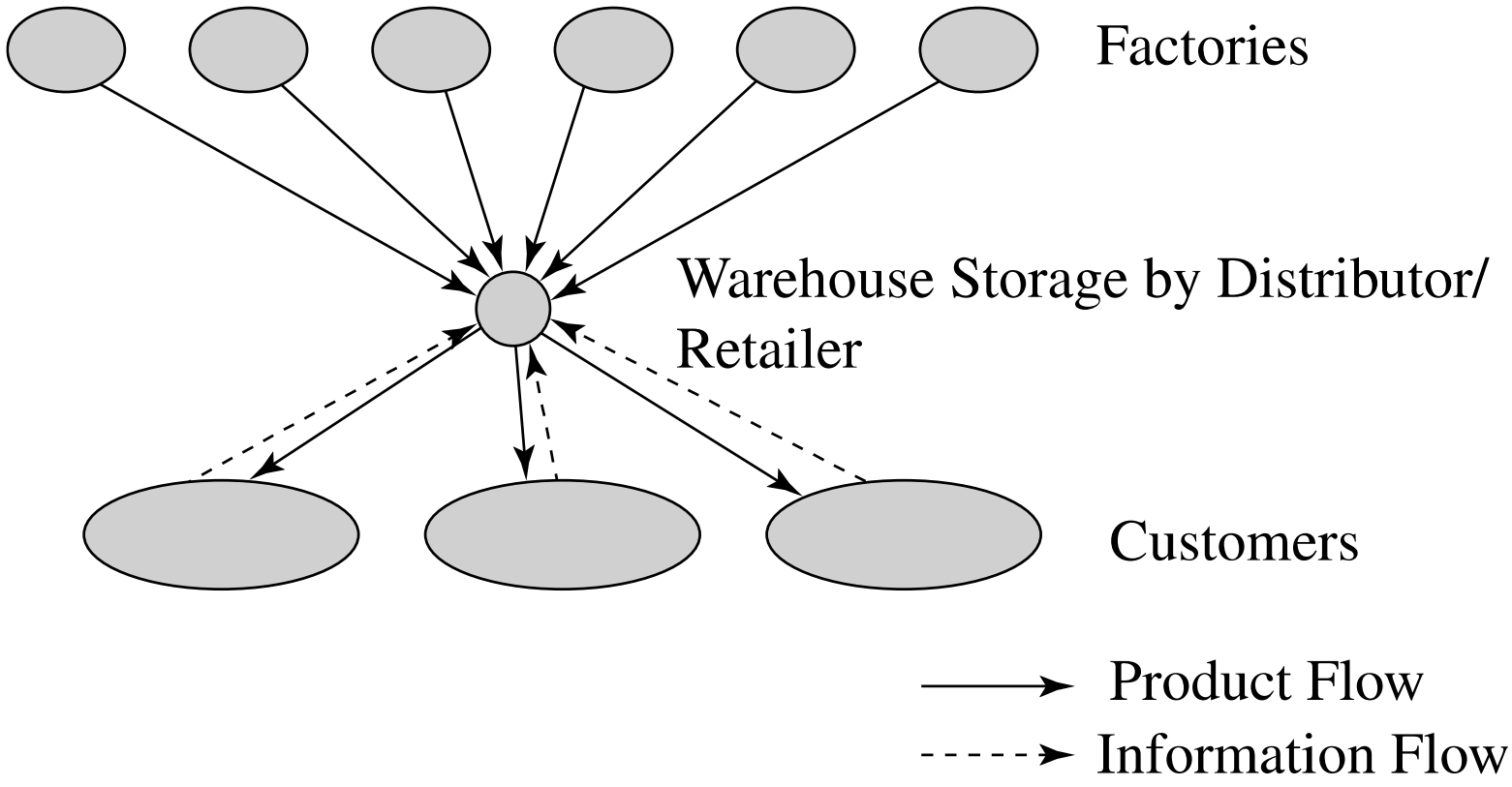
Cost Factor	Performance
Inventory	Similar to drop-shipping.
Transportation	Somewhat lower transportation costs than drop-shipping.
Facilities and handling	Handling costs higher than drop-shipping at carrier; receiving costs lower at customer.
Information	Investment is somewhat higher than for drop-shipping.

In-Transit Merge (2 of 2)

Table 4-2 [Continued]

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 only a single delivery is received.
Time to market	Similar to drop-shipping.
Order visibility	Similar to drop-shipping.
Returnability	Similar to drop-shipping.

Figure 4-8 Distributor Storage with Carrier Delivery



Distributor Storage with Carrier Delivery (1 of 2)

Table 4-3 Performance Characteristics of Distributor Storage with Carrier Delivery

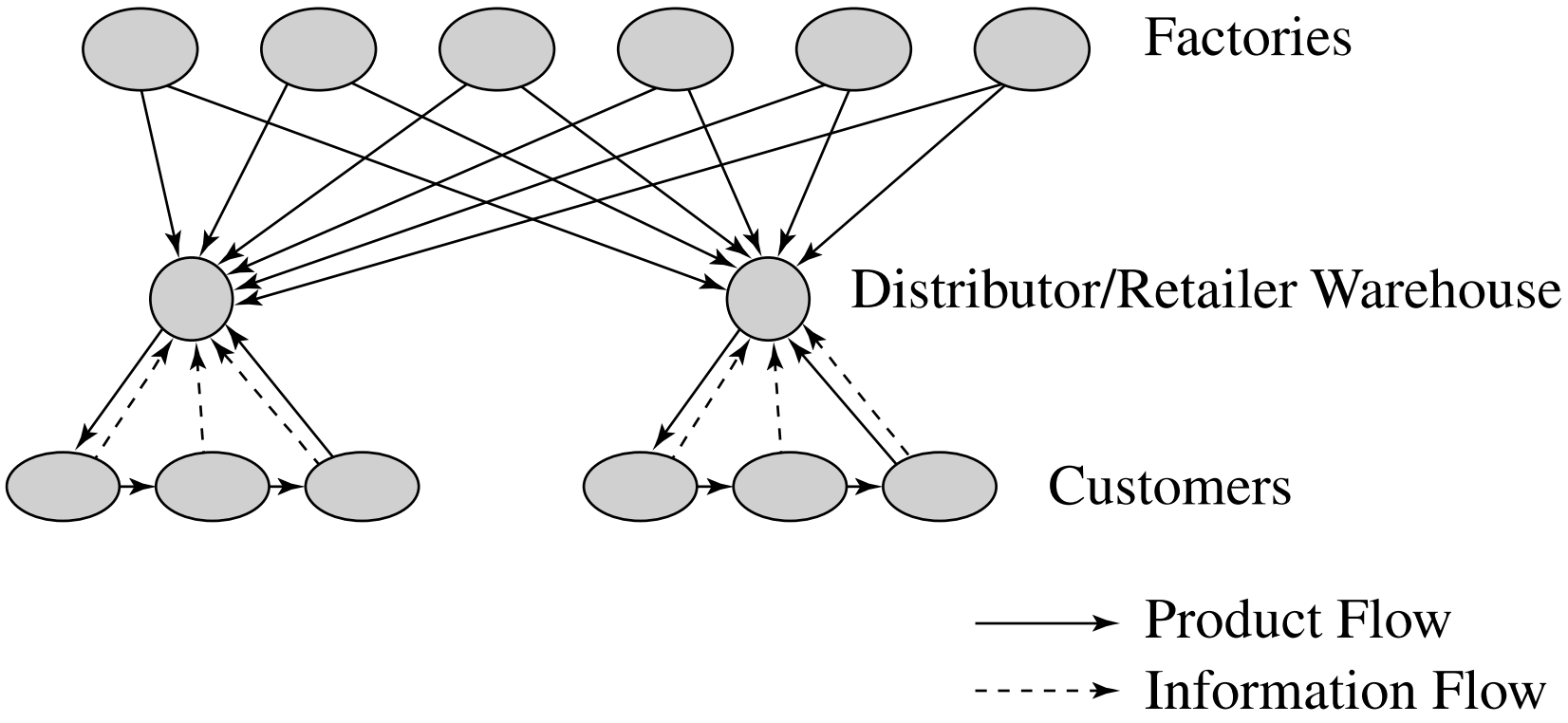
Cost Factor	Performance
Inventory	Higher than manufacturer storage. Difference is not large for faster-moving items but can be large for very slow-moving items.
Transportation	Lower than manufacturer storage. Reduction is highest for faster-moving items.
Facilities and handling	Somewhat higher than manufacturer storage. The difference can be large for very-slow-moving items.
Information	Simpler infrastructure compared to manufacturer storage.

Distributor Storage with Carrier Delivery (2 of 2)

Table 4-3 [Continued]

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.
Time to market	Higher than manufacturer storage.
Order visibility	Easier than manufacturer storage.
Returnability	Easier than manufacturer storage.

Figure 4-9 Distributor Storage with Last Mile Delivery



Distributor Storage with Last Mile Delivery (1 of 2)

Table 4-4 Performance Characteristics of Distributor Storage with Last-Mile Delivery

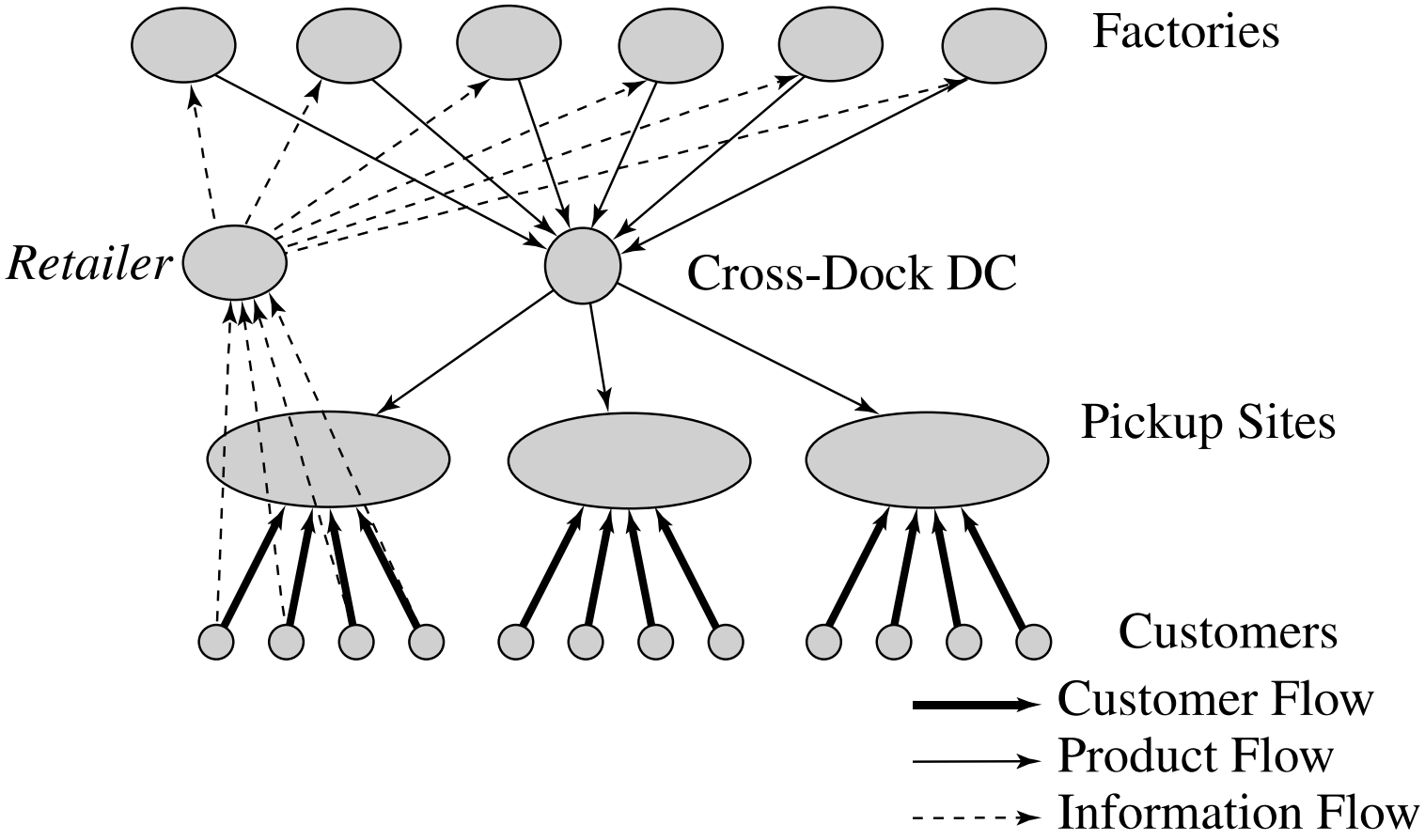
Cost Factor	Performance
Inventory	Higher than distributor storage with package carrier delivery.
Transportation	Very high cost given minimal scale economies. Higher than any other distribution option.
Facilities and handling	Facility costs higher than manufacturer storage or distributor storage with package carrier delivery, but lower than a chain of retail stores.
Information	Similar to distributor storage with package carrier delivery.

Distributor Storage with Last Mile Delivery (2 of 2)

Table 4-4 [Continued]

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.
Time to market	Slightly longer than distributor storage with package carrier delivery.
Order visibility	Less of an issue and easier to implement than manufacturer storage or distributor storage with package carrier delivery.
Returnability	Easier to implement than other previous options. Harder and more expensive than a retail network.

Figure 4-10 Manufacturer or Distributor Storage with Customer Pickup



Manufacturer or Distributor Storage with Customer Pickup (1 of 2)

Table 4-5 Performance Characteristics of Network with Customer Pickup Sites

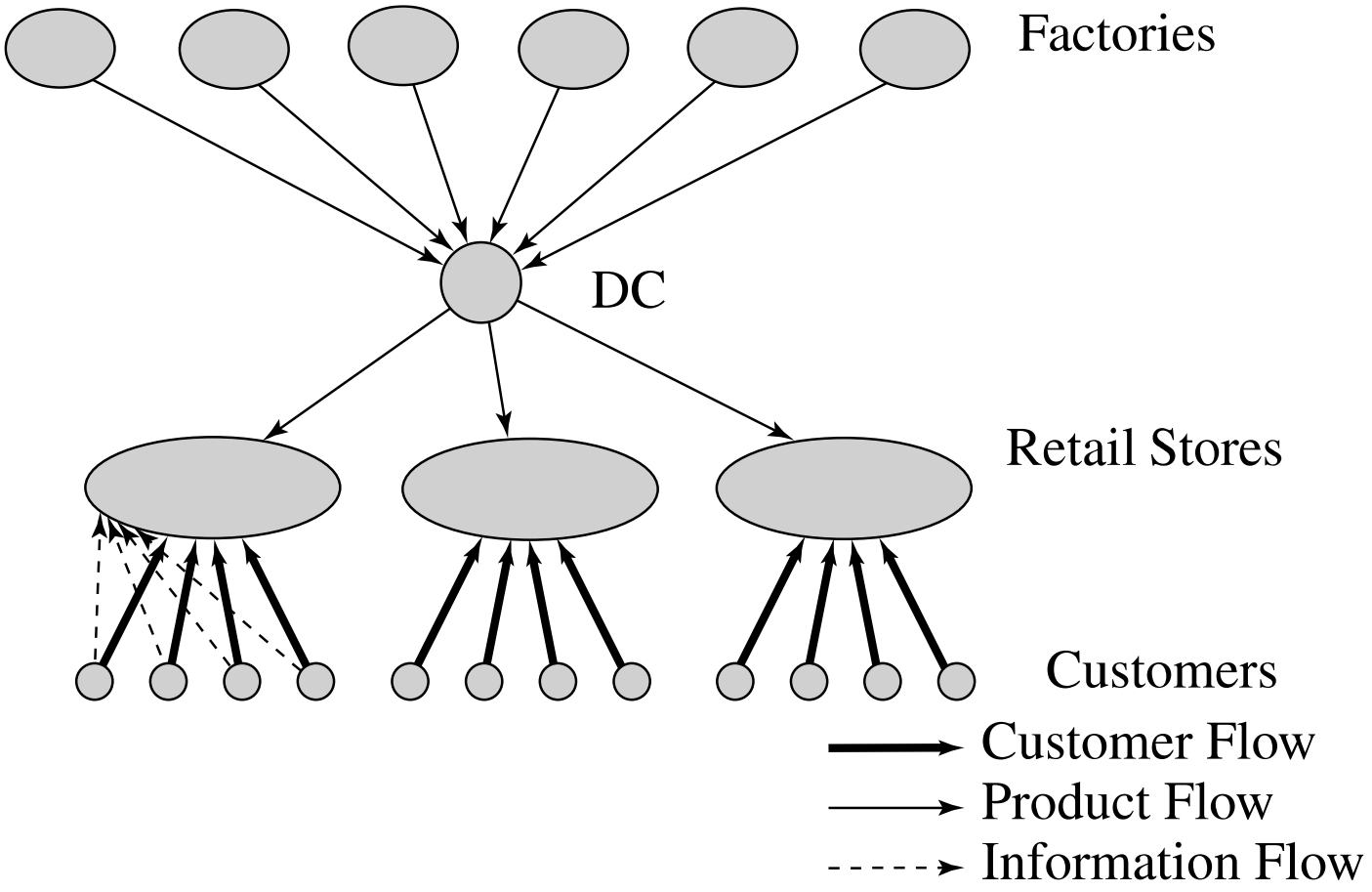
Cost Factor	Performance
Inventory	Can match any other option, depending on the location of inventory.
Transportation	Lower than the use of package carriers, especially if using an existing delivery network.
Facilities and handling	Facility costs can be high if new facilities have to be built. Costs are lower if existing facilities are used. The increase in handling cost at the pickup site can be significant.
Information	Significant investment in infrastructure required.

Manufacturer or Distributor Storage with Customer Pickup (2 of 2)

Table 4-5 [Continued]

Service Factor	Performance
Response time	Similar to package carrier delivery with manufacturer or distributor storage. Same-day pickup is possible for items stored at regional DC.
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. Experience is sensitive to capability of pickup location.
Time to market	Similar to manufacturer or distributor storage options.
Order visibility	Difficult but essential.
Returnability	Somewhat easier, given that pickup location can handle returns.

Figure 4-11 Retail Storage with Customer Pickup



Retail Storage with Customer Pickup (1 of 2)

Table 4-6 Performance Characteristics of Retail Storage with Customer Pickup Sites

Cost Factor	Performance
Inventory	Higher than all other options.
Transportation	Lower than all other options.
Facilities and handling	Higher than other options. The increase in handling cost at the pickup site can be significant for online and phone orders.
Information	Some investment in infrastructure required for online and phone orders.

Retail Storage with Customer Pickup (2 of 2)

Table 4-6 [Continued]

Service Factor	Performance
Response time	Same-day (immediate) pickup possible for items stored locally at pickup site.
Product variety	Lower than all other options.
Product availability	More expensive to provide than all other options.
Customer experience	Related to whether shopping is viewed as a positive or negative experience by customer.
Time to market	Highest among distribution options.
Order visibility	Trivial for in-store orders. Difficult, but essential, for online and phone orders.
Returnability	Easier than other options because retail store can provide a substitute.

Comparative Performance of Delivery Network Designs (1 of 3)

Table 4-7 Comparative Performance Rank of Delivery Network Designs

	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/ Distributor Storage with Customer 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

Comparative Performance of Delivery Network Designs (2 of 3)

Table 4-7 [Continued]

	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/ Distributor Storage with Customer Pickup
Customer experience	Varies From 1 to 5	4	3	2	1	5
Time to market	4	1	1	2	3	1
Order visibility	1	5	4	3	2	6
Returnability	1	5	5	4	3	2

Comparative Performance of Delivery Network Designs (3 of 3)

Table 4-7 [Continued]

	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/ Distributor Storage with Customer Pickup
Inventory	4	1	1	2	3	1
Transportation	1	4	3	2	5	1
Facility and handling	6	1	2	3	4	5
Information	1	4	4	3	2	5

Key: 1 corresponds to the best performance and 6 the worst performance.

Delivery Networks for Different Product/ Customer Characteristics (1 of 2)

Table 4-8 Performance of Delivery Networks for Different Product/Customer Characteristics

	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/ Distributor Storage with Customer 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

Delivery Networks for Different Product/ Customer Characteristics (2 of 2)

Table 4-8 [Continued]

	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/ Distributor Storage with Customer Pickup
Very-low-demand product	−2	+2	+1	0	−2	+1
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

Key: +2 = very suitable; +1 = somewhat suitable; 0 = neutral; −1 = somewhat unsuitable; −2 = very unsuitable.

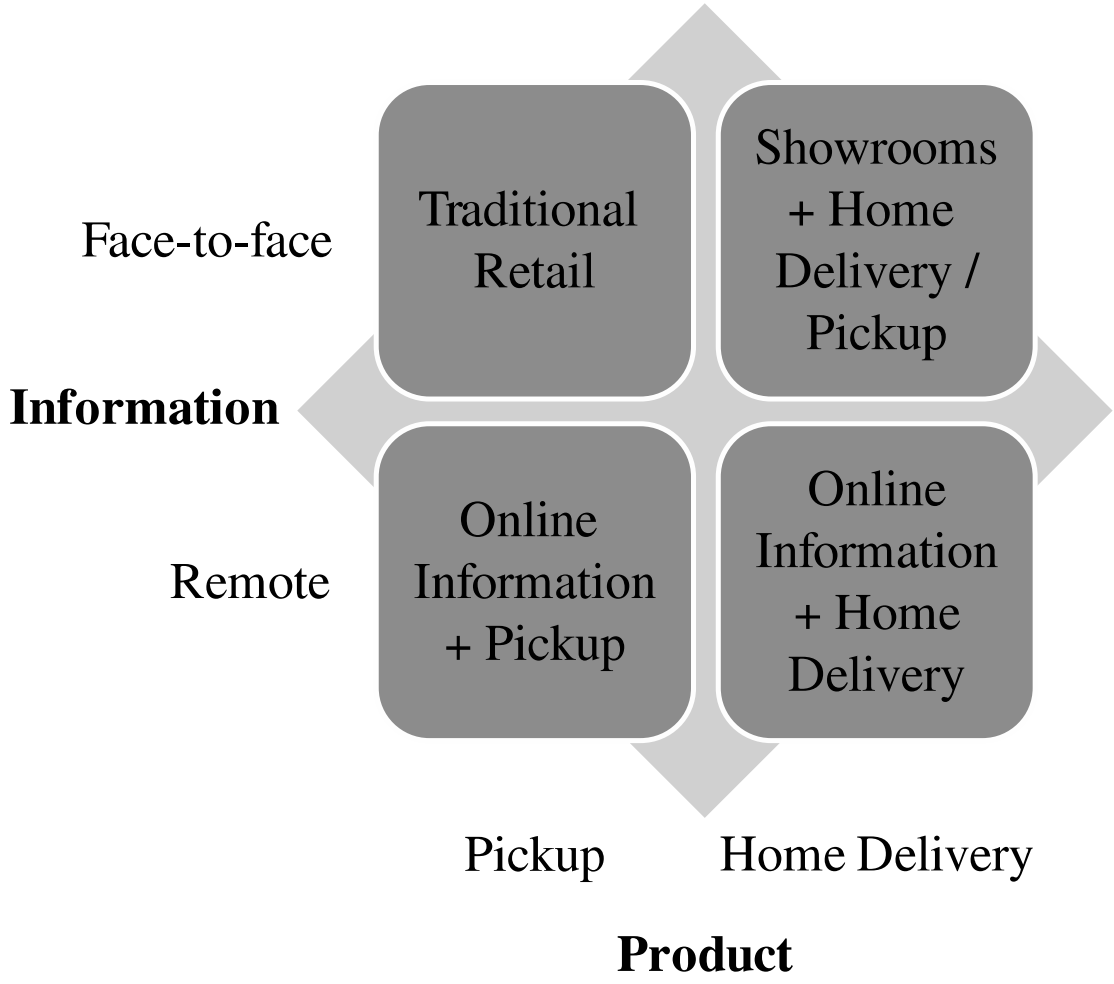
Summary of Learning Objective 2

Distribution networks that ship directly to the customer are better suited for a large variety of high-value products that have low and uncertain demand. These networks incur lower facility costs and carry low levels of inventory but incur high transportation cost and provide a slow response time. Distribution networks that carry local inventory are suitable for products with high demand, especially if transportation is a large fraction of total cost. These networks incur higher facility and inventory cost but lower transportation cost and provide a faster response time.

Online Sales and Omni-Channel Retailing

- **Omni-channel retailing**
  - The use of multiple channels to interact with customers and fulfill their orders
  - Three flows
    - Information
    - Products
    - Funds

Figure 4-12 Alternatives in Omni-Channel Retailing



Alternatives in Omni-Channel Retailing (1 of 3)

- Traditional Retail
  - Face-to-face interaction
  - Customer leaves with product
  - Many facilities close to customers
  - High level of inventory
  - Low transportation costs

Alternatives in Omni-Channel Retailing (2 of 3)

- Showrooms
  - Face-to-face interaction
  - Product ordered for later pickup
  - Low level of inventory
  - Smaller facilities
  - More transportation and information infrastructure than traditional retail

Alternatives in Omni-Channel Retailing (3 of 3)

- Online Information + Home Delivery
  - Aggregation of inventories
  - Few locations
  - High transportation costs
- Online Information + Pickup
  - Reduces outbound transportation costs
  - Customer must travel to pickup location

Performance of Channels (1 of 3)

- **Response time to customers**
  - Picking up physical products faster than other channels
  - Online channel may be fastest for information goods
- **Product variety**
  - Easier to offer larger selection remotely
- **Product availability**
  - Aggregating inventory improves product availability

Performance of Channels (2 of 3)

- **Customer experience**
  - Channels have complementarity strengths
- **Faster time to market**
  - Online/showrooms are quicker than retailing
- **Order Visibility**
  - Critical for showrooms or online
  - Automatic in retail

Performance of Channels (3 of 3)

- **Returnability**
  - Easier with physical locations
  - Proportion of returns likely to be higher when information exchange is remote
- **Direct Sales to Customers**
  - Manufacturers can use remote information exchange for direct access to customers
- **Efficient Funds Transfer**
  - Internet and smartphones

Performance of Channels in Terms of Cost (1 of 2)

- **Inventory**
  - Lower inventory levels if customers will wait
  - Postpone variety until after the customer order is received
- **Facilities**
  - Costs related to the physical facilities in a network
  - Costs associated with the operations in these facilities

Performance of Channels in Terms of Cost (2 of 2)

- **Transportation**
  - Lower cost of “transporting” information goods in digital form
  - For nondigital, aggregating inventories increases outbound transportation
- **Information**
  - Investment higher for channels that provide information remotely

Relative Costs for Omni-Channel Alternatives

Table 4-9 Relative Costs for Omni-Channel Alternatives

	Traditional Retail	Showrooms + Home Delivery	Online Information + Home Delivery	Online Information + Pickup
Inventory	High	Low - Medium	Low	Low - Medium
Facilities	High	Medium	Low	Low - Medium
Transportation by retailer	Low	High	High	Medium
Transportation by customer	High	High	Low	Medium
Information	Low	High	High	High

Framework for Omni-Channel Retailing (1 of 4)

- Product characteristics and customer needs influence choice of channel
- Product dimensions
  - Demand uncertainty
  - Value
  - Information complexity
- Customer dimensions
  - Willingness to pay
    - Price conscious/service conscious

Framework for Omni-Channel Retailing (2 of 4)

Table 4-10 Product Demand Uncertainty and Omni-Channel Retailing

	Predictable Demand Product	**Unpredictable Demand Product**
Traditional Retail	Compete on price	Compete on service for high information complexity products
Showrooms	Not suitable	Compete on price and variety for high information complexity products
Online Information + Home Delivery	Compete on service	Compete on price and variety
Online Information + Pickup	Compete on ability to provide service at a lower price	More competitive on price than home delivery option

Framework for Omni-Channel Retailing (3 of 4)

Table 4-11 Product Value and Omni-Channel Retailing

	Low Value Product	High Value Product
Traditional Retail	Compete on price for predictable demand products	Compete on service for products with uncertain demand and high information complexity
Showrooms	Compete on high variety at reasonable price for high information complexity Products	Compete on price for customizable, high information complexity products
Online Information + Home Delivery	Compete on service	Compete on price and variety
Online Information + Pickup	Compete on ability to provide service at a lower price	More competitive on price than home delivery option

Framework for Omni-Channel Retailing (4 of 4)

Table 4-12 Product Information Complexity and Omni-Channel Retailing

	Low Information Complexity Product	High Information Complexity Product
Traditional Retail	Compete on price for predictable demand products	Compete on service for uncertain demand products
Showrooms	Not suitable	Compete on price for uncertain demand products
Online Information + Home Delivery	Compete on price for uncertain demand products	Compete on service in terms of variety and availability for uncertain demand products
Online Information + Pickup	Compete on price for uncertain demand products	A slightly cheaper option to compete on service in terms of variety and availability for uncertain demand products

Summary of Learning Objective 3

Omni-channel retailing has the potential to combine the complementary strengths of physical stores and the online channel. Physical stores are good at letting customers experience high information complexity products in person. They are also cost effective at selling products with predictable demand. The online channel, in contrast, is cost effective at selling products with unpredictable demand but cannot let customers experience high information complexity products. An effective portfolio results if brick-and-mortar stores sell predictable demand items, serve as showrooms for high information complexity items with unpredictable demand, and serve as pickup locations for the online channel, while the online channel delivers unpredictable demand items to the customer.