CPIM

CERTIFIED IN PLANNING
AND INVENTORY MANAGEMENT

MODULE 7: DISTRIBUTION

APICS

ASCM

Module 7 Overview

Distribution

- Section A: Planning Distribution
- Section B: Replenishment and Order Management
- Section C: Waste Hierarchy and Reverse Logistics

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CERTIFIED IN PLANNING
AND INVENTORY MANAGEMENT

SECTION A:
PLANNING DISTRIBUTION

APICS

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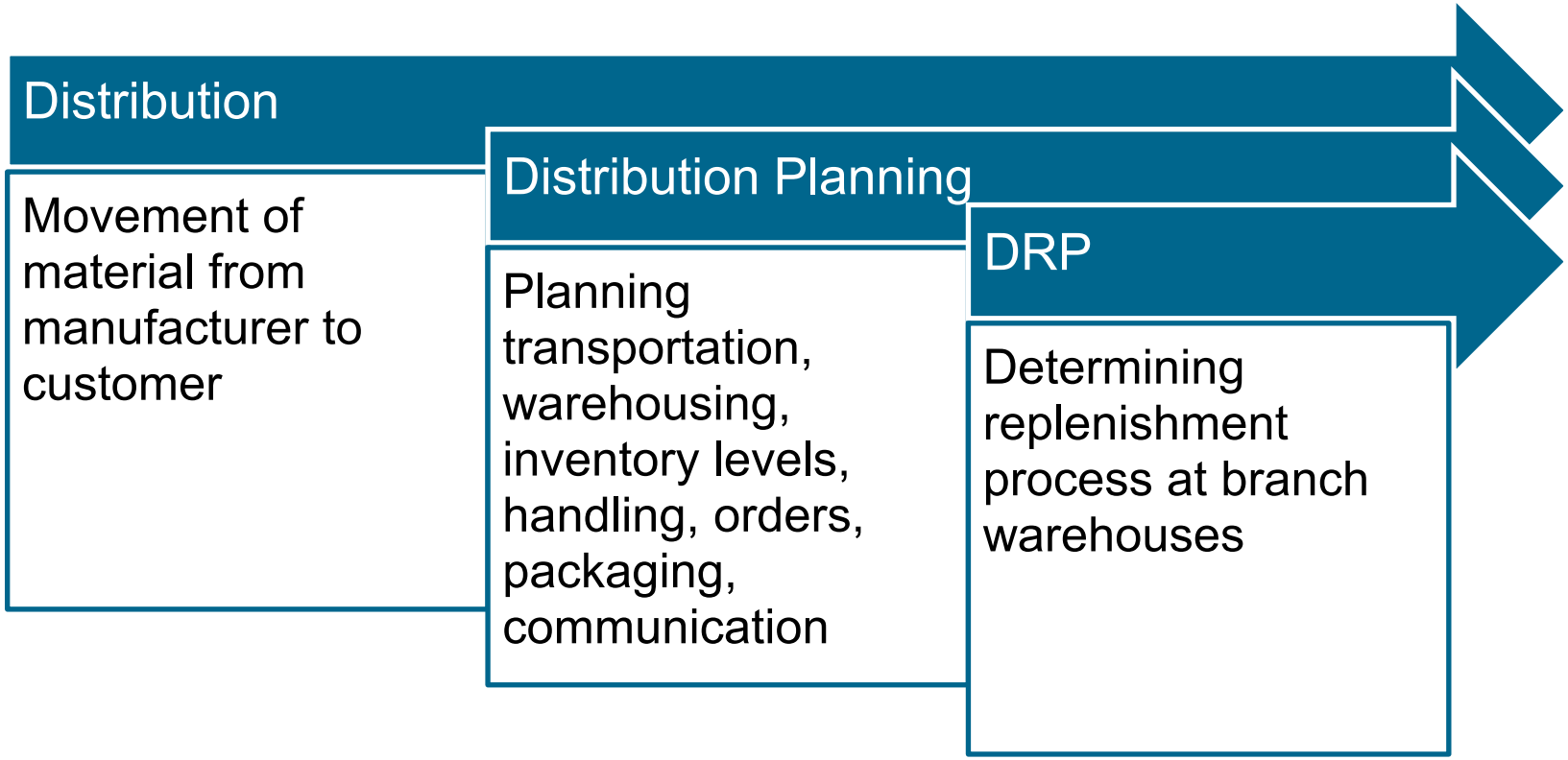
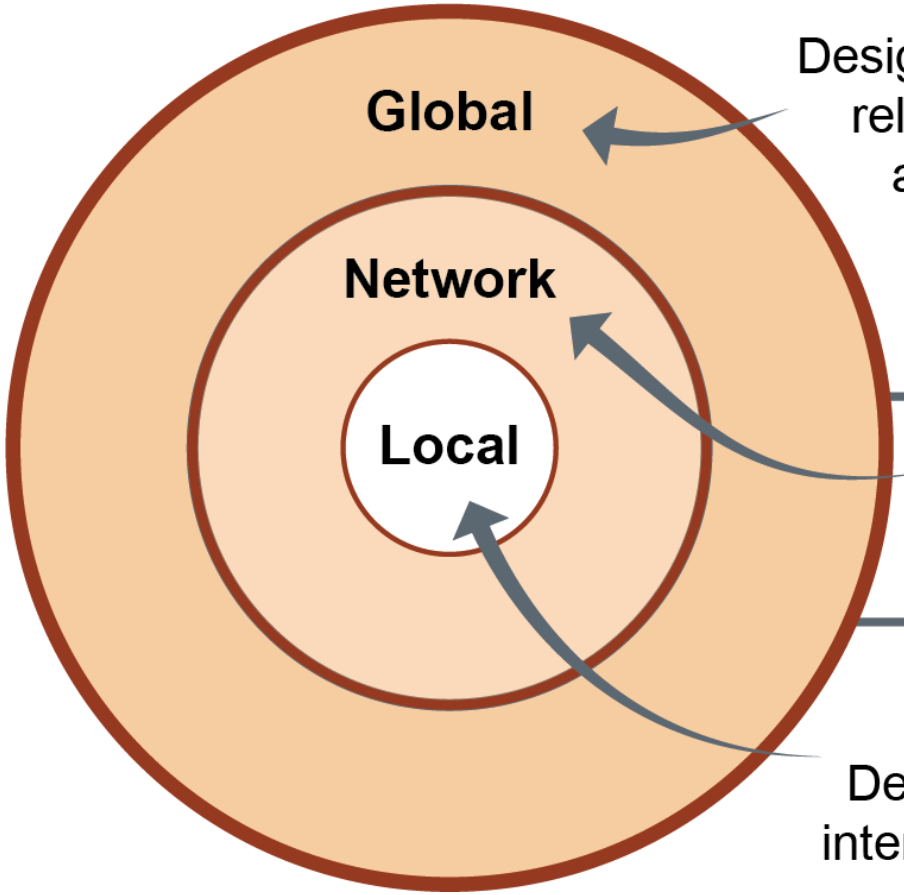
Section A Learning Objectives

- Distribution inventory planning objectives
- Channel strategies
- Network configurations
- Shipping costs and rates
- Distribution center locations and inventory levels
- Tradeoffs related to customer service and total costs as well as costs of inventory, customer service, lead time, facilities, and transportation
- Distribution plan
- Warehouse activities: storage systems, ownership types
- Transportation activities: management process, mode factors, tradeoffs, risks, sustainability, and carrier types

Distribution and Related Terms



Network Design Principles



Design principles affecting the organization's relationship to the physical environment and society, including local communities, the workforce, and sustainability

Design principles guiding collaborative interactions with upstream and downstream suppliers and customers

Design principles shaping the internal activities of organizations

Design Considerations and Principles

Logistics principles

- Physical proximity
- Transportation considerations and modes
- Tracking capabilities

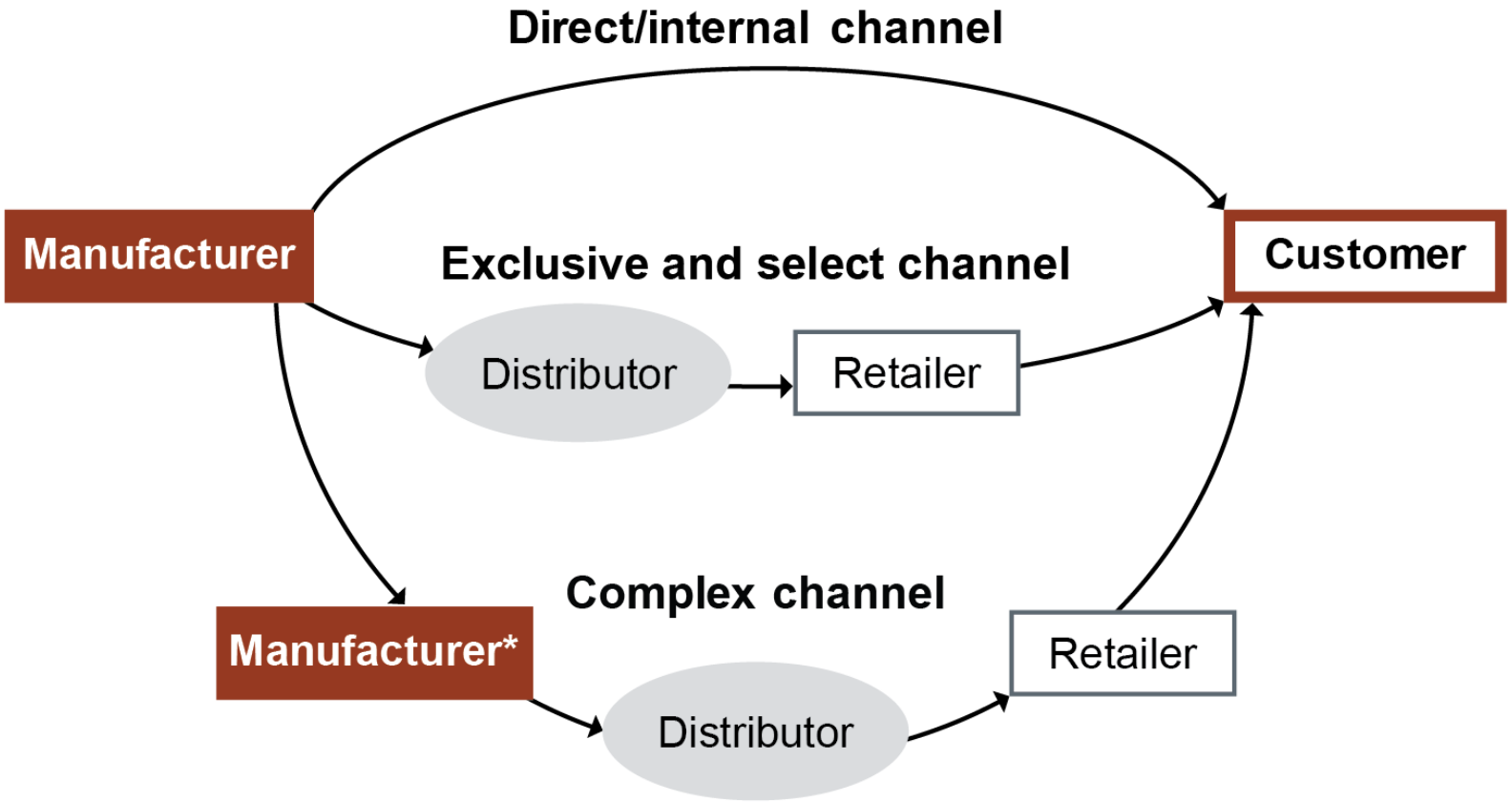
Network design principles

- Ensuring dependability of intermediaries
- Establishing collaborative relationships

Distribution Inventory Planning System Objectives

Targeted level of customer service at each stockkeeping location	Smoothest interaction with supply chain partners	Targeted service at lowest cost
▪ Central supply may hold all types of inventory while regional DCs vary what they carry (demand patterns).	▪ Minimize scheduling problems. ▪ Communicate reasons for larger or smaller orders.	▪ Minimize materials handling (number of times handled). ▪ Maximize turnover, e.g., cross-docking.

Distribution Planning Strategy



* Regional distribution centers owned by manufacturer

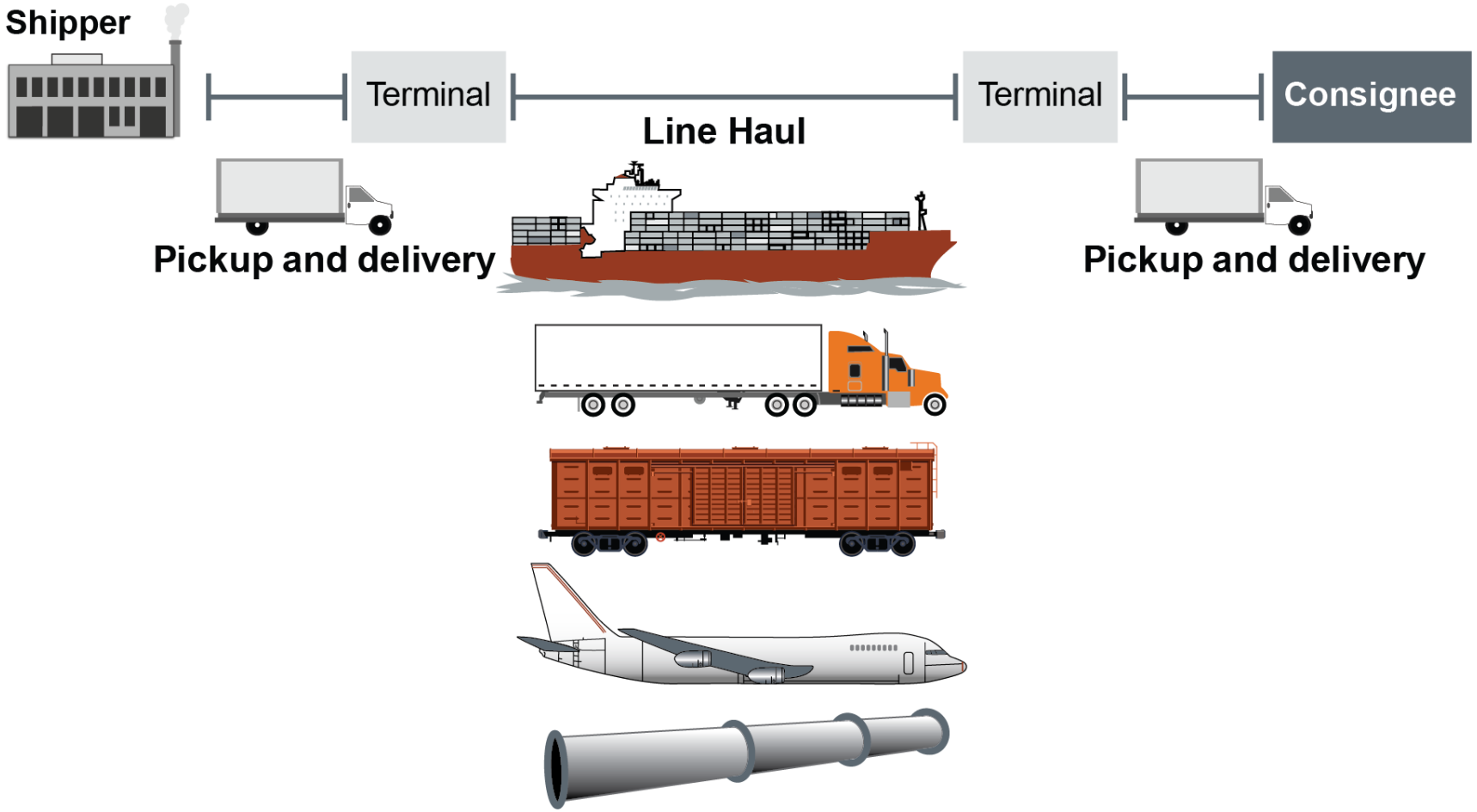
Distribution and Inventory Planning

Activity

1. Give manufacturing environments and examples of products in first two rows for all three channels.
2. Rate other attributes as high or low in the “Direct or internal” and “Complex” columns.

	Channel type		
Attributes	**Direct or internal**	**Exclusive or selective**	**Complex**
Manufacturing environment	ETO, MTO	MTO, ATO, MTS	MTS
Examples of products	Aircraft engines	Cars, brand apparel	Groceries
Distribution intensity	Low <---		---> High
Product variety	High <---		---> Low
End user order lead time	High <---		---> Low
Lot size or volume	Low <---		---> High
Location convenience	Low <---		---> High
Channel dependency	Low <---		---> High
Production cost per unit	High <---		---> Low
Inventory cost	Low <---		---> High

Shipping Patterns



Shipping Costs

Line-haul	▪ Costs for main portion of transportation journey ▪ Includes drivers' wages and usage depreciation
Pickup and delivery	▪ Charges for shipment pickup and weight ▪ Depends on weight and number of pickups
Terminal-handling	▪ Fees for materials handing, inspections, and customs ▪ Dependent on number of times shipment is handled
Billing and collecting	▪ Fixed administrative costs ▪ Fewer shipments or pickups reduce costs

TL Versus LTL and Other Factors Influencing Rates

- Two basic rate structures
  - Truckload (TL) or mode equivalent: lower rate
    - Quantity discount but lot-size inventory
  - Less-than-truckload (LTL) or equivalent: higher rate
    - More terminal handling, materials handling, billing, trips
- Hazardous, perishable, frozen, high value, fragile (packaging mitigates), cumbersome
- Low density (max volume), very dense (max weight)
- Backhauling, expediting

Shipping Exercise

Data

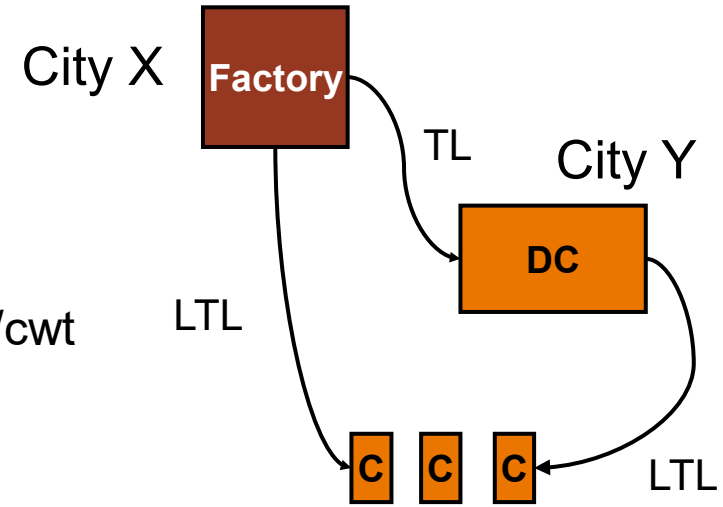
Estimated annual shipped volume = 10,000 cwt

Cost of LTL shipments direct to customers = $80/cwt

Cost of TL shipments to DC = $40/cwt

Cost of carrying inventory at DC = $8/cwt

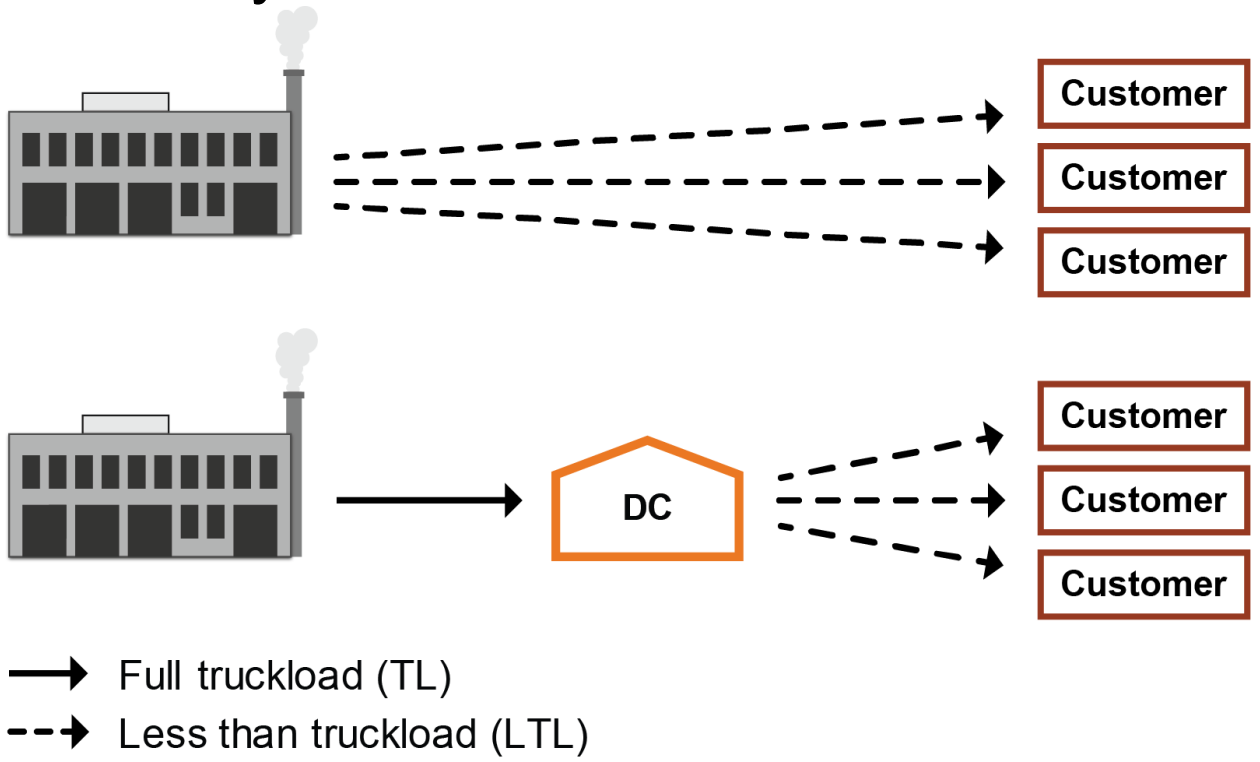
Cost of local delivery = $16/cwt



Estimated annual shipment volume =	10,000 cwt
Total annual cost of shipments direct to customers ($80/cwt) =	$800,000
Cost of full-truckload shipments to DC ($40/cwt) =	$400,000
Cost of carrying inventory at DC ($8/cwt) =	$80,000
Cost of local delivery ($16/cwt) =	$160,000
Total annual distribution costs to customers through DC =	$640,000

How Warehousing Can Reduce Transportation Costs

- Value-added role: break-bulk, freight consolidation.
- Warehouses cost money.



Number of Distribution Centers (DCs)

Simulation

- Trial and error
- Annual fixed cost
- Variable costs

Heuristic procedures

- Experiments
- Number of DCs and locations
- Add-and-drop (least total cost for first, then add)

Branch-and-bound

- Optimal number of DCs and locations
- Tree search treats even fixed costs as variable to eliminate paths

Location of DCs

Factor-rating method

- Qualitative and quantitative
- Priority weighting times score for site = weighted score
- Site(s) with highest overall scores

Center-of-gravity approach

- Optimize supply/distribution costs as function of distance and quantity shipped
- Map with longitude-latitude coordinates for location

Location break-even analysis

- Crossover point in units shipped where DC with higher fixed cost but lower variable cost becomes best choice

Least-cost-per-lane method

- Which warehouse to ship from based on which shipping lane can satisfy demand at least cost
- Considers capacity

Channel Design Model

	Design Factor	Project	Job Shop	Batch	Mass	Continuous
Supply	**Supply channel complexity**	Low	Low/ medium	Medium	High	Very high
	Supply integrative intensity	Very low	Low	Low/ medium	High	Very high
	Supplier intensity	Very low	Low	Medium	High	Very high
Distribution	**Market penetration intensity**	Low	Low	Medium	High	Very high
	Distribution integrative intensity	Very high	High	Medium/ high	Medium/ high	Low
	Distribution intensity	Low	Low	Low/ medium	Medium/ high	Very high

Distribution Plans

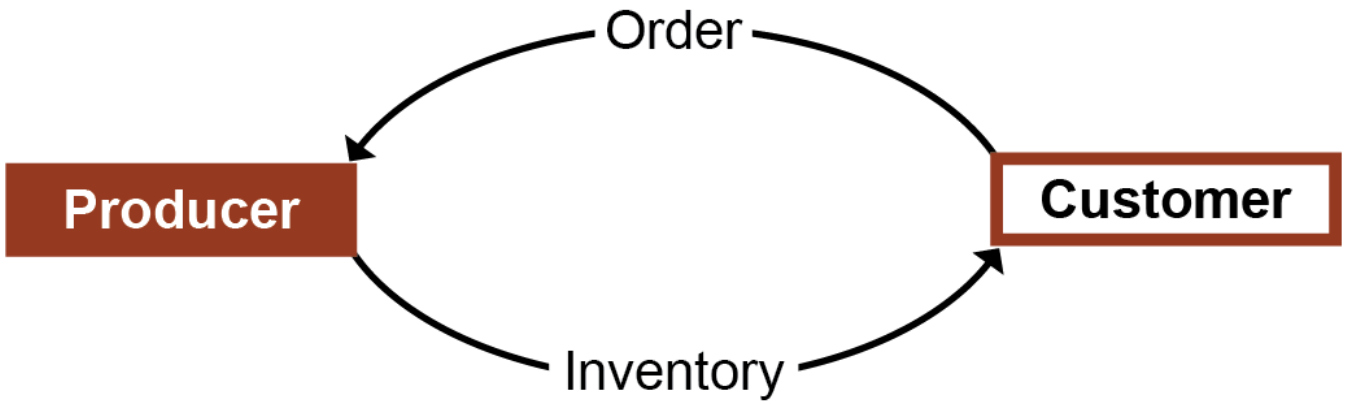
Delivery Channel Service Outputs

- Break-bulk (bulk-breaking or breaking bulk)
- Spatial convenience (proximity)
- Waiting and delivery lead time
- Variety (assortment)
- Technology

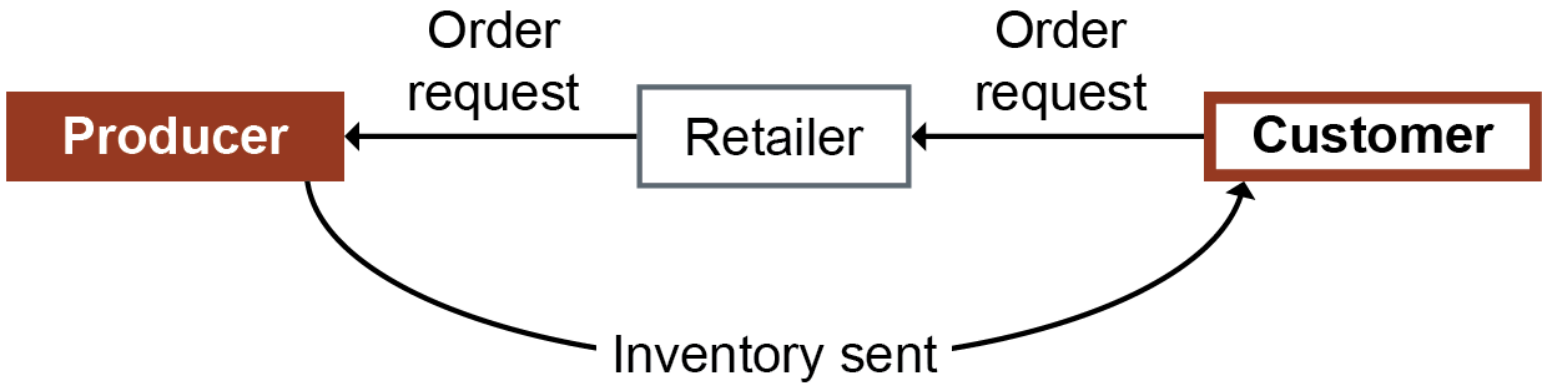
Matching demand with service outputs

Channel Structure

Producer storage with direct delivery

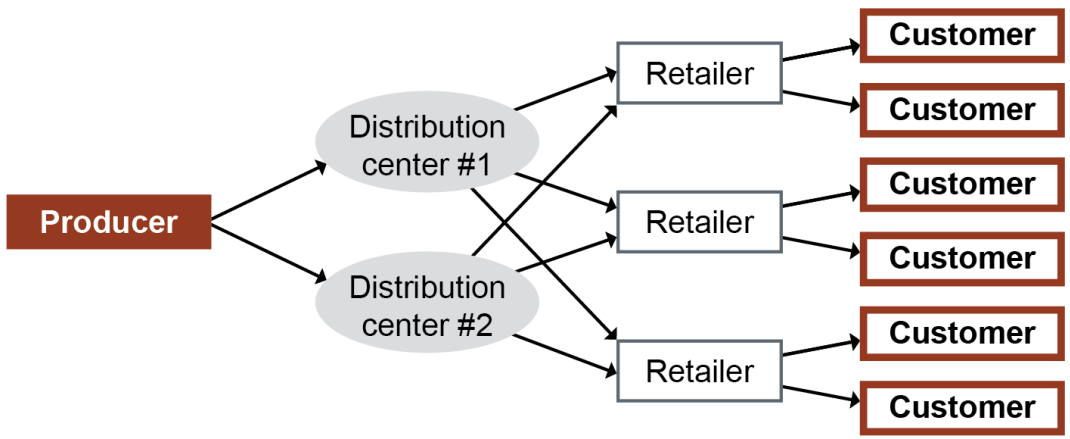


Producer storage with drop ship

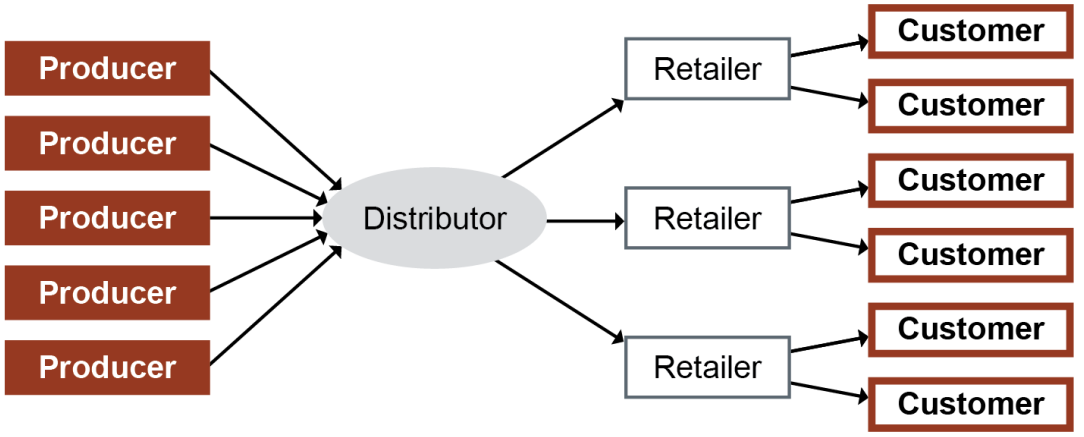


Channel Structure

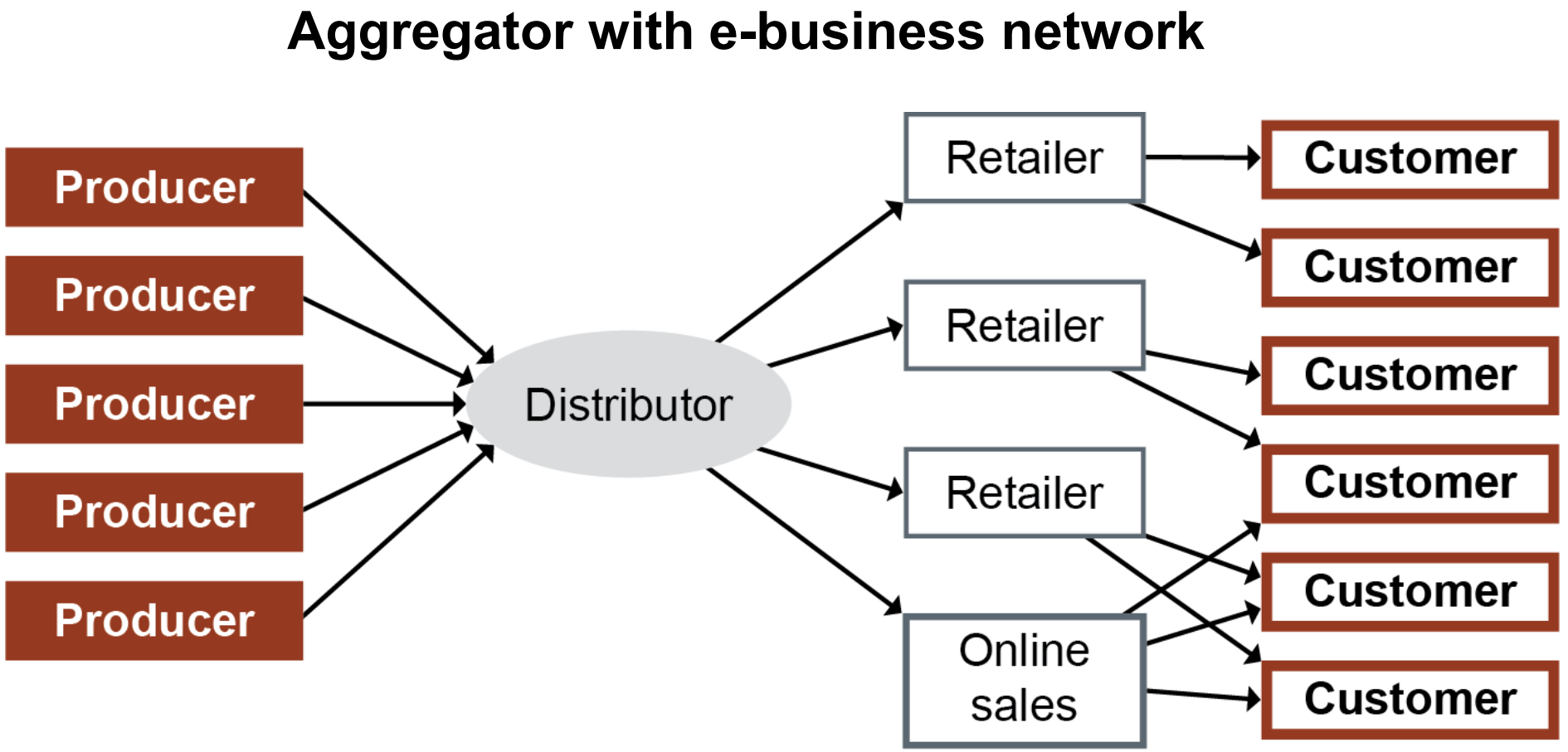
Producer with extended channel network



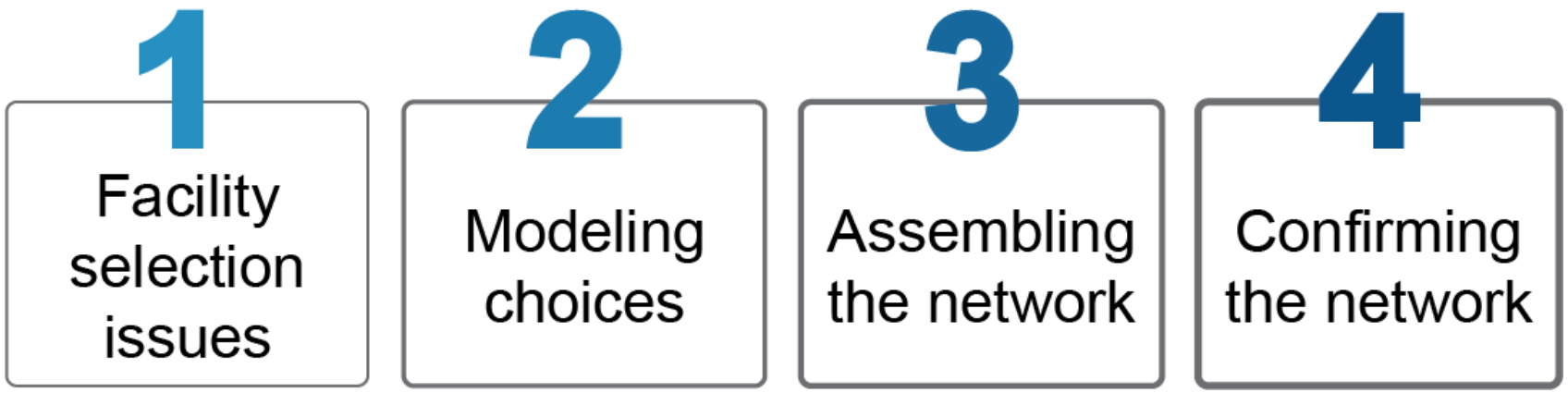
Distributor with extended channel network



Channel Structure



Channel Selection



Warehouse Objectives

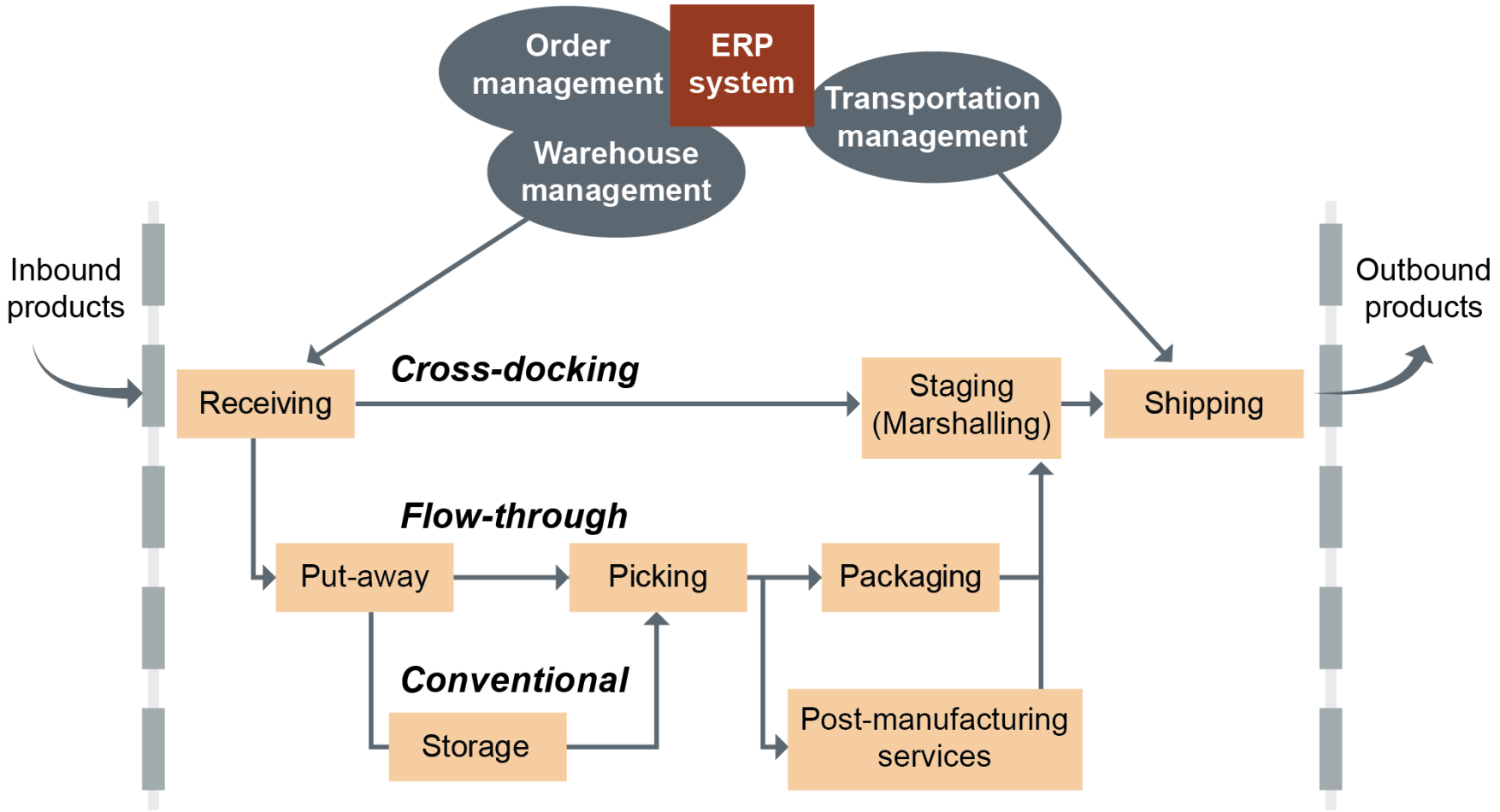
Best number of warehouses

- More lowers some costs and raises others.
- More reduces lead times for MTS.

Objective: Add value to supply chain.

- Reduce total costs compared to transportation alone
- Reliable delivery lead times and deliveries
- Value-added services: break-bulking, freight consolidation, cross-docking
- Maximize materials-handling efficiency (unitization and unit load)

Warehousing Processes and Activities



Inventory Location Systems

Fixed-location storage

- Relatively permanent locations
- ~50% of time half of locations empty
- Easy to learn where things are

Random-location storage

- Computer assigns spot
- Maximize cube utilization
- WMS-directed picking

Zone

- Zones hold certain types
- Fixed and floating benefits
- Less searching for lost item

Picking Methods

Each method uses a printed or electronic picking list

- Discrete order picking
- Batch picking
- Wave picking
- Zone picking

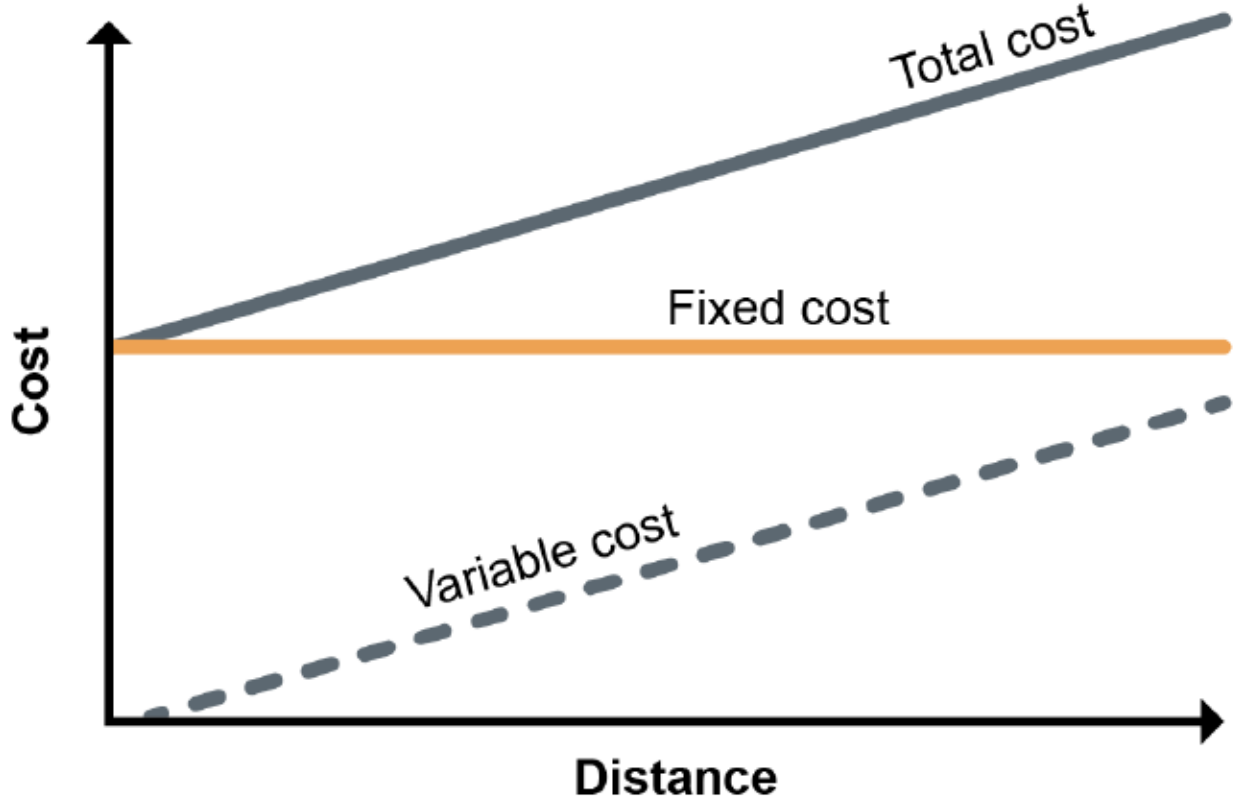
Types of Distribution Centers

Type	Advantages	Disadvantages
Private	▪ Direct control ▪ Less expensive than other types ▪ Tax advantage ▪ Simplify communication ▪ Direct ERP connections ▪ Ability to use for other purposes	▪ Inability to adjust to market-size demands ▪ Fixed location ▪ Structural limitations ▪ Capital investment
Public	▪ No fixed capital investment ▪ Costs are variable in proportion to services ▪ Can adjust with marketplace demands ▪ Access to technology without the investment ▪ Ability to purchase additional services as needed	▪ Lack of timely and accurate communication ▪ Availability of specialized services ▪ Availability of public warehouse space where needed (globally, regionally)

Transportation Management Process

1.	**Logistics strategy**	Establish logistics strategy and objectives.
2.	**Costs, rates, and prices**	Determine private fleet and for-hire carrier costs; establish rates and pricing models.
3.	**Transport mode and carrier**	Select transport mode and for-hire carriers toward goal of lowest cost for maximum service.
4.	**Scheduling and routing**	Select orders to be shipped and sequence of deliveries during the transportation route.
5.	**Documentation, audit, and claims**	Prepare shipping documents, audit and payment of invoices, and claims management.
6.	**Performance**	Track transportation metrics and illuminate regions for increased productivity and competitive advantage.

Cost of Transportation



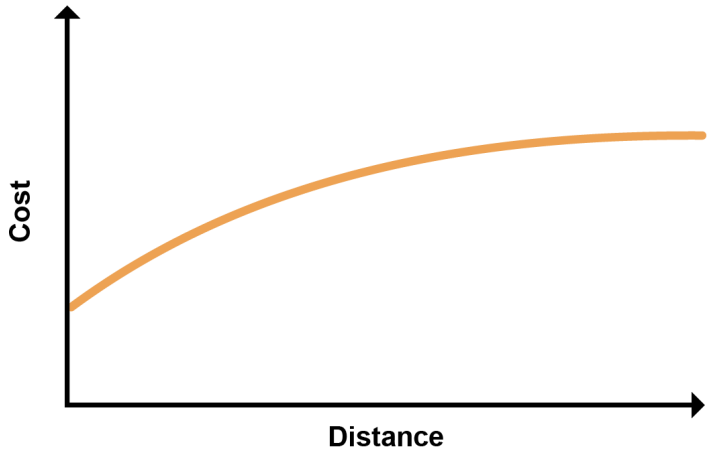
Transportation Mode and Carrier Selection

Performance characteristics

- Speed
- Completeness
- Dependability
- Capability and capacity
- Quality and safety
- Frequency
- Cost

Selection tradeoffs

- Vehicle profitability
- Liability
- Volume
- Distance
- Stowability
- Handling
- Density



Transportation Risk Management

Risk Category	Specific Risk
Delivery delay	Congestion, poor weather, equipment malfunction
Shipment loss	Theft and pilferage, piracy and hijacking, extortion, cargo jettison, loss of life or injury
Shipment damage	Operator accident, inappropriate packaging, poor freight-handling methods, improper equipment loading
Shipment contamination	Temperature control failure, product tampering, exposure to hazardous materials
Security breach	Shipment control breakdown, unprotected transfer facilities, lax security processes
Channel disruption	Capacity shortage, carrier bankruptcy, labor disruption and strikes
Storage in transit	Unavailable until received

Warehouse Sustainability Elements

Design and layout	Materials handling	Packaging
▪ Track energy savings ▪ Locate site closer to customers ▪ Monitor inputs	▪ Purchase sustainable equipment ▪ Monitor emissions	▪ Reduce product overpacking ▪ Utilize reusable or recyclable packaging

Transportation

Water

Subsets: ocean and inland waterway

Potential fees at waterways, locks, dams, and terminals

Slow but low cost: spread cost over many units

Good for very dense, low-value cargo (e.g., ore)

Long lead times, higher safety stock, carrying cost

Often still cheapest even after pickup and delivery

Rail

Low cost, especially variable cost (highly efficient), high fixed costs

Best for durable, dense, and low-value cargo due to rough ride

Useful for moving shipping containers

Line-haul speed good, but delays can occur

In Europe, rail gauges change between countries, causing cost and delay

Pickup and delivery cost will apply in most situations

Transportation

Road

- Semis, short haul, containers without unloading
- Roads maintained by governments, reducing fixed cost
- Terminals typically owned by carriers
- Vehicles are low capital cost
- Variable cost is most significant: labor, fuel, wear and tear
- Highly flexible, can provide direct end-to-end transport
- Relatively fast, moderately priced, smaller loads

Transportation

Air

Cargo planes and space on commercial flights

Most expensive, fastest, but limited space

Lead time of one to two days with pickup/delivery

Gentle ride

Primarily variable cost, but planes are high capital cost

Need suitable airports at each end

Pipeline and Intermodal

Pipeline

- Each carries one type of material
  - Crude oil
  - Slurries
- High capital cost, low operating cost
- Far less expensive than rail (main alternative)
- Unaffected by weather
- Regulatory issues, terrorist threats, power outages

Intermodal

- Combines best features of two or more modes
- Used for line haul
- Special logistics
- Examples of containers:
  - Truck to terminal
  - Ocean carrier to terminal
  - Rail to terminal
  - Truck to destination

Carriers

Private carrier	For-hire (public) carrier	Specialists
▪ Own or lease for private use	▪ Services for hire ▪ Common carrier: – All customers treated the same – Basically a commodity itself ▪ Contract carrier: – Dedicated use based on contract – Benefits of private with less cost or risk	▪ Truckload (TL) carriers ▪ Package shipping companies ▪ Postal services

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SECTION B:
REPLENISHMENT AND ORDER MANAGEMENT

APICS

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Section B Learning Objectives

- Pull and push systems
- How DRP monitors inventory levels by location
- Warehouse replenishment systems: reorder point/EOQ, base stock, DRP's TPOP, DDMRP
- SKU replenishment parameters
- Location-specific forecast
- Linkages between DRP, S&OP, and master scheduling
- Inventory tracking technology
- Distribution KPIs
- Data collection methods for gathering feedback
- Order management, including monitoring availability and lead time
- Order cycle stages
- Expediting

Push versus Pull

Key Attributes	Pull Systems	Push Systems
Replenishment initiation	Decentralized (warehouse)	Centralized (central supply planners)
Inventory planning	At warehouse level	For total system inventory
Customer service	Measured at DC level	Measured systemwide
Reorder point	Order point, min/max, periodic review; at signal—pull item, kanban signal	When projected available balance for future given period is negative or below safety stock level
Systemwide safety stock	High: safety stock carried at each location and level	Lower: consolidated at one location
Organizational implications	Downstream inventory requirements not visible	Central planners responsible; forecasting training; need accurate demand/supply data

Distribution Requirements Planning (DRP)

- Determines need to replenish at distribution centers
- Time-phased order point (TPOP)
  - Logic very similar to MRP
  - Gross requirements from forecast, not explosion
  - Allows for lumpy withdrawals rather than average demand
- Has push and pull features
  - Distribution centers place orders
  - Advance notice for central supply order size suggestions

Replenishment Planning

Improving Performance of Distribution Network

- Quick responses to market changes can be made by relocating products to areas where they are in demand.
- The systems assist management in planning for future requirements in the field.

Robust DRP systems

- Material supply and demand are closely matched.
- Inventory can be located and deployed from specific locations to best meet customer service requirements.

Basic DRP Concepts

- **Coordinates materials flow** through physical distribution system
- **Addresses when, where, and how much** inventory is needed
- **Shapes what resources are needed** to ensure that replenishment inventory can be delivered, handled, and stored per replenishment plans
- **Goal** is efficient, timely service with minimal inventory investment

Warehouse Replenishment Systems

	ROP/EOQ	Base Stock	TPOP	DDMRP
Time	When actual DC inventory reaches reorder point	When scheduled shipment date occurs	Projected on-hand balance offset by lead time	Daily reviews of buffer priorities for ordering (net flow position) and expediting (on hand versus projected)
Amount	Lot size based on EOQ	Actual usage in previous period	Economic shipment quantity based on projected time-phased use	Dynamic based on average daily usage and adjustment factors
Decision point	DC	Lot-for-lot with central location decisions if there is supply demand mismatch	Central location	DC or central location
Complexity	Low	Medium	High	Medium

Time-Phased Order Point (TPOP) Planning

		Period				
	On-Hand	**1**	**2**	**3**	**4**	**5**
Forecast requirements		20	20	20	20	20
In-transit						
Projected available balance	32	12	37	17	42	22
Planned order receipts			45		45	
Planned order releases		45		45		

Safety stock: 10 Shipping quantity: 45 Lead time: 1

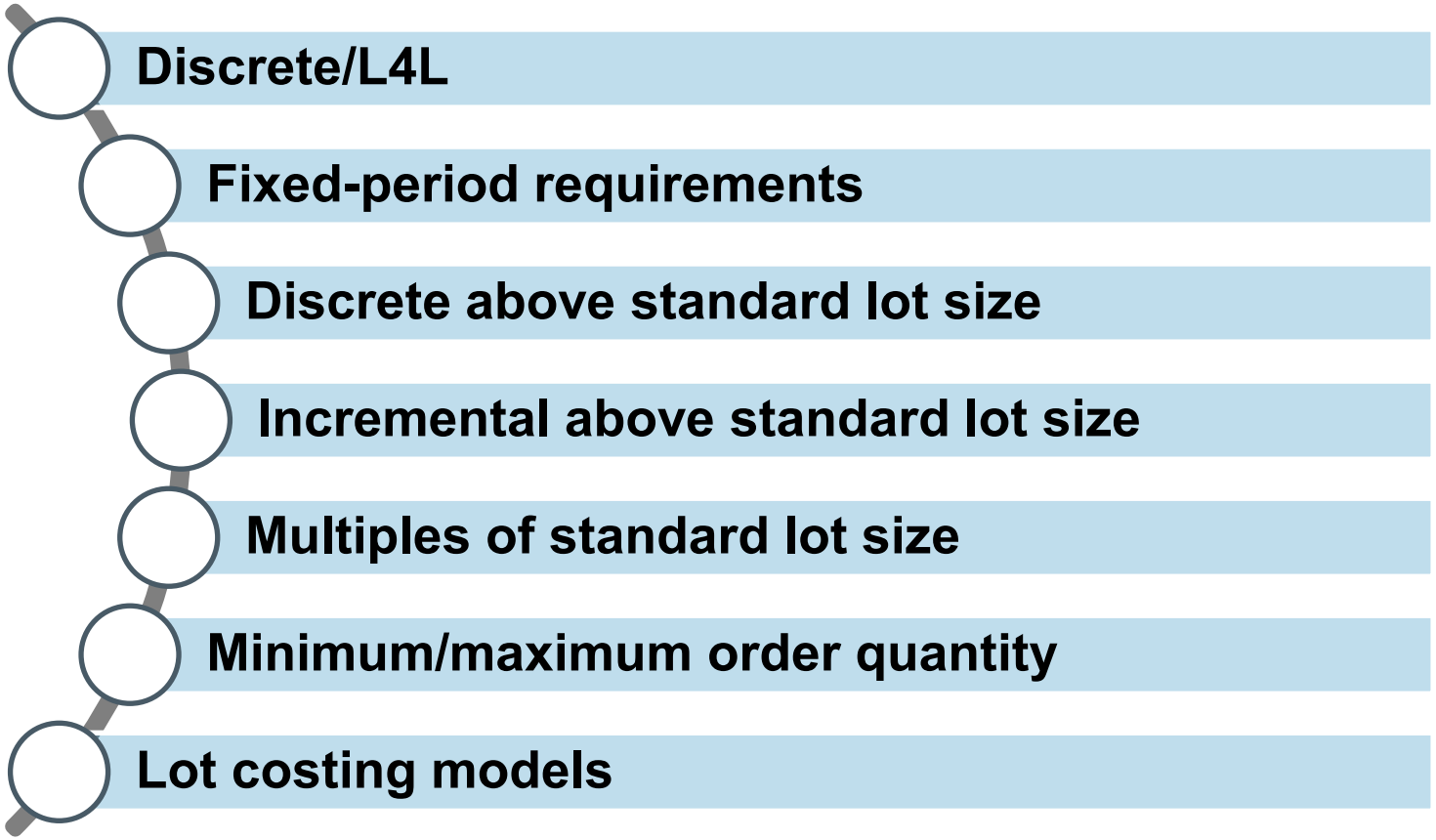
Advantages of TPOP Compared to Q, R

- TPOP provides planned shipment data; Q, R does not.
- TPOP does not assume or require constant consumption.
- TPOP can integrate actual order data, not just planned shipment data.

Demand-Driven MRP (DDMRP) System

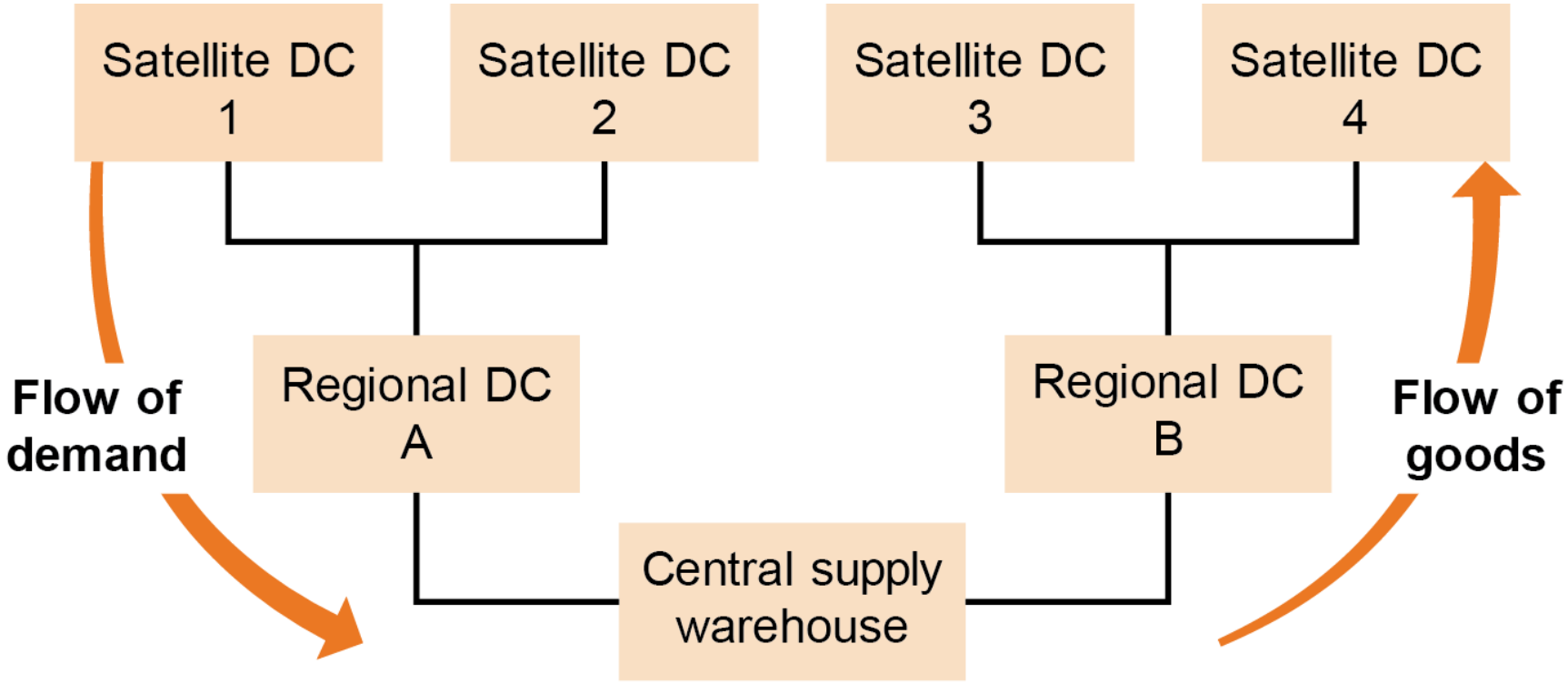
- For dependent and independent demand at any point in supply chain
- Strategic decoupling points or buffers to
  - Reduce lead time, bullwhip effect, and overall inventory
  - Increase customer service KPIs
- Buffer size
  - Item traits: average daily usage, decoupled lead time, order multiples
  - Buffer profiles: part type, lead time, variability
- Buffer zones compare zone status to net flow position (on hand + on order + qualified sales order demand)
  - Green: size and timing of replenishment orders (“order up to” level)
  - Yellow: average amount of replenishment in transit
  - Red: safety stock amount

DRP Order Policies



Distribution Requirements Planning

Bills of Distribution



DRP Safety Stock Calculation Options

- Set safety stock using preset number of days of inventory.
- Set safety stock based on usage and lead time.

Safety Stock = (Maximum Daily Usage × Maximum Lead Time in Days) – (Average Daily Usage × Average Lead Time in Days)

- Estimate safety stock (SS) using square root law.

$$\text{Future SS} = \text{Current SS} \times \sqrt{\frac{\text{Number of DCs in Future}}{\text{Number of DCs in Present}}}$$

Distribution Safety Stock Exercise

1. Safety stock for a product in the region is 500 units. Assuming equal sales from each warehouse, what is the effect on safety stock requirements of increasing the number of satellite DCs to two and locating safety stock in each DC?

$$\text{SS for DC} = \frac{\text{SS for 1 DC}}{\sqrt{\text{Number of DCs}}}$$

Where:
SS = Safety stock in each warehouse
DC = Satellite distribution center

$$\textit{Safety Stock for Each Satellite DC} = \frac{500}{\sqrt{2}} = \frac{500}{1.414} = 354$$

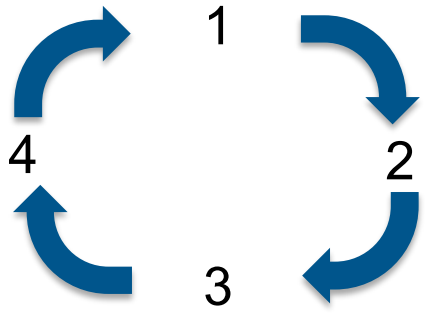
2. Why not just keep the total safety stock at 500 units by carrying 250 units of safety stock at each location?

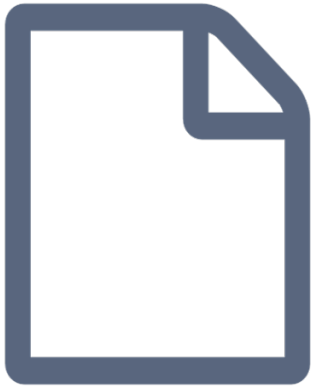
3. Under what circumstance would it be appropriate to maintain a total safety stock level of 500 units at a regional DC to cover both satellite DCs?

Distribution Requirements Planning

Inventory Control

- People
- Process
- Paper





DRP Inputs, Calculations, and Outputs

- Inputs
  - Planning horizon length and bucket size
  - Item forecast
  - Open customer orders
  - Beginning on-hand quantities
  - Open purchase, interbranch, postponement orders
  - Replenish/finish lead times
  - Safety stock
  - Order policy code
  - Supply sources based on BOD
- Calculations
  - DRP processor populates each planning grid bucket.
  - Bucket resupply is by item's order policy code.
- Outputs
  - Exception reporting
  - Planned orders
  - Action messages
  - Pegged requirements

Distribution Requirements Planning (DRP) Grids

DC A Week		1	2	3	4	5	6	7	8
Gross Requirements								300	
Scheduled Receipts									
Projected Available Balance	170	170	170	170	170	170	170	270	270
Net Requirements								200	
Planned Order Receipts								400	
Planned Order Releases							400		

DC B Week		1	2	3	4	5	6	7	8
Gross Requirements									500
Scheduled Receipts									
Projected Available Balance	200	200	200	200	200	200	200	200	200
Net Requirements									400
Planned Order Receipts									500
Planned Order Releases							500		

Central Supply Week		1	2	3	4	5	6	7	8
Gross Requirements							900		
Scheduled Receipts									
Projected Available Balance	500	500	500	500	500	500	200	200	200
Net Requirements							600		
Planned Order Receipts							600		
Planned Order Releases				600					

Master Schedule Grid Week	1	2	3	4	5	6
Gross Requirements			600			
Projected Available Balance	0	0	200	200	200	200
Master Production Schedule			800			

	Lot Size (units)	Lead Time (weeks)	Safety Stock (units)
DC A	400	1	70
DC B	500	2	100
Central Supply	600	3	200
Master Schedule Grid	800	N/A	N/A

DRP Problem Overview

Warehouse A		Week							
Lot: 100, Lead time: 1, SS: 0		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		80	80	80	70	80	90	90	90
Scheduled receipts									
Projected available balance	90	10	30	50	80	0	10	20	30
Net requirements			70	50	20		90	80	70
Planned order receipts			100	100	100		100	100	100
Planned order releases		100	100	100		100	100	100	

Warehouse B		Week							
Lot: 50, Lead time: 2, SS: 10		1	2	3	4	5	6	7	8
Gross requirements		30	30	30	30	30	35	35	35
Scheduled receipts		50							
Projected available balance	30								
Net requirements									
Planned order receipts									
Planned order releases									

Warehouse C		Week							
Lot: 100, Lead time: 2, SS: 15		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		60	60	70	70	80	90	90	90
Scheduled receipts		100							
Projected available balance	70								
Net requirements									
Planned order receipts									
Planned order releases									

Central Supply		Week							
Lot: 300, Lead time: 2, SS: 50		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements									
Scheduled receipts		300							
Projected available balance	250								
Net requirements									
Planned order receipts									
Planned order releases									

DRP Warehouse B Exercise

Warehouse B	Week								
Lot: 50, Lead time: 2, SS: 10		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		30	30	30	30	30	35	35	35
Scheduled receipts		50							
Projected available balance	30	50	20	40	10	30	45	10	25
Net requirements				20		30	15		35
Planned order receipts				50		50	50		50
Planned order releases		50		50	50		50		

DRP Warehouse C Exercise

Warehouse C	Week								
Lot: 100, Lead time: 2, SS: 15		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		60	60	70	70	80	90	90	90
Scheduled receipts		100							
Projected available balance	70	110	50	80	110	30	40	50	60
Net requirements				35	5		75	65	55
Planned order receipts				100	100		100	100	100
Planned order releases		100	100		100	100	100		

DRP Central Supply Gross Requirements Exercise

Warehouse A		Week							
Lot: 100, Lead time: 1, SS: 0		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		80	80	80	70	80	90	90	90
Scheduled receipts									
Projected available balance	90	10	30	50	80	0	10	20	30
Net requirements			70	50	20		90	80	70
Planned order receipts			100	100	100		100	100	100
Planned order releases		100	100	100		100	100	100	

Warehouse B		Week							
Lot: 50, Lead time: 2, SS: 10		1	2	3	4	5	6	7	8
Gross requirements		30	30	30	30	30	35	35	35
Scheduled receipts		50							
Projected available balance	30	50	20	40	10	30	45	10	25
Net requirements				20		30	15		35
Planned order receipts				50		50	50		50
Planned order releases		50		50	50		50		

Warehouse C		Week							
Lot: 100, Lead time: 2, SS: 15		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		60	60	70	70	80	90	90	90
Scheduled receipts		100							
Projected available balance	70	110	50	80	110	30	40	50	60
Net requirements				35	5		75	65	55
Planned order receipts				100	100		100	100	100
Planned order releases		100	100		100	100	100		

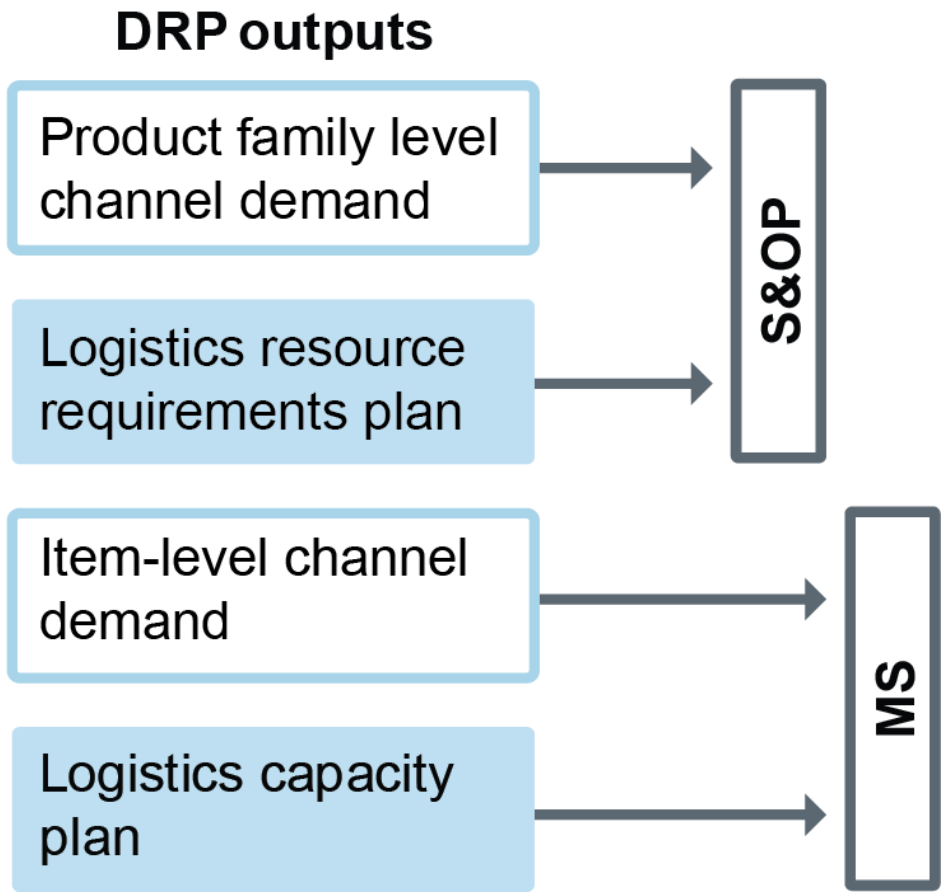
Central Supply		Week							
Lot: 300, Lead time: 2, SS: 50		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		250	200	150	150	200	250	100	0
Scheduled receipts		300							
Projected available balance	250								
Net requirements									
Planned order receipts									
Planned order releases									

DRP Central Supply Exercise

Central Supply	Week								
Lot: 300, Lead time: 2, SS: 50		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross requirements		250	200	150	150	200	250	100	0
Scheduled receipts		300							
Projected available balance	250	300	100	250	100	200	250	150	150
Net requirements				100		150	100		
Planned order receipts				300		300	300		
Planned order releases		300		300	300				

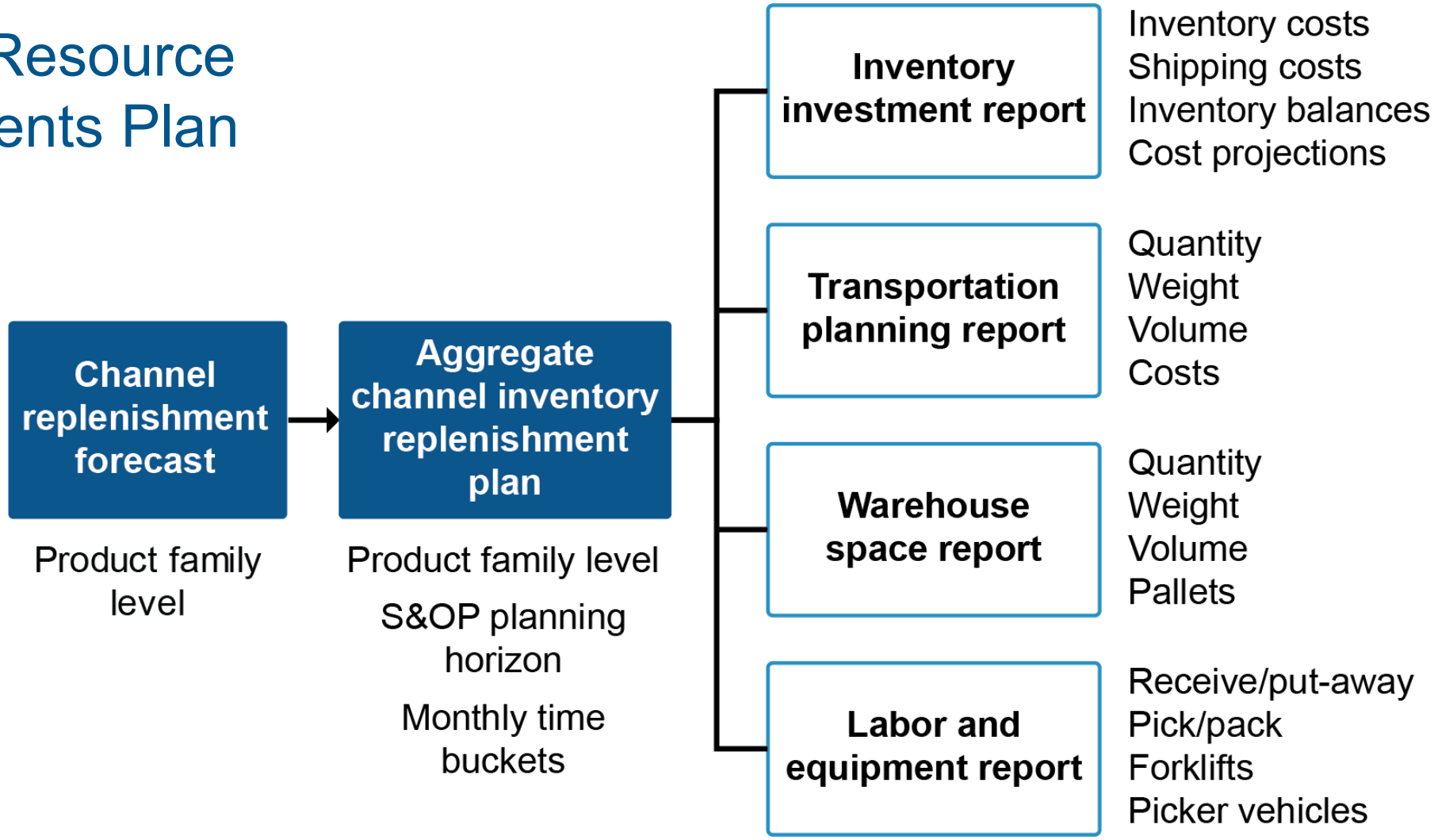
Distribution Requirements Planning

Linking DRP, S&OP, and Master Scheduling

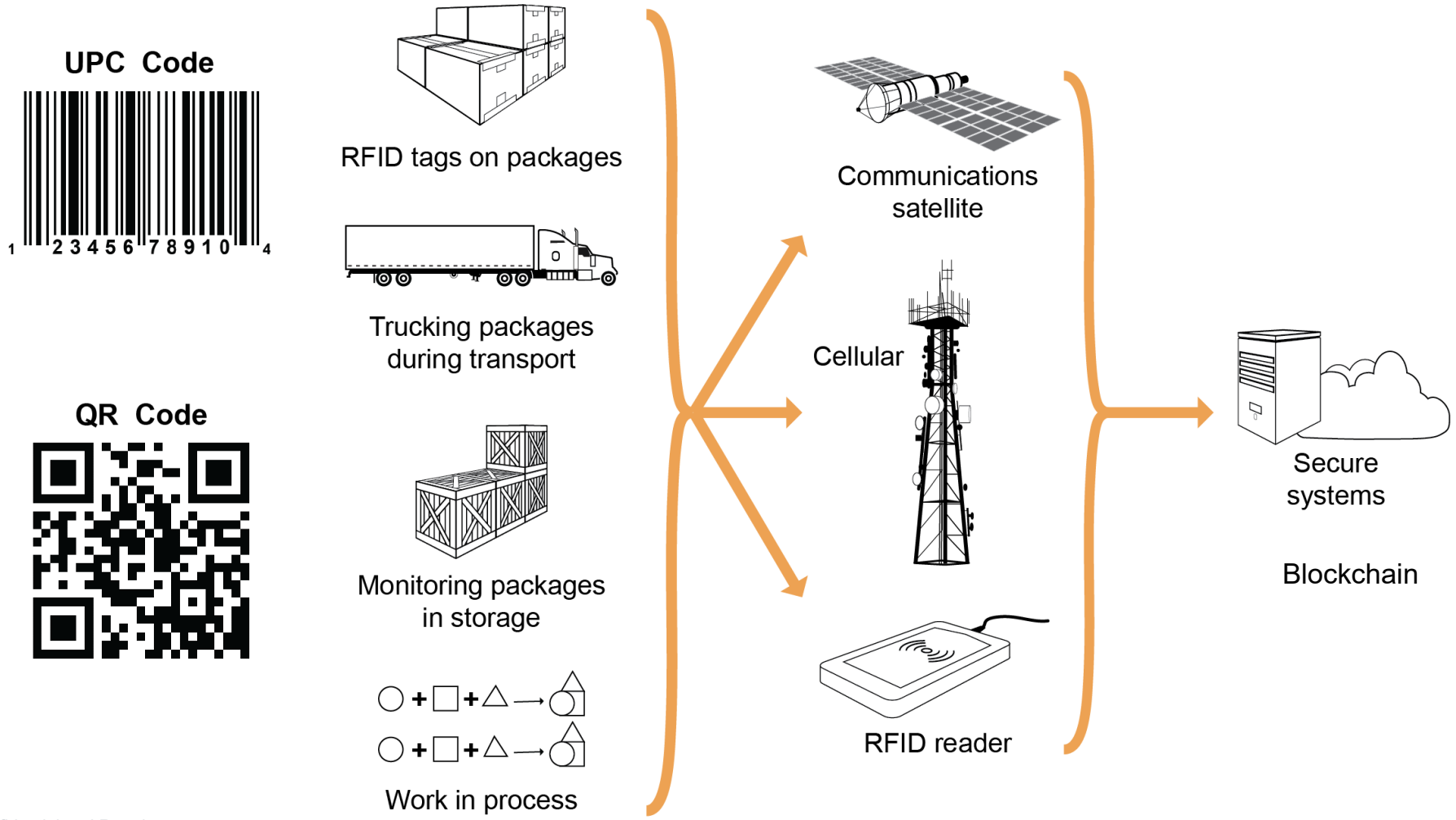


Distribution Requirements Planning

Logistics Resource Requirements Plan



Inventory Tracking: Bar Codes and RFID



Inventory Tracking Technology and Distribution Performance

Performance Indicators

- Service
- Fast flow response
- Reduction of operating variance
- Minimum inventories
- Transportation reduction
- Quality management
- Product life cycle support

Distribution System Performance Measures

Customer service

- % of orders satisfied from stock
- % of units required filled from stock
- % of units required delivered on time
- % of item stockouts
- % of stock cycles without shortages
- % of months without stockout

Distribution efficiency

- % throughput
- % order filling
- % shipping accuracy
- % inventory record accuracy
- % storage utilization

Inventory management

- Inventory turns
- Cash-to-cash cycle

Inventory Tracking Technology and Distribution Performance

Data Collection Methods

Email and contact forms

Feedback surveys

Interviews/ focus groups

Social media

Improvements in Distribution Planning Process

- Fill rates
- Average length of time required to satisfy backorders
- Percentage of order replenishment cycles in which one or more units are backordered

Order Cycle Stages

Stage 1: Order Transmittal

1. Customer requests information and price is quoted.
2. Customer places order.

Stage 2: Order Processing

3. Order is received and entered into system.
4. Reserve inventory and identify delivery date.
5. Consolidate orders for freight and warehouse picking.
6. Plan and build loads.
7. Route shipments.
8. Use routing guide to select carriers and rates.

Stage 3: Order Picking and Packing

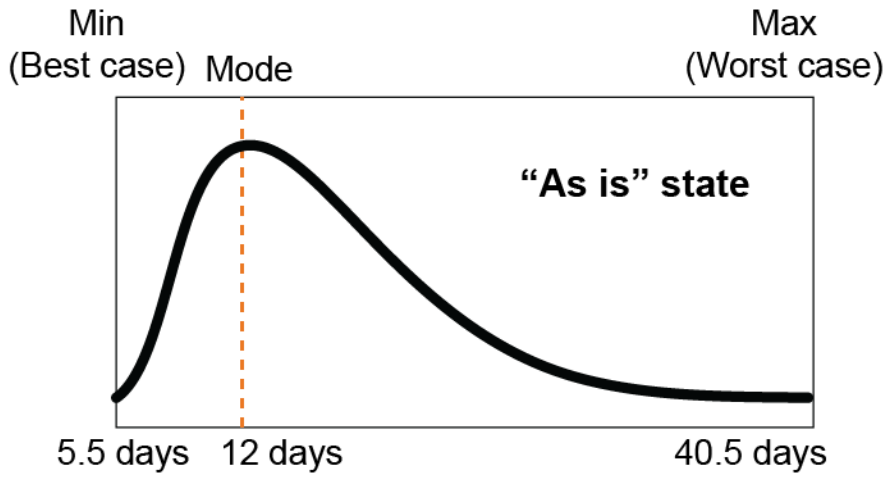
9. Pick reserved product(s) at depot/distribution centers.
10. Load vehicle and create shipping documents.

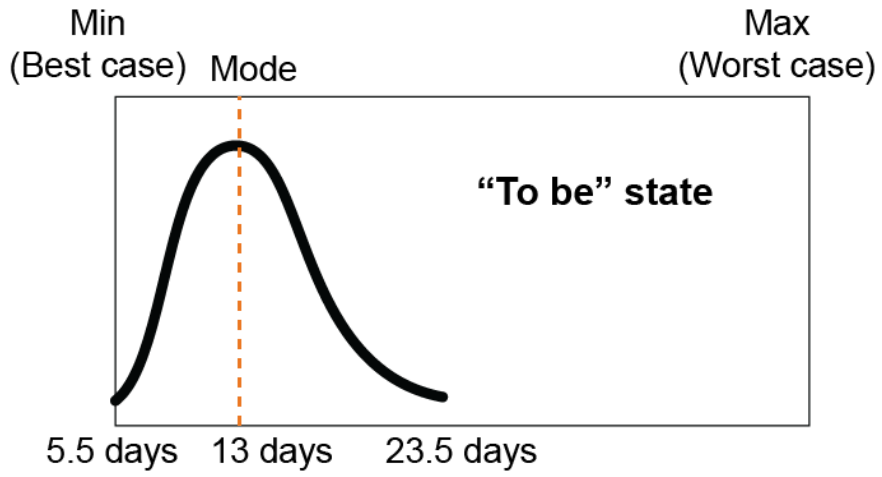
Stage 4: Order Delivery

11. Receive and verify product order at customer site.
12. Install product if required.
13. Invoice and receive payment.

Improving Order Delivery Performance

In this example, the goal was to reduce overall variability (e.g., maximum days).





Source: Adapted from Donald J. Bowersox, David J. Closs, M. Bixby Cooper, and John C. Bowersox. *Supply Chain Logistics Management*, 2013.

Exceptions and Expediting

Exceptions

- Problem during any portion of the delivery process
- Transporter not liable for external issues; is liable for negligence

Open Order Monitoring

- Pre-expediting process to ensure timely delivery

Expediting supply or transportation

- Taking extraordinary action because of increase in relative priority

CPIM

CERTIFIED IN PLANNING
AND INVENTORY MANAGEMENT

SECTION C:
WASTE HIERARCHY AND REVERSE LOGISTICS

APICS

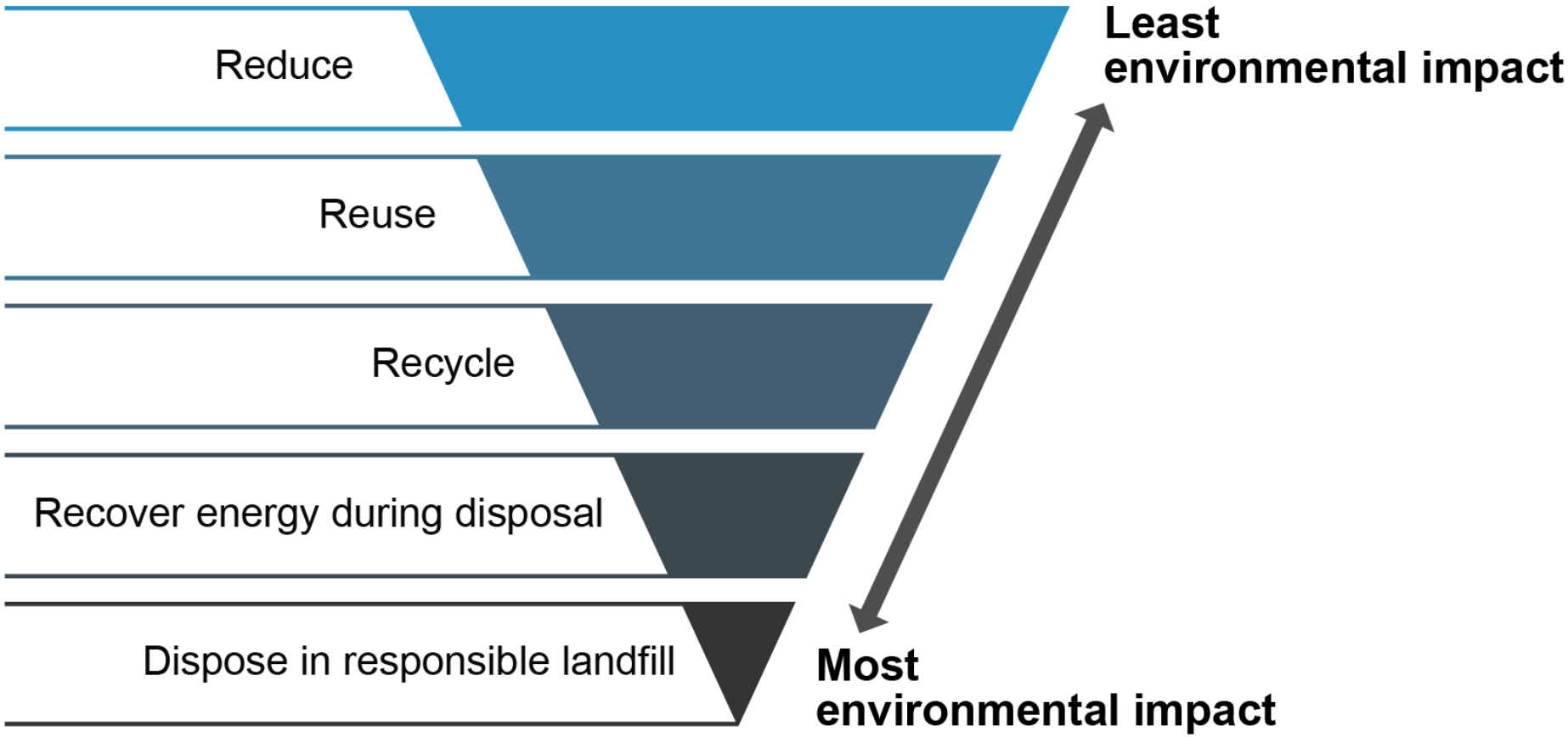
ASCM

Section C Learning Objectives

- Role of waste hierarchy and total cost of ownership in sustainability
- Circular economy (reduce, reuse, recover)
- Minimize materials/enable recycling in products, packaging, processes
- Reverse logistics goals, policies, and process
- Reverse logistics as part of distribution network design
- Alternative reverse logistics providers (e.g., third-party logistics providers)
- Sustainable disposition process

Waste Hierarchy

Toward More Sustainable Options



Waste Hierarchy

Toward a Circular Economy

- Reduced extraction from earth
- Reduced disposal into landfills

- Extends from raw material extraction to final disposition.
- Minimize changes to materials during life cycle.
- Increase number of industries benefiting from materials in some form throughout their life cycle.

Waste Hierarchy

Sustainability in Product/Process Design

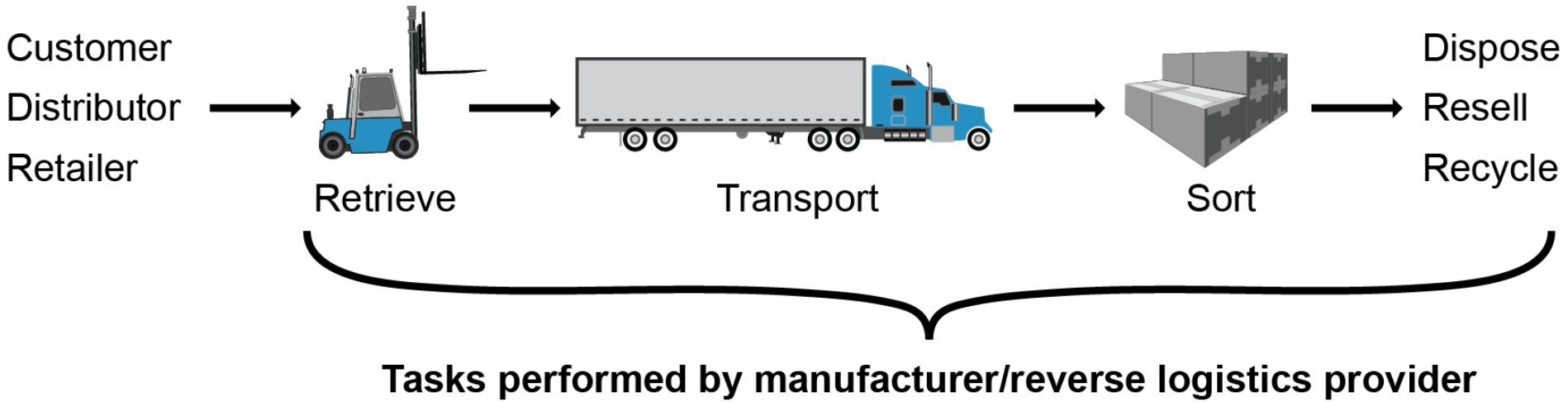
- Fewer hazardous materials in BOMs
- Recycled materials in BOMs
- Design for disassembly
- Less packaging
- Recycled packaging
- Reverse logistics as part of product/service package
- Easy recycling
- Total cost of ownership (TCO)
  - More-sustainable material higher in unit cost could be lower in cost in long run than less-sustainable option with hidden costs.

Waste Hierarchy Policy for Supply Chain Partners

Avoid	▪ Prohibit specific hazardous materials. ▪ Promote using pricing incentives.
Reduce	▪ Lot-size return policy. ▪ Requirement for customer service to discuss return. ▪ Incentives to be efficient and use of efficient modes. ▪ Efficient DC layout, materials handling, and energy use.
Reuse	▪ For example, stackable totes.
Recycle	▪ Sustainable procurement policy.
Recover	▪ For example, refrigerant recovery.
Dispose	▪ Responsible disposal policy.

Reverse Logistics

"A complete supply chain dedicated to the reverse flow of products and materials for the purpose of returns, repair, remanufacture, and/or recycling" (*ASCM Supply Chain Dictionary*)



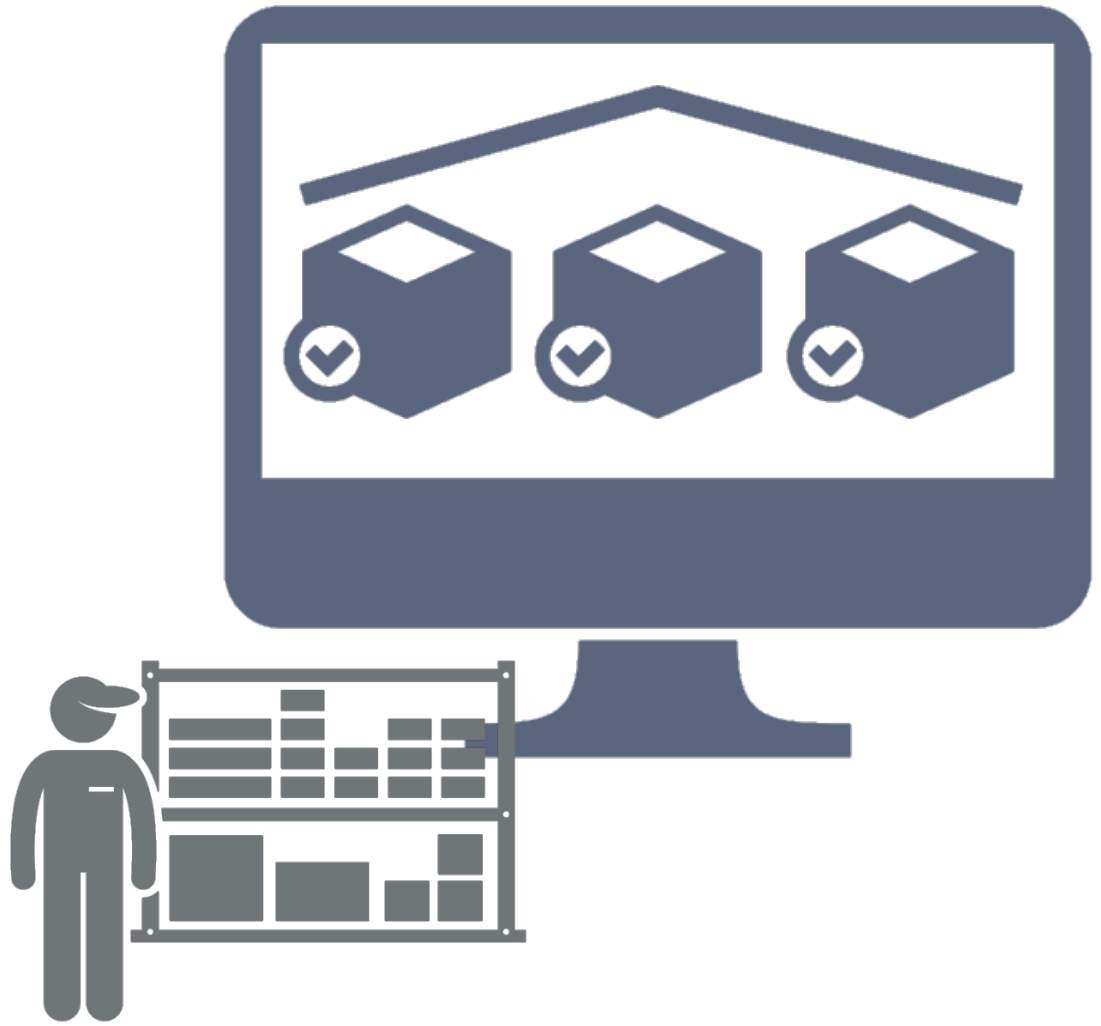
Reverse Logistics Design

- Design must not be an afterthought.
  - Customer service (marketing in reverse).
  - Reverse product flows in warehouses and transportation (may not use the same nodes; dedicated reverse logistics warehouses can specialize).
  - Unpackaging, disassembly, remanufacturing, and/or recycling.
- Reverse information flows and reverse logistics information systems.
- Reverse cash flows.
- Location of reverse logistics activities and services/capacity to provide.

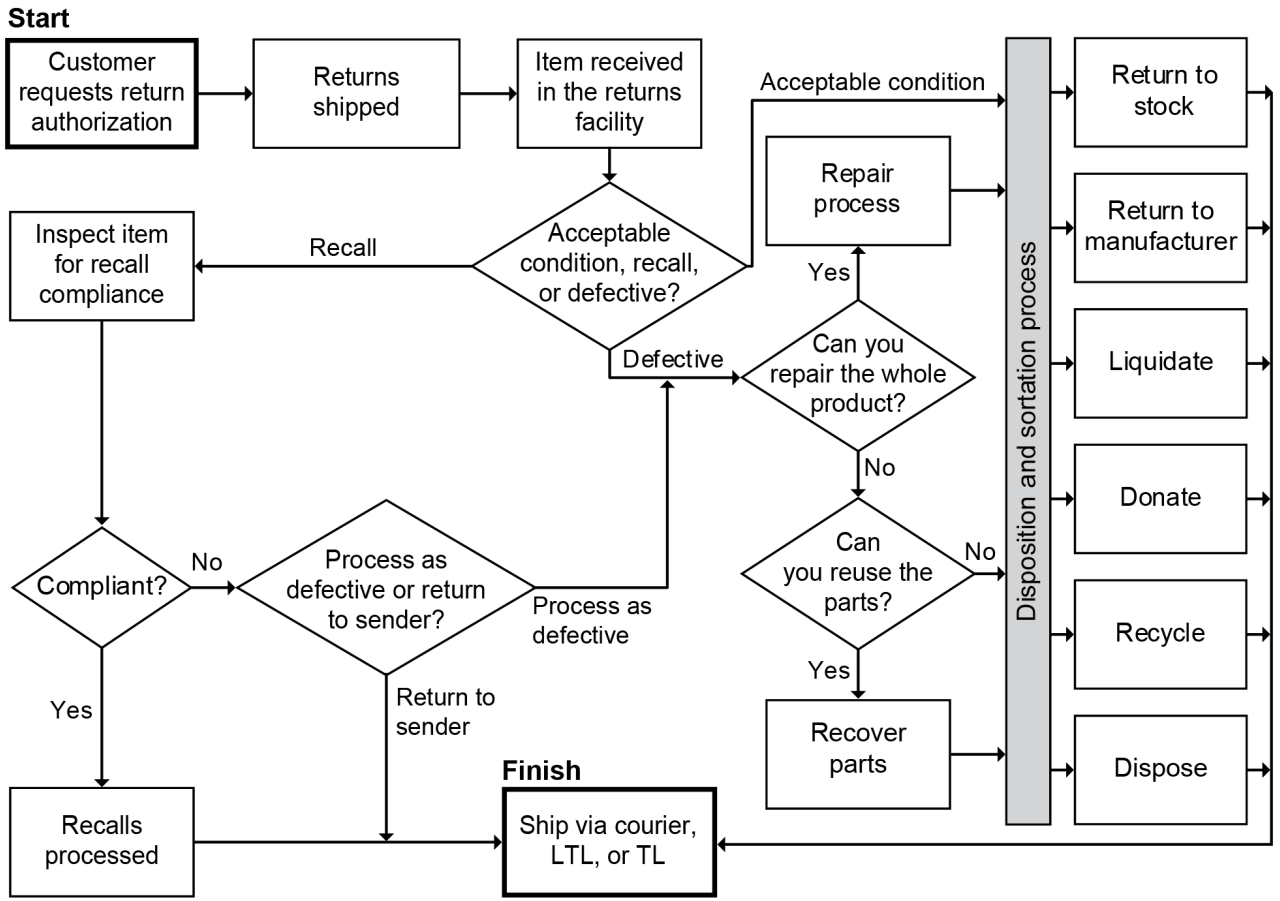
Reverse Logistics and Product Disposition

Who Performs Reverse Logistics?

- Producer “owns” reverse logistics entirely.
- Parts of the process are contracted out (e.g., transportation, warehousing).
- Producer contracts entire process to reverse 3PL/4PL.



Disposition of Returned Products



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