

# Logistics and Supply Chain Management

## Distribution Network Design

Chopra and Meindl (2006) Supply Chain Management: Strategy, Planning and Operation. Prentice Hall.  
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## Outline

- The Role of Distribution in the Supply Chain
- Factors Influencing Distribution Network Design
- Design Options for a Distribution Network
- E-Business and the Distribution Network
- Distribution Networks in Practice
- Summary of Learning Objectives

## The Role of Distribution

- **Distribution**: the steps taken to move and store a product from the supplier stage to the customer stage in a supply chain.
- Distribution directly affects **cost** and the **customer experience** and therefore drives profitability.
- Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness.
- Examples in the computer industry: Dell, HP, Gateway, Apple.

## 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
- A firm must evaluate the impact on **customer service** and cost as it compares different distribution network options.

## Factors Influencing Distribution Network Design

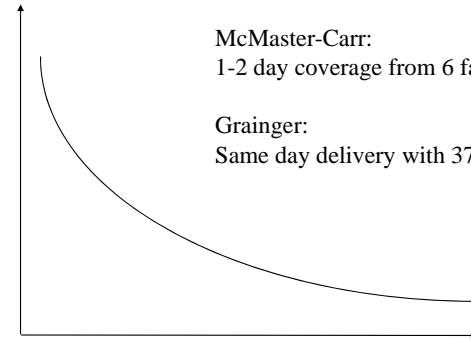
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- Elements of **customer service** influenced by network structure:
  - ✓ Response time
  - ✓ Product variety
  - ✓ Product availability
  - ✓ Customer experience
  - ✓ Order visibility
  - ✓ Returnability
- Supply chain **costs** affected by network structure:
  - ✓ Inventories
  - ✓ Transportation
  - ✓ Facilities and handling
  - ✓ Information

## Service and Number of Facilities

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Number of  
Facilities



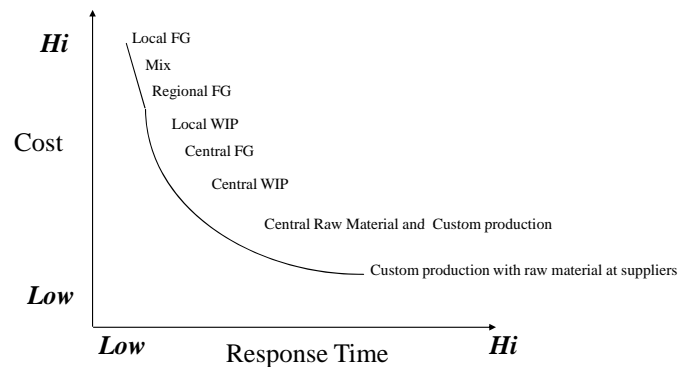
McMaster-Carr:  
1-2 day coverage from 6 facilities.

Grainger:  
Same day delivery with 370 facilities.

Response Time

## The Cost-Response Time Frontier

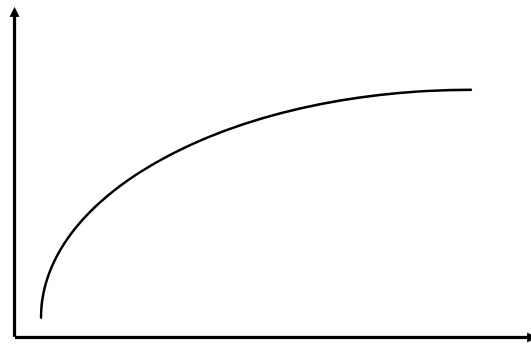
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## Inventory Costs and Number of Facilities

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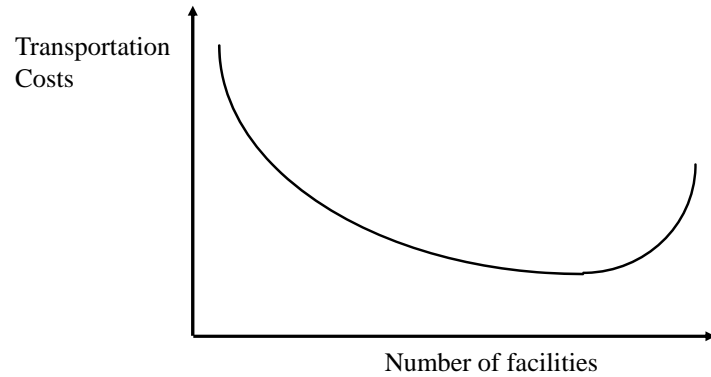
Inventory  
Costs



Number of facilities

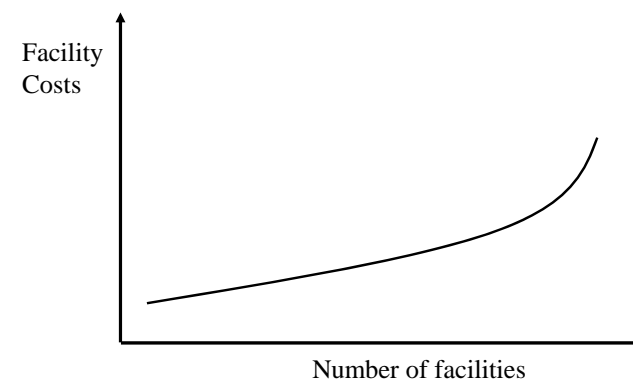
## Transportation Costs and Number of Facilities

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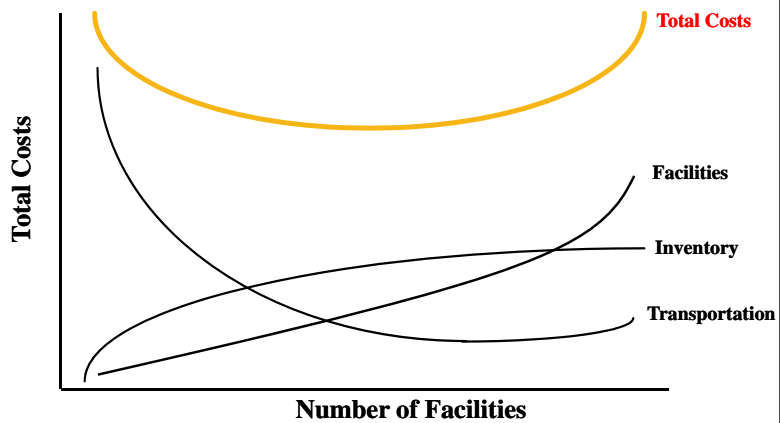
## Facility Costs and Number of Facilities

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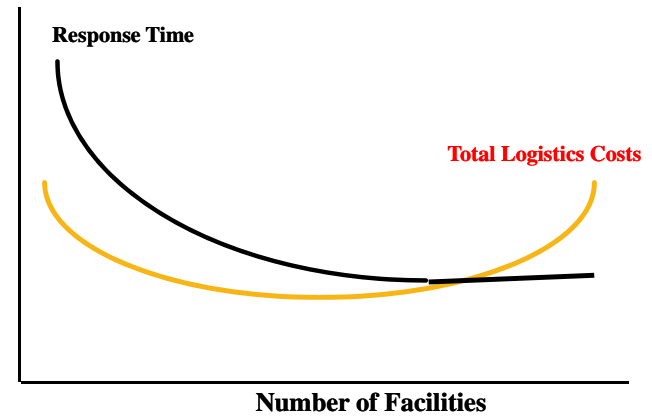
## Total Costs Related to Number of Facilities

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## Variation in Logistics Costs and Response Time

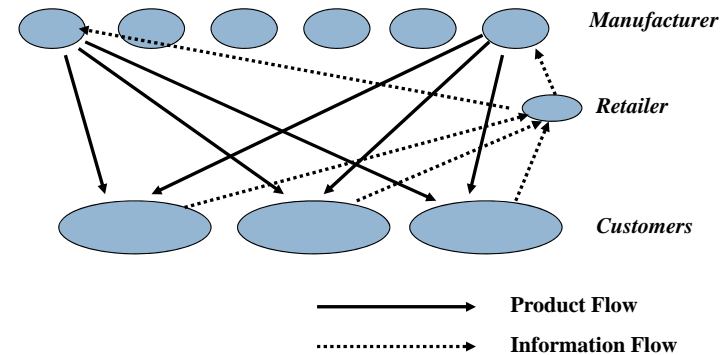
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## Design Options for a Distribution Network

- 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

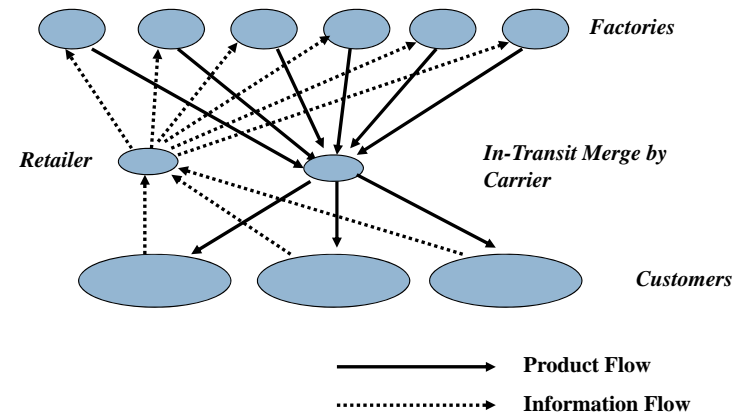
## Manufacturer Storage with Direct Shipping



## Performance characteristics of drop-shipping

Cost Factor	Performance
Inventory	Lower costs because of aggregation. Benefits of aggregation are highest for low-demand, high-value items. Benefits are very 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.
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 very 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.

## In-Transit Merge Network



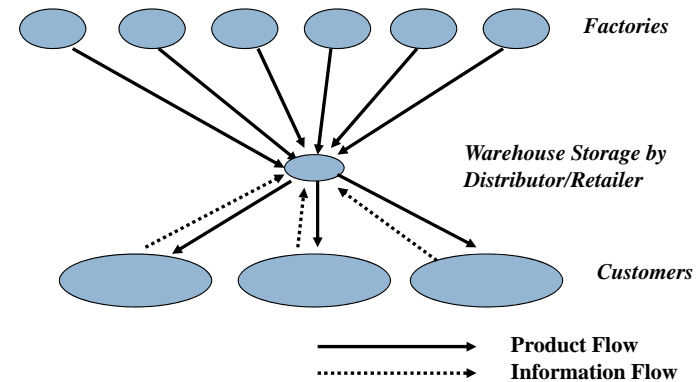
## Performance characteristics

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<i>Cost Factor</i>	<i>Performance</i>
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.
<i>Service Factor</i>	<i>Performance</i>
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.
Time to market	Similar to drop-shipping
Order visibility	Similar to drop-shipping.
Returnability	Similar to drop-shipping.

## Distributor Storage with Carrier Delivery

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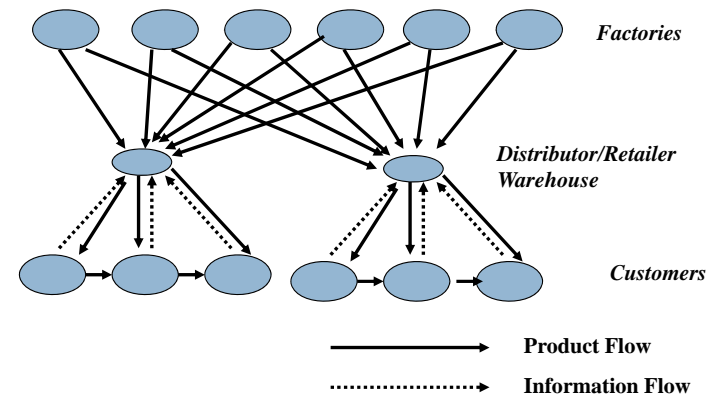
## Performance characteristics

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<i>Cost Factor</i>	<i>Performance</i>
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 very slow-moving items.
Information	Simpler infrastructure compared to manufacturer storage.
<i>Service Factor</i>	<i>Performance</i>
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.

## Distributor Storage with Last Mile Delivery

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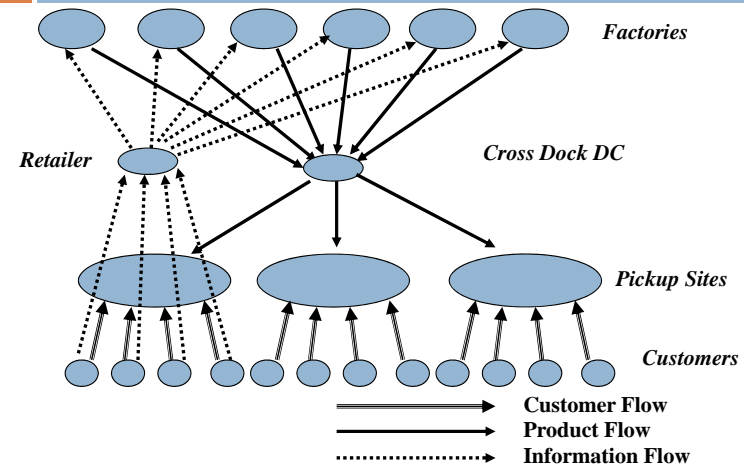
## Performance characteristics

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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.
Time to market	Slightly higher than distributor storage with package carrier delivery.
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

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## Performance characteristics

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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.
Time to market	Similar to manufacturer storage options.
Order visibility	Difficult but essential.
Returnability	Somewhat easier given that pickup location can handle returns.

## Performance characteristics of retail storage with customer pickup

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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.
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 given that pickup location can handle returns.

## Comparative Performance of Delivery Network Designs

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	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

## Product Characteristics and Customer Preferences

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	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

## E-Business and the Distribution Network

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- Impact of E-Business on Customer Service
- Impact of E-Business on Cost
- E-business scorecard:

Area	Impact
Response time	
Product variety	
Product availability	
Customer experience	
Time to market	
Order visibility	
Direct sales	
Flexible pricing, portfolio, promotions	
Efficient funds transfer	
Inventory	
Facilities	
Transportation	
Information	

- value of setting up an e-business is not the same in every industry

## E-Business in DELL

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Area	Impact
Response time	-1
Product variety	+2
Product availability	+1
Customer experience	+2
Time to market	+2
Order visibility	+1
Direct sales	+2
Flexible pricing, portfolio, promotions	+2
Efficient funds transfer	+2
Inventory	+2
Facilities	+2
Transportation	-1
Information	0

## Distribution Networks in Practice

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- The **ownership** structure of the distribution network can have as big an impact as the type of distribution network
- The choice of a distribution network has very **long-term consequences**
- Consider whether an **exclusive distribution strategy** is advantageous
- Product, price, commoditization, and criticality have an impact on the type of distribution system preferred by customers

## Summary of Learning Objectives

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- What are the key factors to be considered when designing the distribution network?
- What are the strengths and weaknesses of various distribution options?
- What roles do distributors play in the supply chain?