AGEC 632: AGRIBUSINESS LOGISTICS

Chapter 4.
Designing Distribution Networks and Applications to Omni-Channel retailing

2021

Manhattan, Kansas

KANSAS STATE UNIVERSITY | Agricultural Economics

Network Design of Facilities

SECTION ONE

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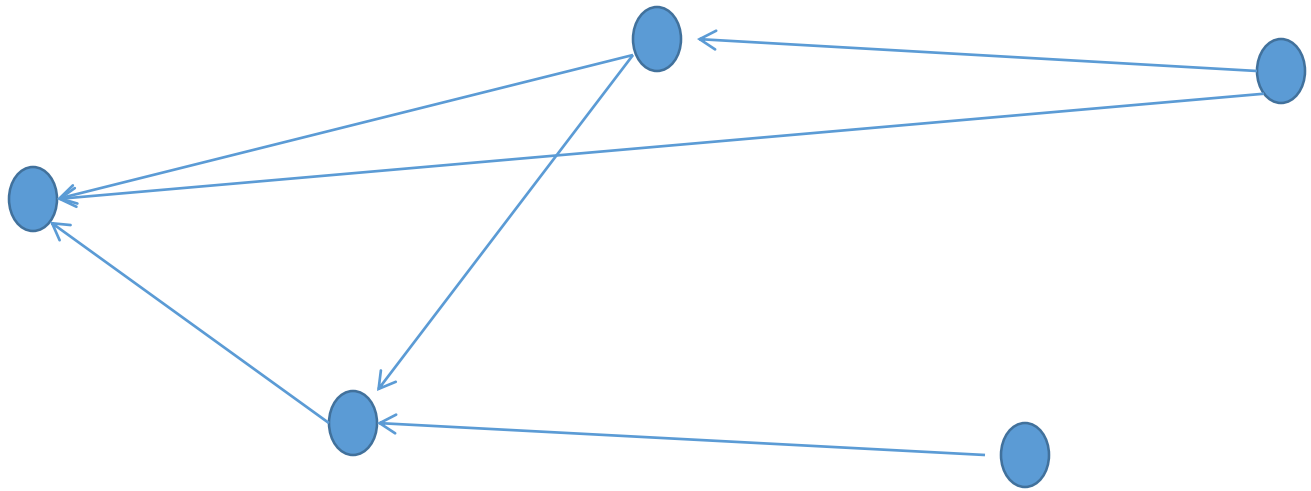
Learning Objectives

- Understand role of Network design
- Identify factors affecting design decisions
- Develop framework for making network design decisions
- Optimization modeling used to develop the best network arrangement.

Facilities Network

- Each node represents the location of a facility
- Each arrow represents a flow from location to location



Network Design Decisions

Very important because they

- Determine the SC configuration
- Set constraints and determine flexibility

SC Network Decisions Determine . . .

- Each facility's **role**—e.g., are some feed mills may be more specialized than others in the SC
- Facility **location**—long-term decision (Sunk costs)
- **Flexibility** of the whole SC
- **Capacity allocation** (too little or too much is costly)
- **Supply sources & markets to serve**

Importance of design decisions

- Decisions have long-term impacts—"must live with them once made, sunk costs"
  - Capacity decisions can be altered some, but tend to remain in place for a good while.

- Decisions affect one another
  - Network is interconnected so that a decision on one aspect likely affects decisions on another.
  - Also, decisions on the role of each facility determine the flexibility and cost of the supply chain.

- Allocation decisions need to be reconsidered from time to time.

Factors (affecting network design decisions)

- Strategic factor—low cost vs. responsive
  - Define strategic role of each facility
- Technological factors
  - Significance of fixed cost per location
  - Economies of scale
- Macroeconomic factors
  - Tariffs, tax incentives, exchange rate risk, demand risk

Factors (continued)

- Political, such as stability concerns, legal structure
- Infrastructure, roads, ports, rails, communications
- Competitive
  - Positive externalities
    - Gas station location example
    - Presence of competitors leads to development of infrastructure—consider the role McDonald's have played in development of SCs in other countries.
  - Locate to capture the largest market share
  - Response time issues

Nature of the Process and Location

- Weight losing—process at source
  - Packing plant
  - Ore processing
  - Flour mill

- Weight gaining—process near demand
  - Bakery
  - Processed food manufacturing

Framework for Network Design

Framework for Network Design Decision Making

- Phase I, Determine Supply Chain Strategy
- Phase II, Consider Regional Facility Configuration
- Phase III, Consider Desirable Sites
- Phase IV, Location Choices

Phase I: SC Strategy

- Competitive Strategy

- Internal constraints
  - Capital constraints
  - Growth strategy
  - Existing network

- Global Competition—e.g. South America, Australia, etc.
  - Consider decisions facing companies such as Cargill, ADM and Bunge

Phase II: World-wide Regional Facility Configuration

- Production technologies
  - Cost
  - Scale, scope impacts
  - Support required
  - Flexibility
- Tariffs and tax incentives
- Competitive environment
- Regional demand
- Demand risk
- Political stability
- Exchange rate risk

Phase III: Select Desirable Sites from which to choose

Each site must have the infrastructure to support the desired production

- Hard infrastructure
  - Suppliers, transportation services, communications, utilities, and warehousing
- Soft infrastructure
  - Skilled workforce
  - Community receptivity to the proposal
    - Locating incentives
    - Cases of states or communities prohibiting a plant or a business.

Phase IV: Location choices

- Factor costs
  - Labor
  - Materials
  - Site specific issues

- Logistics costs
  - Distribution firm moved its warehouse to take advantage of transportation infrastructure—Interstate Highways and RR.
  - Modeling or optimization can be used to locate desirable sites.

Designing Distribution Networks

SECTION TWO

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Learning Objectives

- Identify the **key factors** to be considered when designing a distribution network
- Discuss the *strengths and weaknesses* of various distribution options
- Discuss how Omni-Channel Retail may be structured to be *both cost effective and responsive to the customers needs*

What is distribution?

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.

• Drives profitability by directly affecting supply chain cost and the customer experience.

• Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness.

Factors Influencing Distribution Network Design

Factors Influencing Distribution Network Design

- Distribution network performance is evaluated along two dimensions
  - Value provided to the customer
  - Cost of meeting customer needs

- Evaluate the impact on customer service and cost for different distribution network options

- Profitability of the delivery network is determined by revenue from net customer value and network costs

Factors Influencing Distribution Network Design

Elements of customer service influenced by network structure or how we measure customer value:

- Response time
- Product variety
- Product availability
- Customer experience
- Order visibility
- Returnability

Factors Influencing Distribution Network Design

Supply chain costs affected by network structure:

- Inventories
- Transportation
- Facilities
- Handling Information

The Process of Designing Distribution Network Options

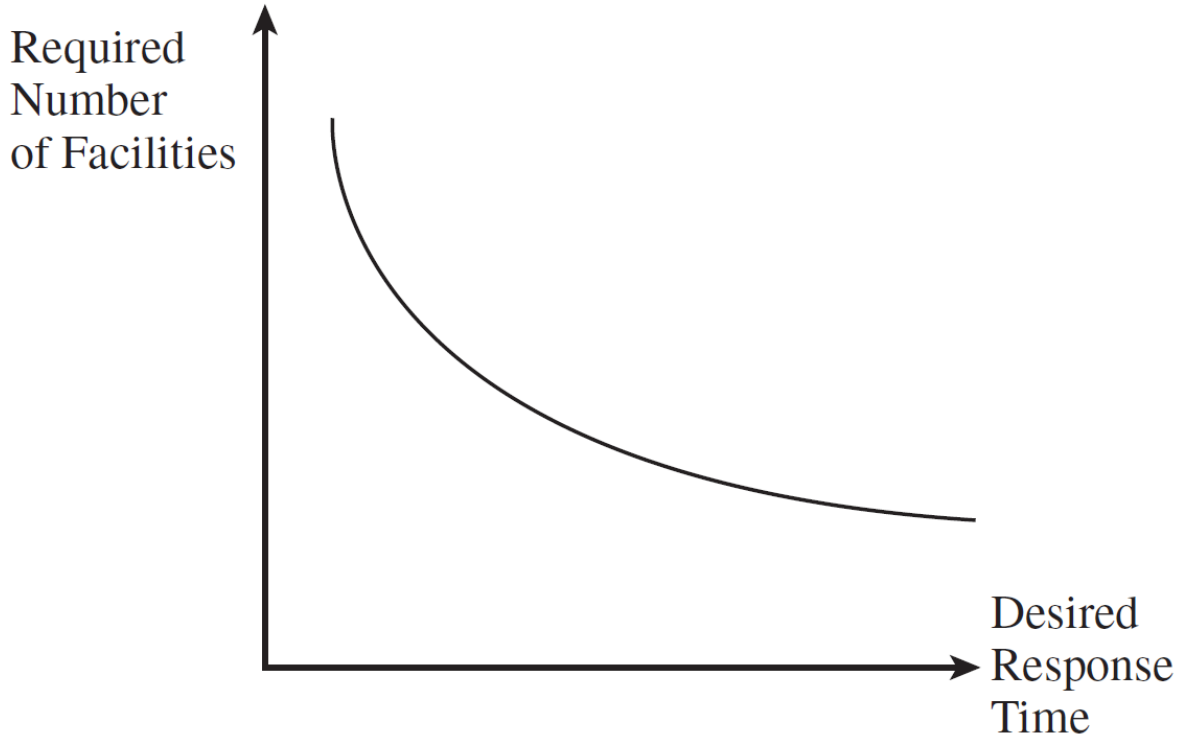
The Process of Designing a Distribution Network Design

The process of designing a distribution network is determined by two phases:

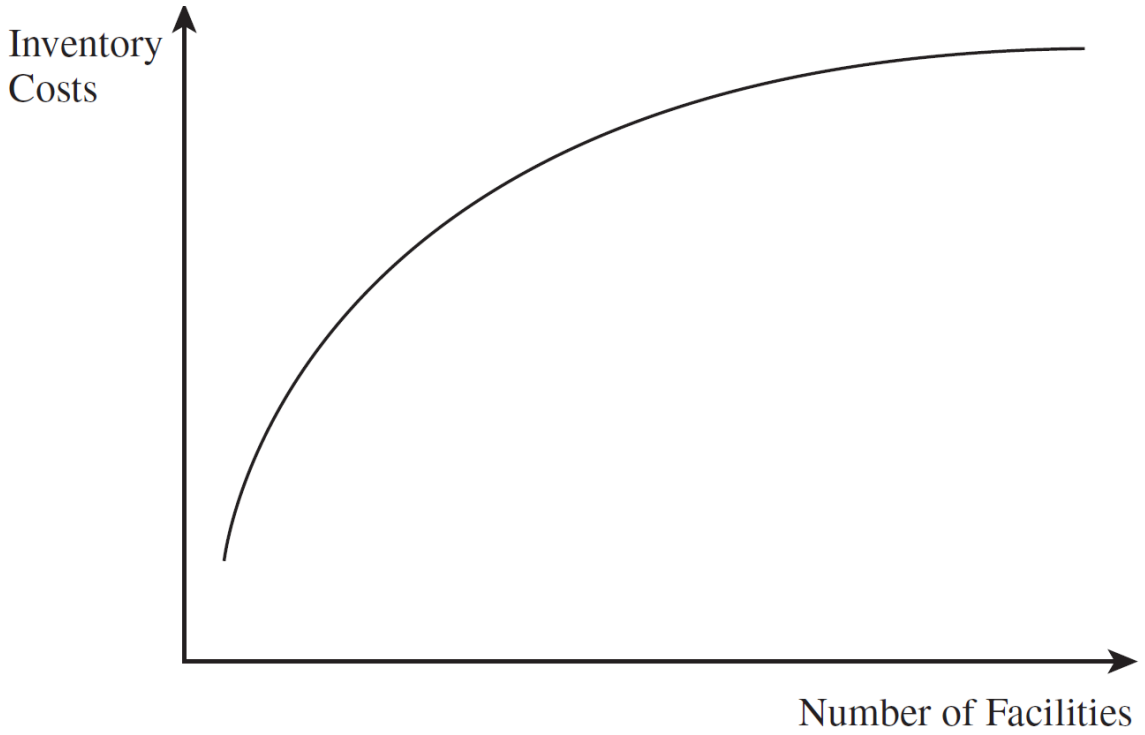
1. The broad structure of the distribution network is visualized. Decides the number of stages in the supply chain and their role.

2. Then, the broad structure is converted into specific locations and their capability, capacity, & demand allocation

Desired Response Time and Number of Facilities



Inventory Costs and Number of Facilities



Inbound and Outbound Transportation Costs

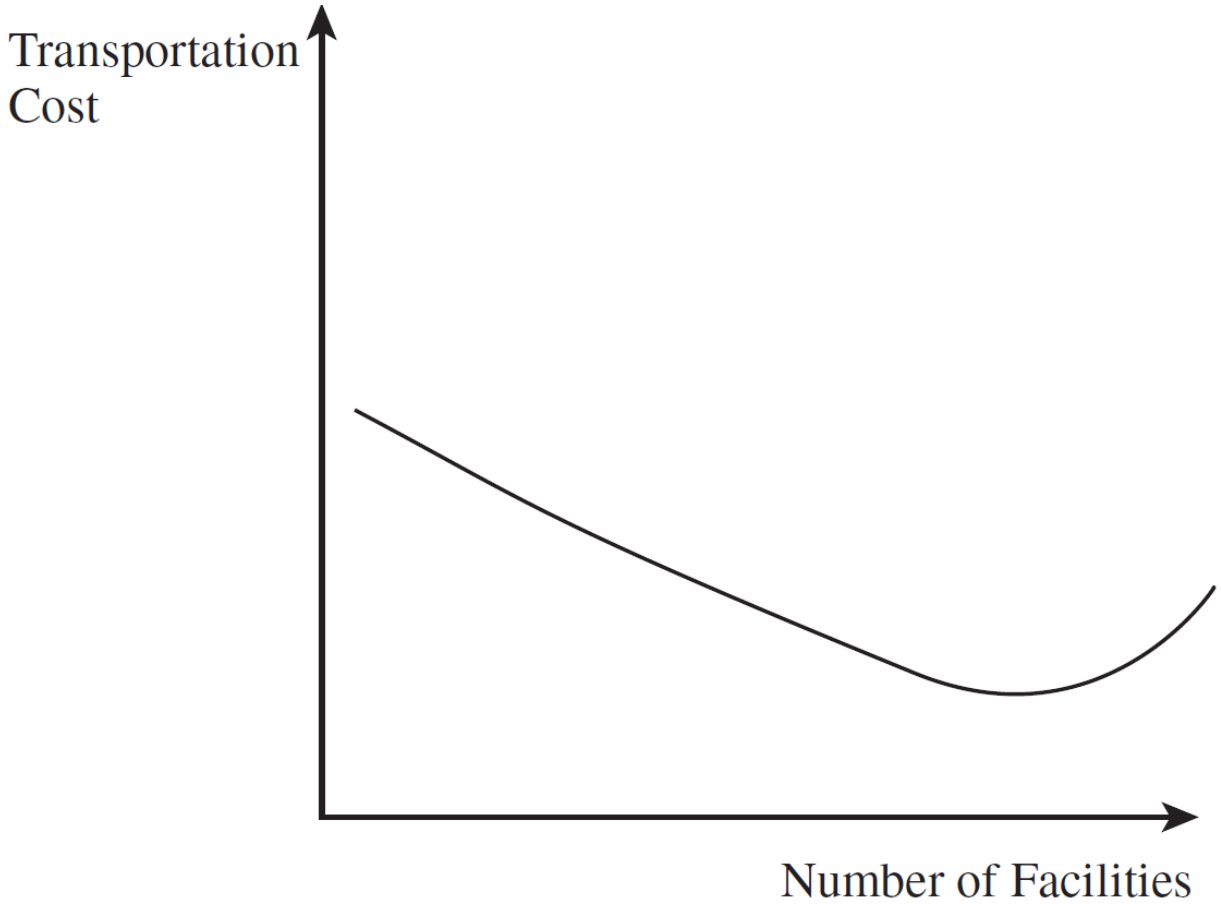
Inbound Transportation Cost

- The costs incurred to to bring material into a facility

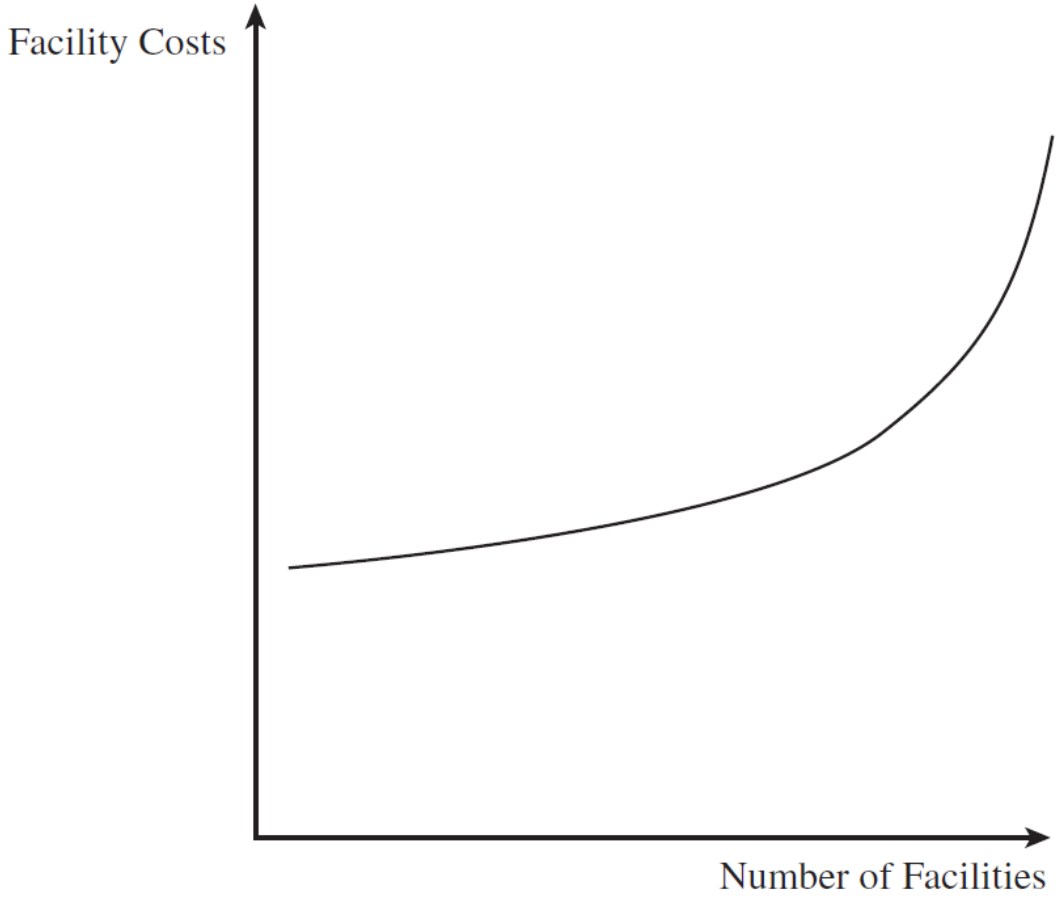
Outbound Transportation Cost

- The costs of sending material out of a facility

Transportation Costs and Number of Facilities

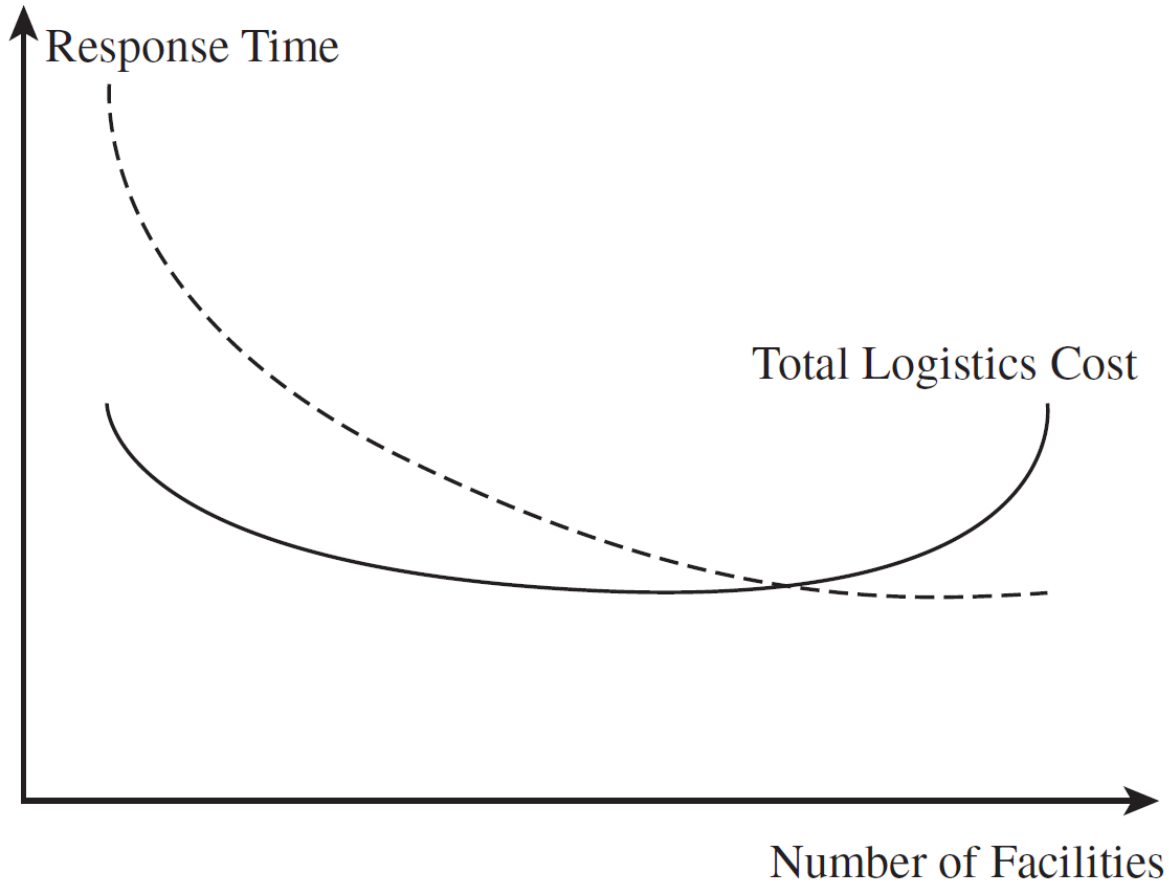


Facility Costs and Number of Facilities



Logistics Cost, Response Time, and Number of Facilities

Total Logistics Cost: The sum of inventory, transportation, and facility costs for a supply chain network



Design Options for a Distribution Network

Design Options for a Distribution Network

Two key decisions

1. Will product be delivered to the customer location or picked up from a prearranged site?

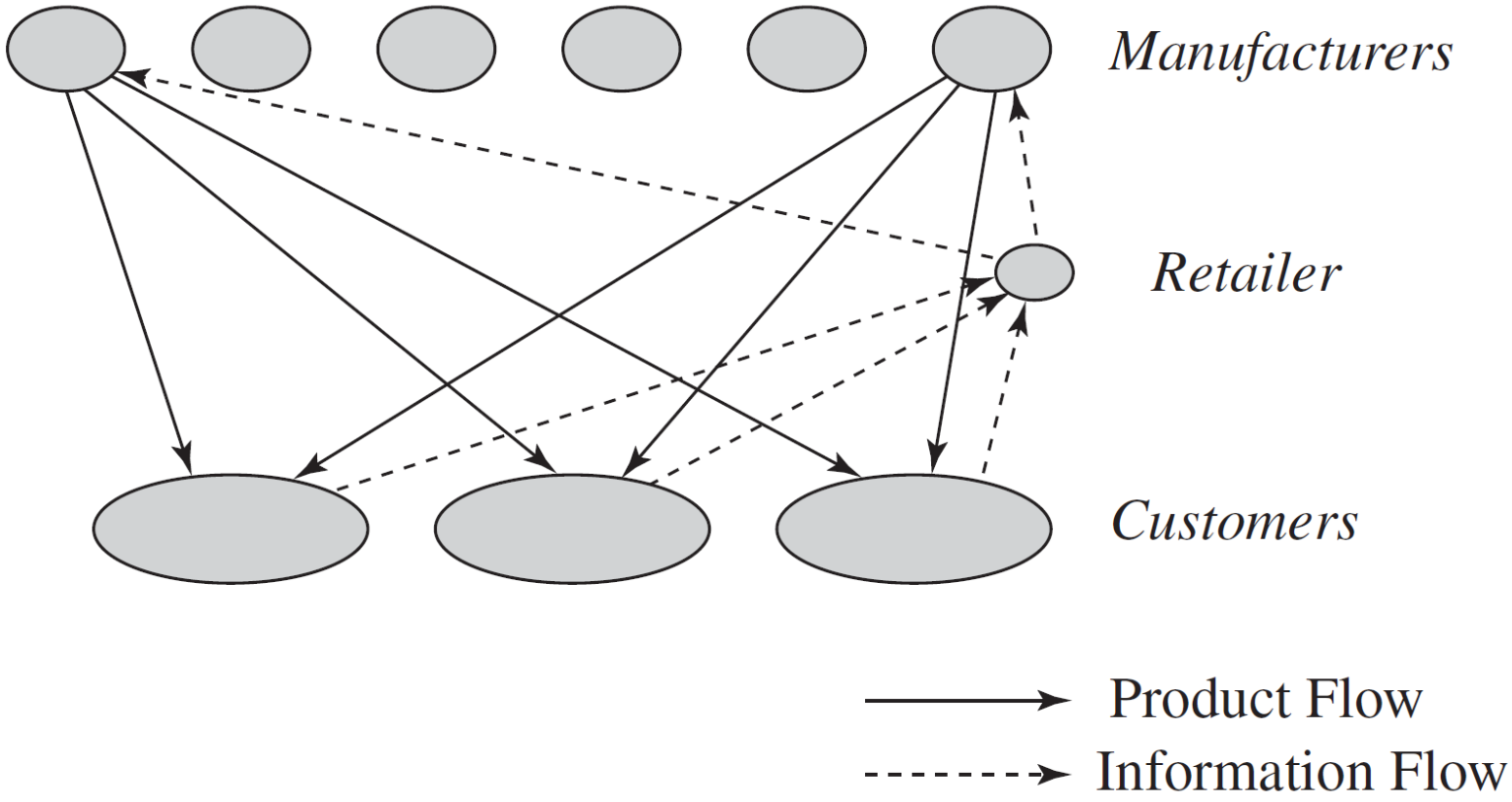
2. Will product flow through an intermediary (or intermediate location)?

Design Options for a Distribution Network

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

Manufacturer Storage with Direct Shipping



DROP-SHIPPING

In-Transit Merge Network

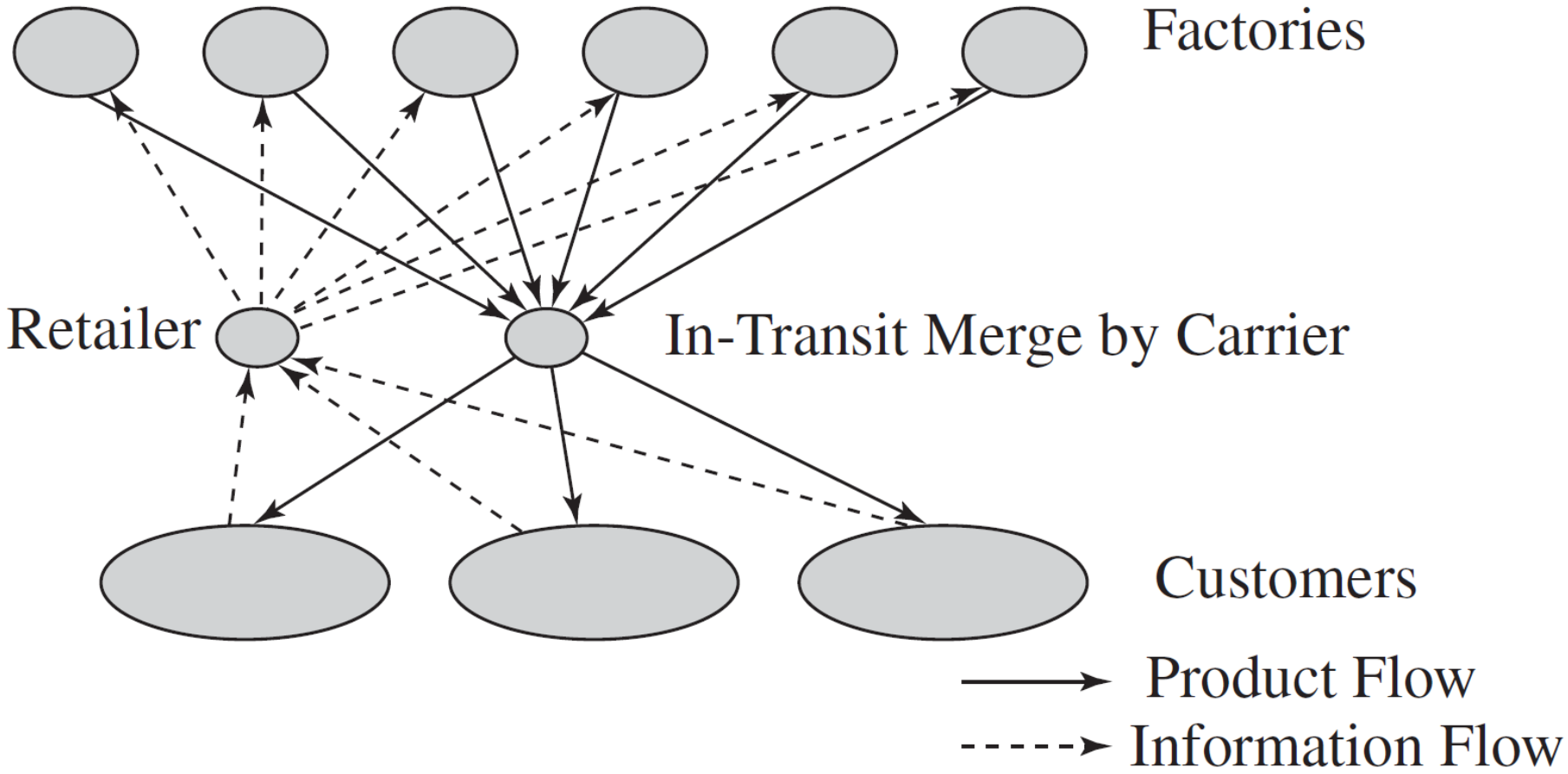
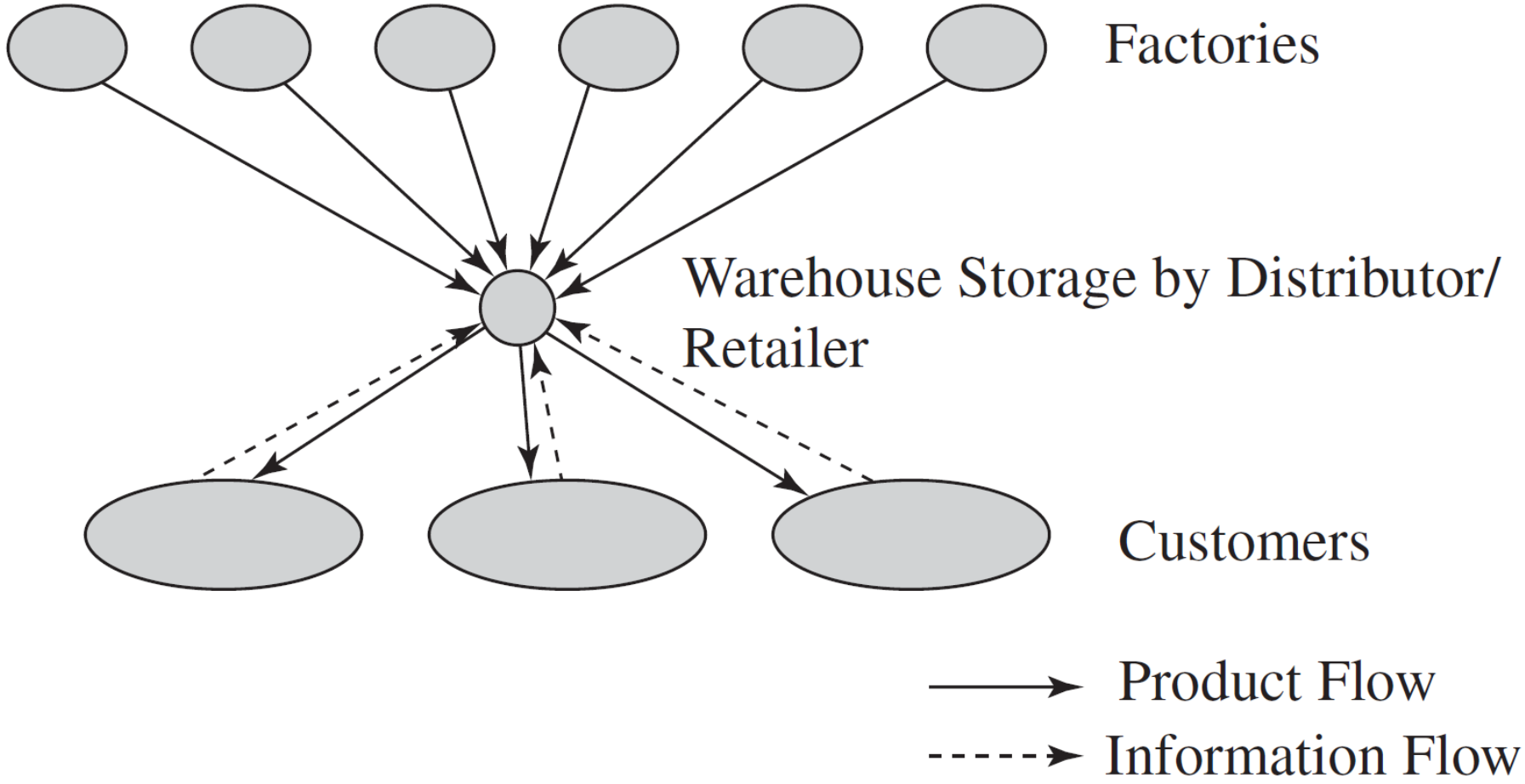


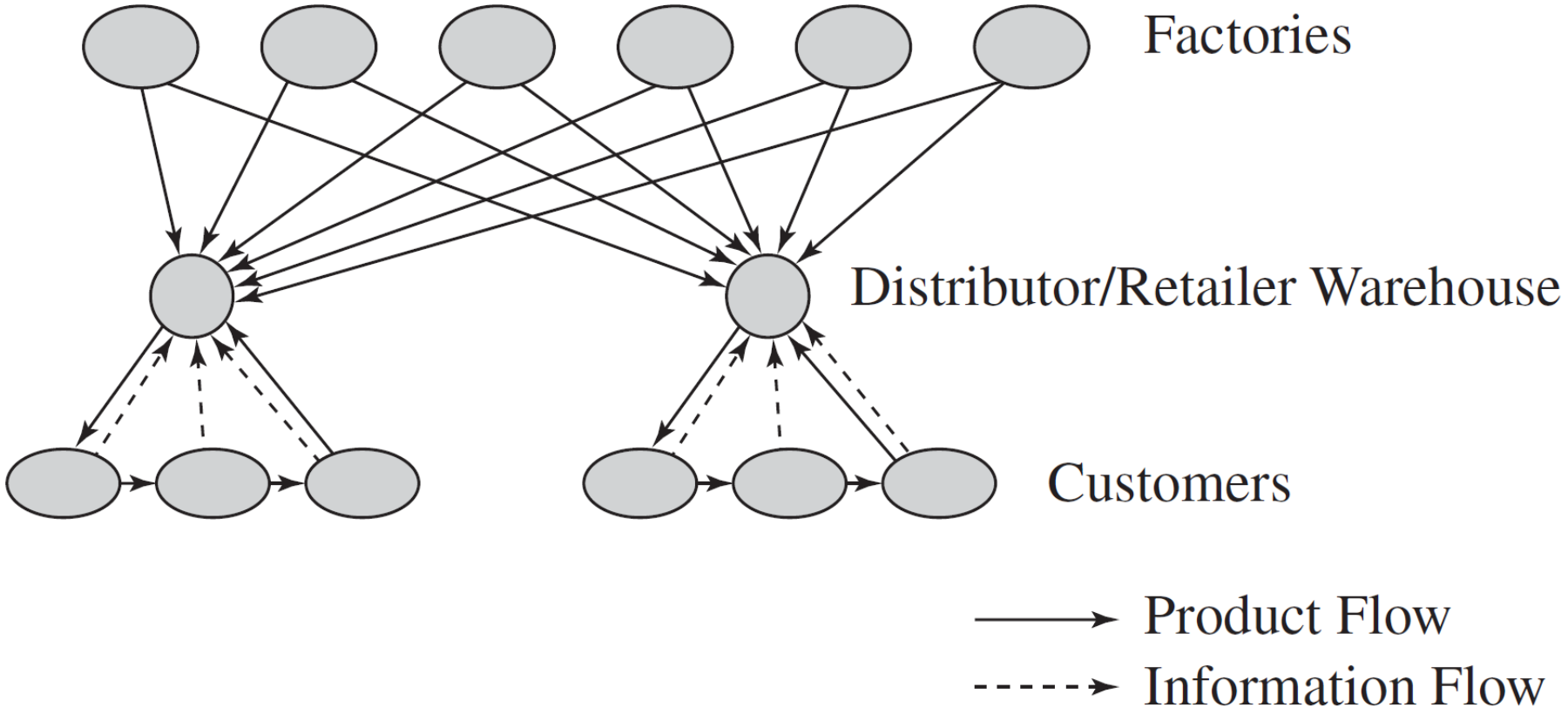
Figure 4-7

Distributor Storage with Carrier Delivery

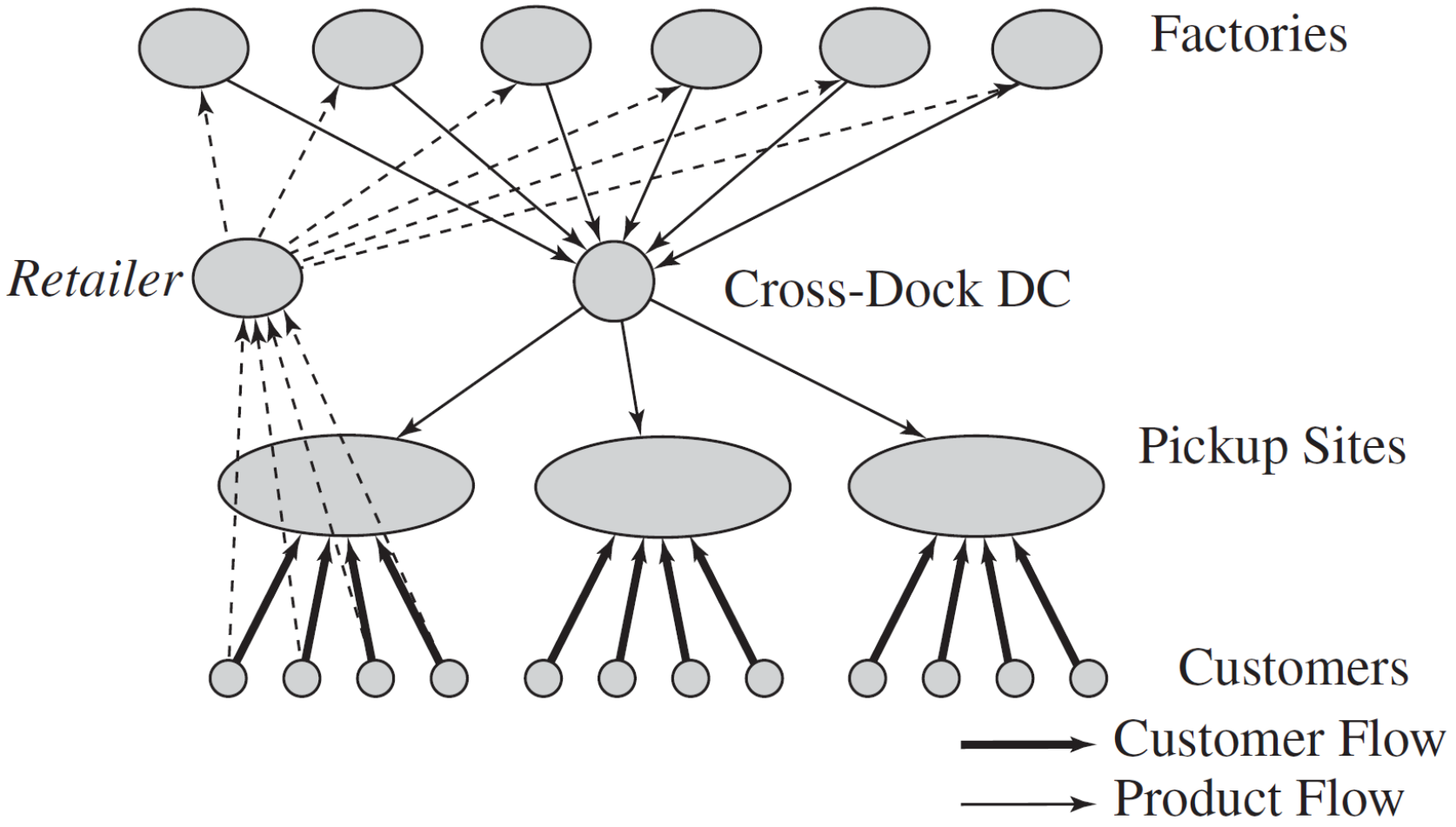


Distributor Storage with Last Mile Delivery

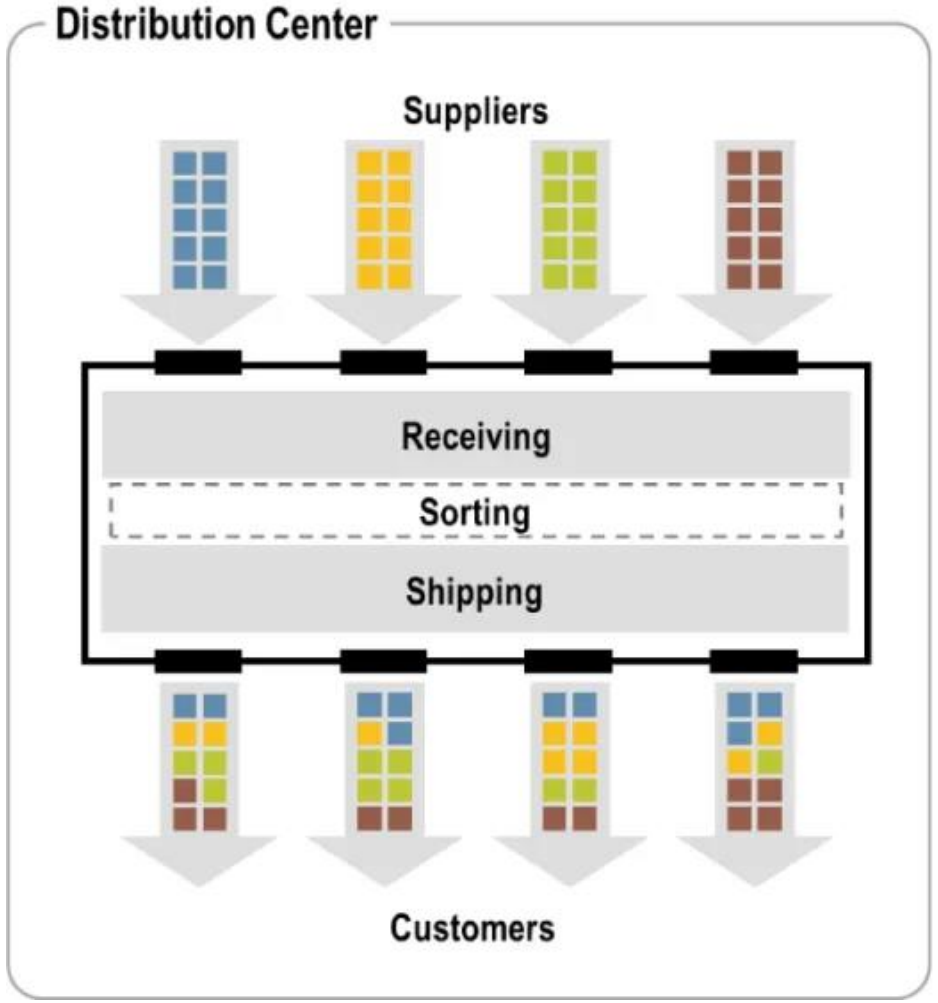
Figure 4



Manufacturer or Distributor Storage with Customer Pickup



Cross-Docking



Retail Storage with Customer Pickup (Traditional)

- In this option, often viewed as the most traditional type of supply chain, inventory is stored locally retail stores.
- Customers walk into the retail store or place an order online or by phone and pick it up at the retail store

High Demand Products

Selecting a Distribution Network Design

Comparative Performance 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 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	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
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 strongest performance and 6 the weakest performance.

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 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

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

Online sales and Omni-Channel Retailing

What is Omni- Channel Retail?

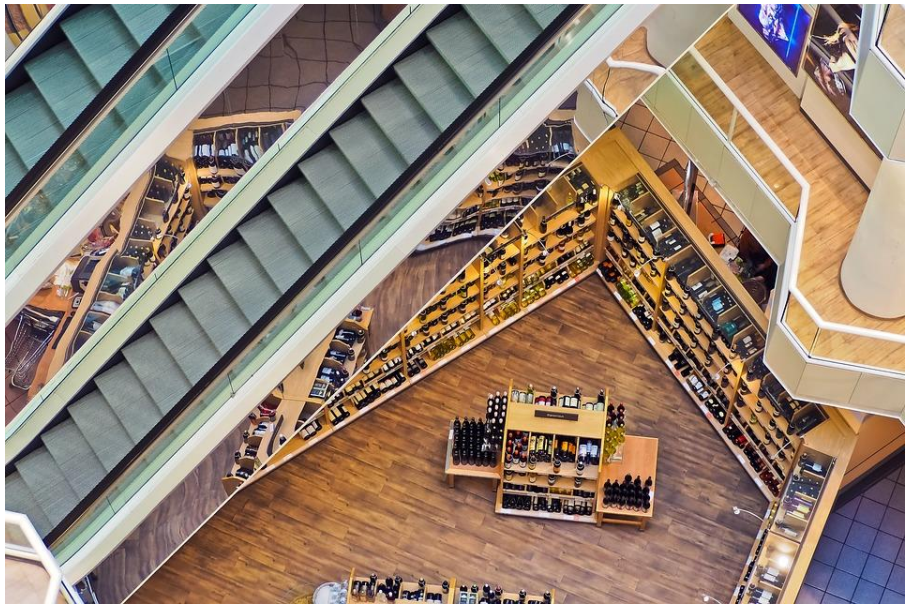
Omni-Channel Retail: Refers to the use of multiple channels to interact with customers and to fulfill their orders.

A hybring combination of a physical channel and an online channel, serves customers needs more effectively than a single channel.

Types of Sales Channels

1. Online Sales
2. Traditional Retail
3. Showrooms
4. Online Information + Home Delivery
5. Online Information + Pickup

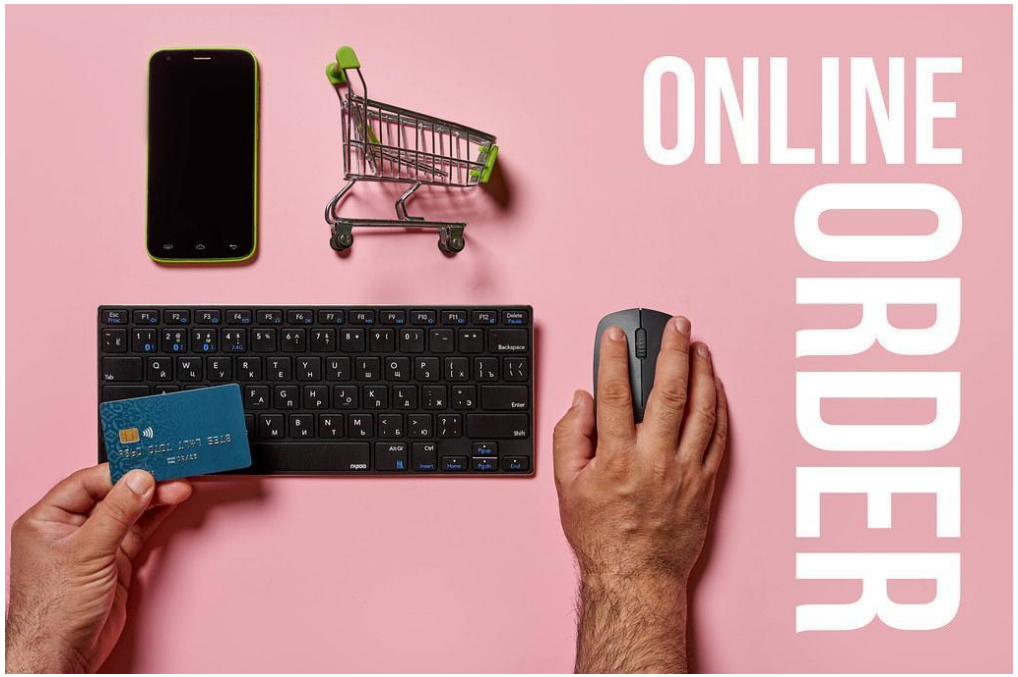
Traditional Retail



Showrooms

Online Information + Home Delivery

Online Information + Pickup



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