CLTD

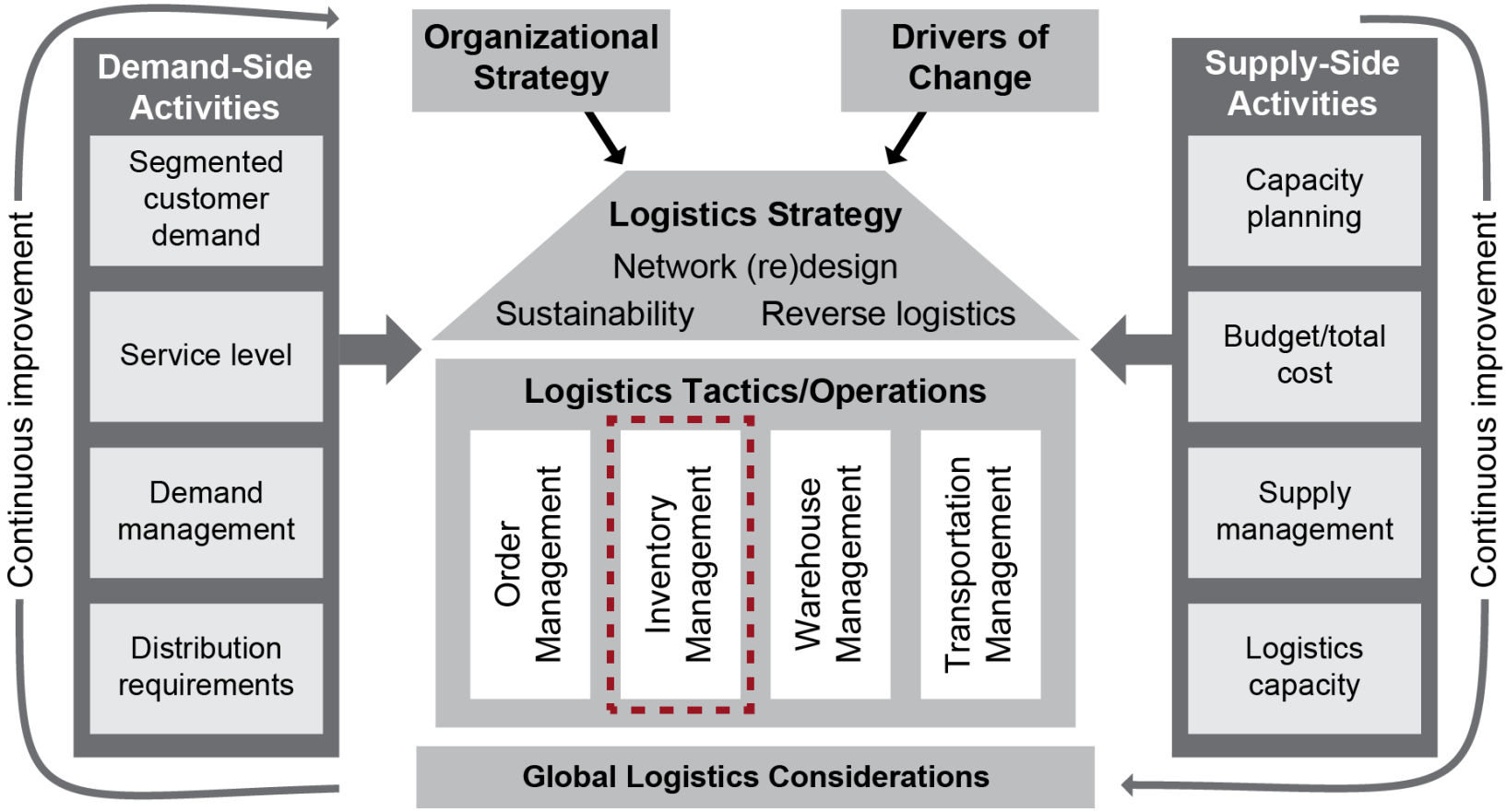
CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 6:
INVENTORY MANAGEMENT

APICS

ASCM

Module 6 Overview



CLTD

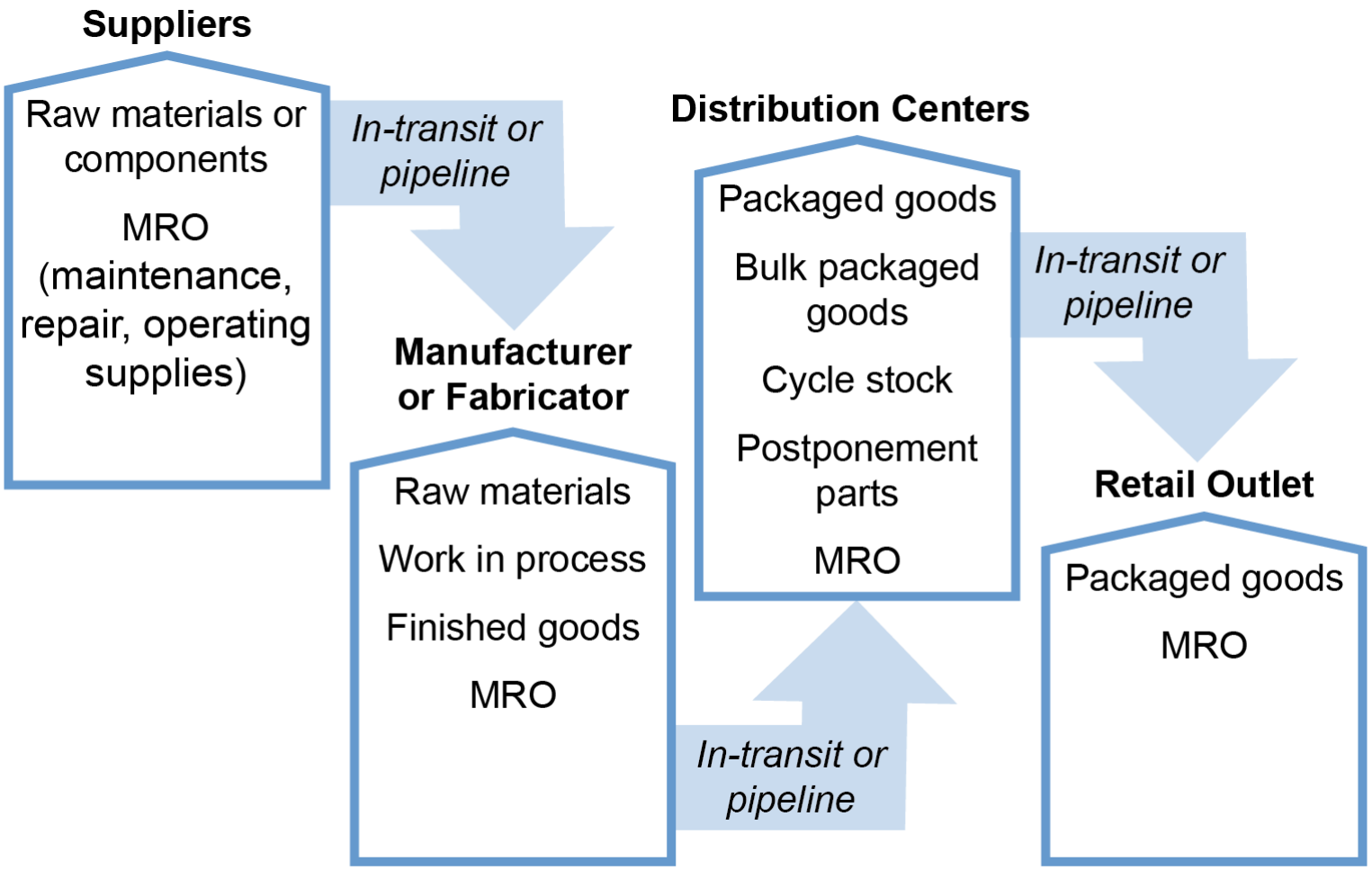
CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 6, SECTION A: INVENTORY MANAGEMENT IN LOGISTICS

APICS

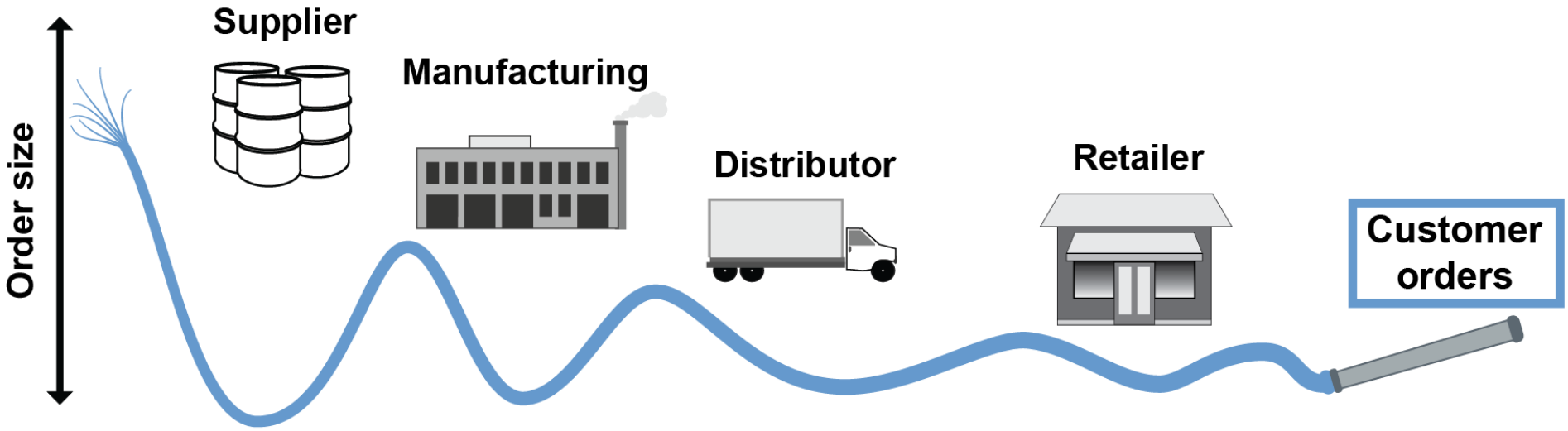
ASCM

Inventory in the Supply Chain



Bullwhip Effect

- Caused by repeated upstream communication and downstream logistics delays
- Primarily impacts make-to-stock environments



Stakeholder Perceptions of Inventory

Business leaders

Cost that may limit investments in new opportunities and growth.

Financial managers

Keep value of inventory low as it affects business financials.

Operations managers

Inventory is key to output; when low performance drops.

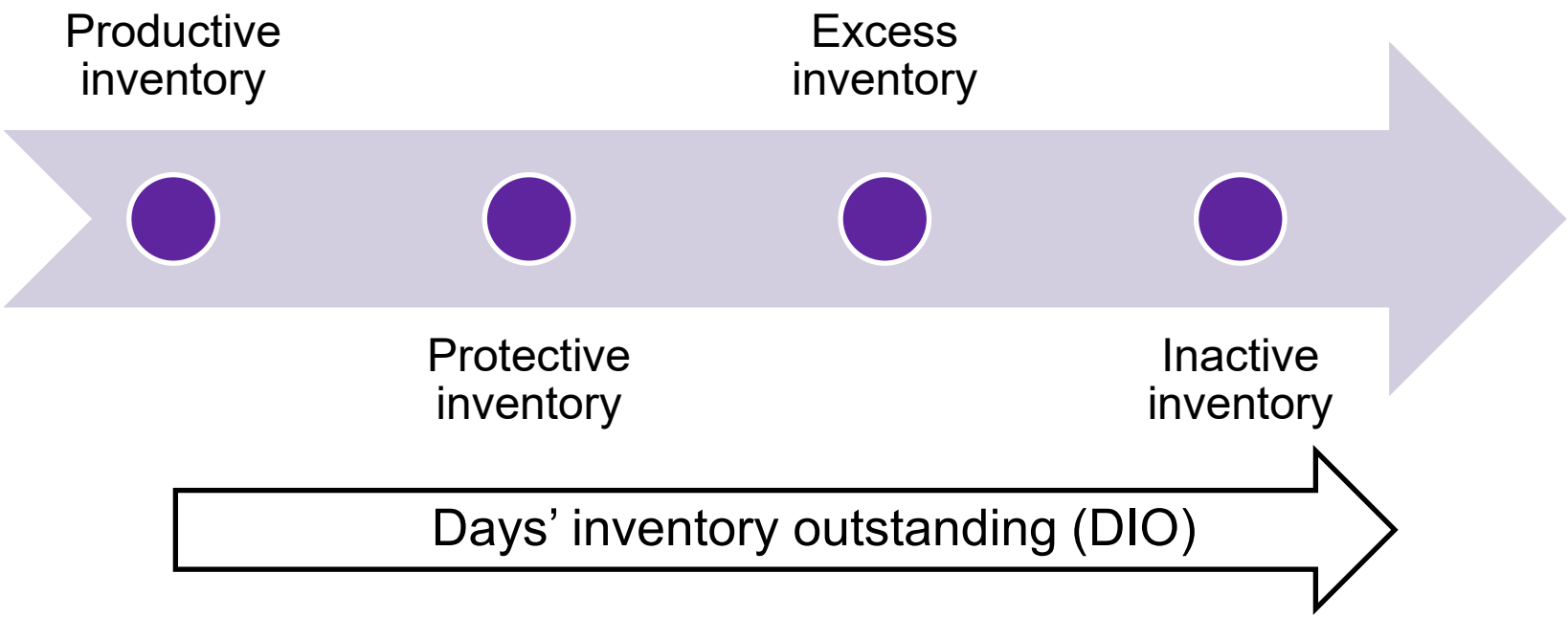
Sales and marketing

Enough inventory to satisfy demand.

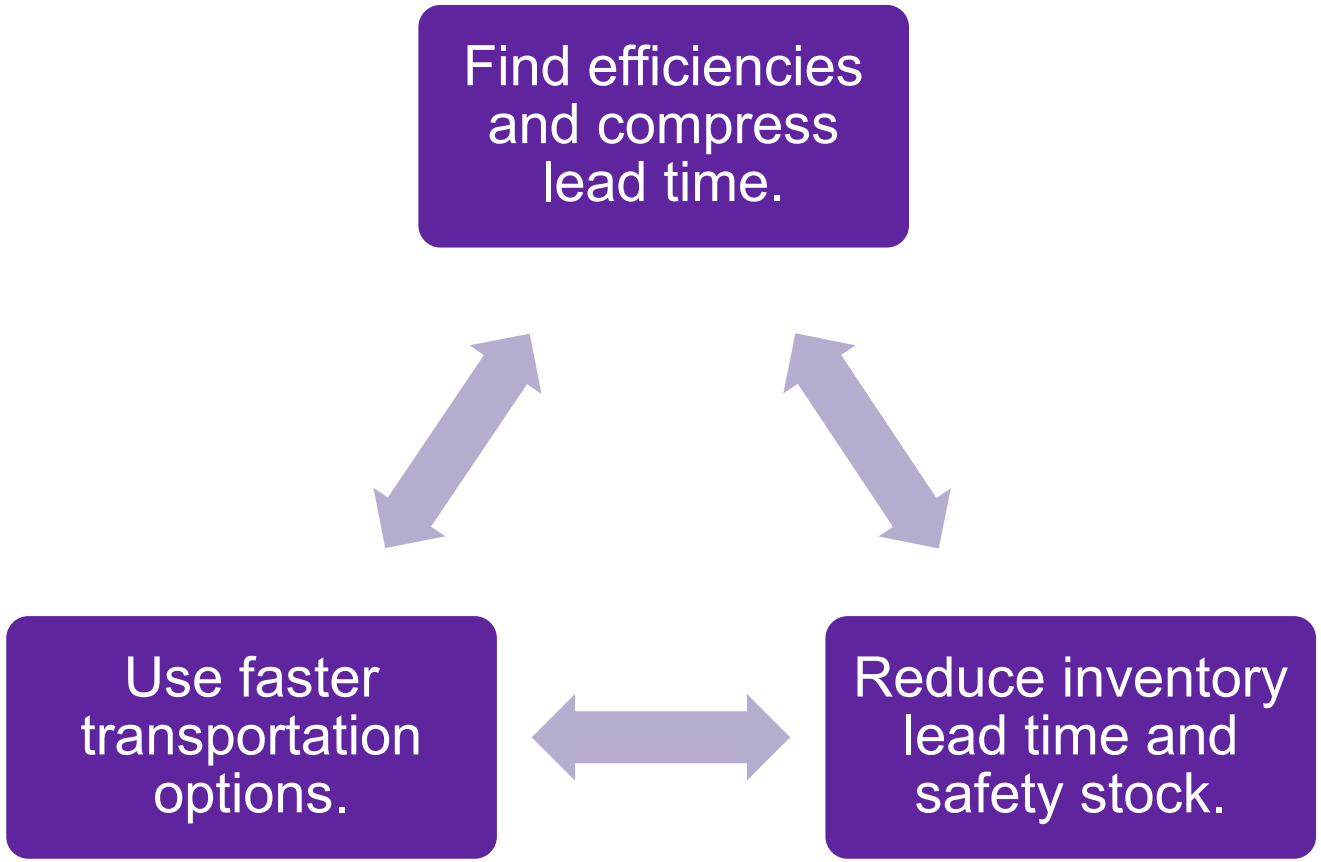
Consumers

Right product in the right amount at the right time.

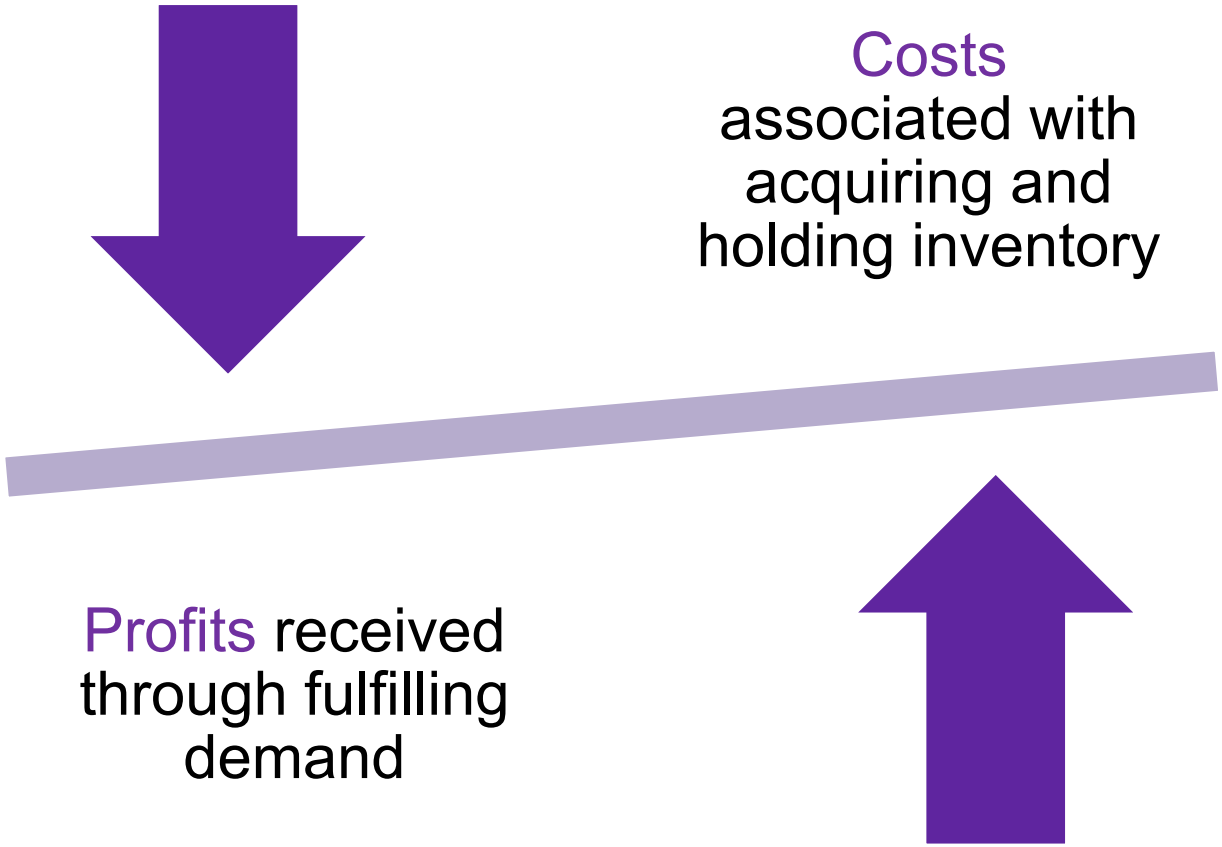
Inventory and Time



Faster Inventory Turns Means Less Cash Investment



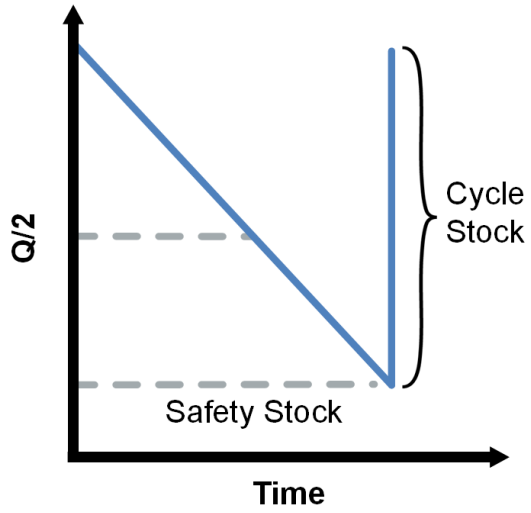
Demand Fulfillment



Cycle and Pipeline Stock

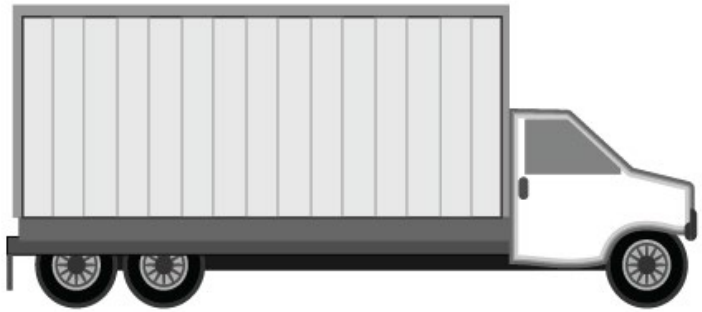
Cycle stock

- Amount of inventory required to satisfy normal demand

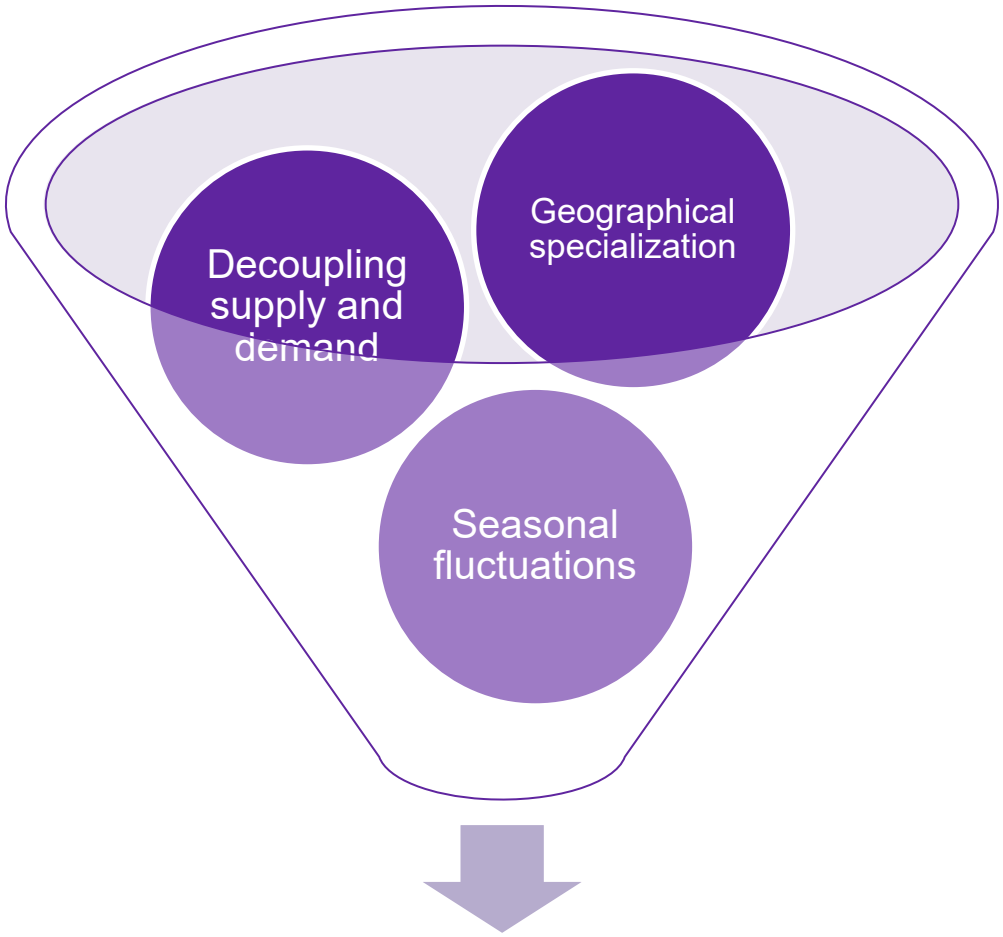


Pipeline stock

- Amount of inventory in the transportation network and distribution system



Topic 2: Functions of Inventory

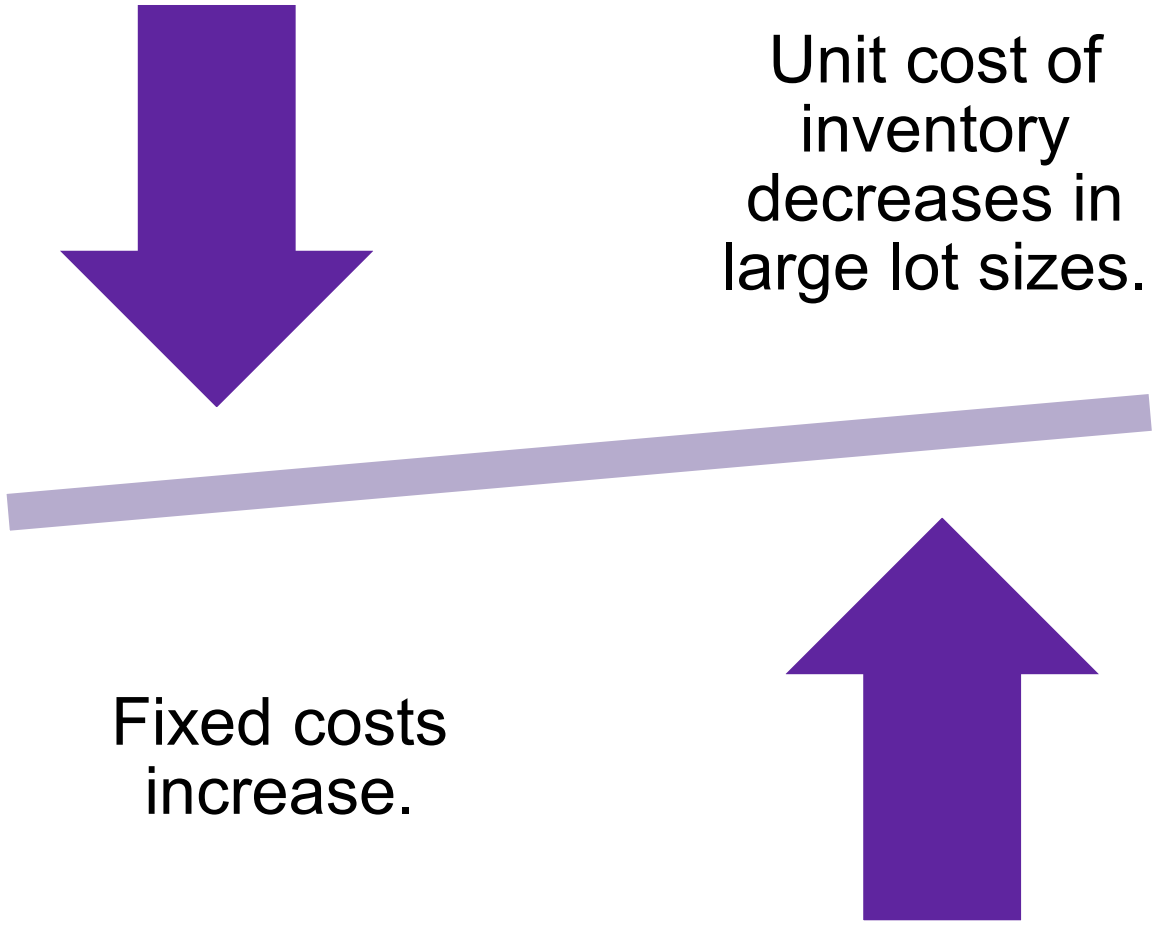


Fluctuations in supply and demand

Safety Stock and Hedge Inventory

Hedge inventory is used to buffer against events that may not happen.

Economies of Scale



Inventory Costs

Acquisition Costs	Carrying Costs	Stockout Costs
• Unit cost — Overhead costs • Ordering cost — Setup costs • Handling cost	• Capital cost • Storage • Insurance • Taxes • In-transit cost	• Immediate loss of revenue • Damaged customer relations • Damaged business reputation • Lost future revenue

Acquisition Costs

Unit cost
- Material
- Labor to produce items
- Overhead
- Packaging
- Inbound transportation

Ordering costs
- Setup costs (calibration, downtime)

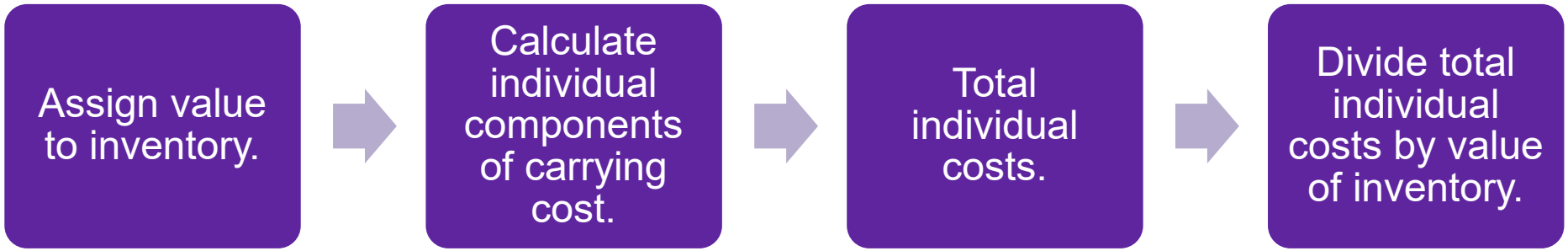
Handling costs
- Share of capital costs, labor, packaging for transportation

Carrying Costs

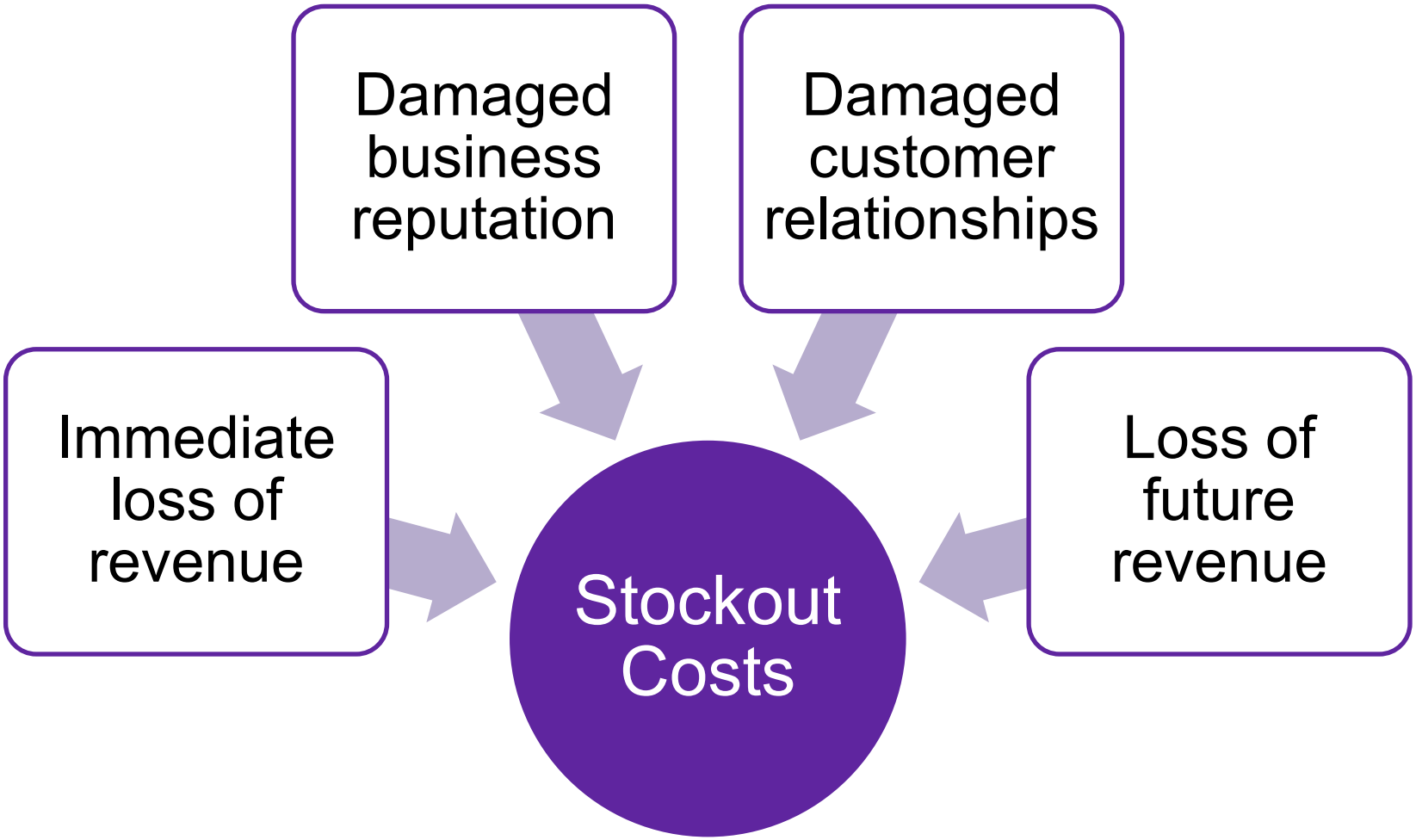
"The cost of holding inventory, usually defined as a percentage of the dollar value of inventory per unit of time (generally one year)."

Calculating Carrying Cost

- Carrying cost is indicated as a percentage of the value of inventory.



Stockout Costs



CLTD

CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 6, SECTION B:
INVENTORY CONTROL, STRATEGY, AND POLICY

APICS

ASCM

Demand Types

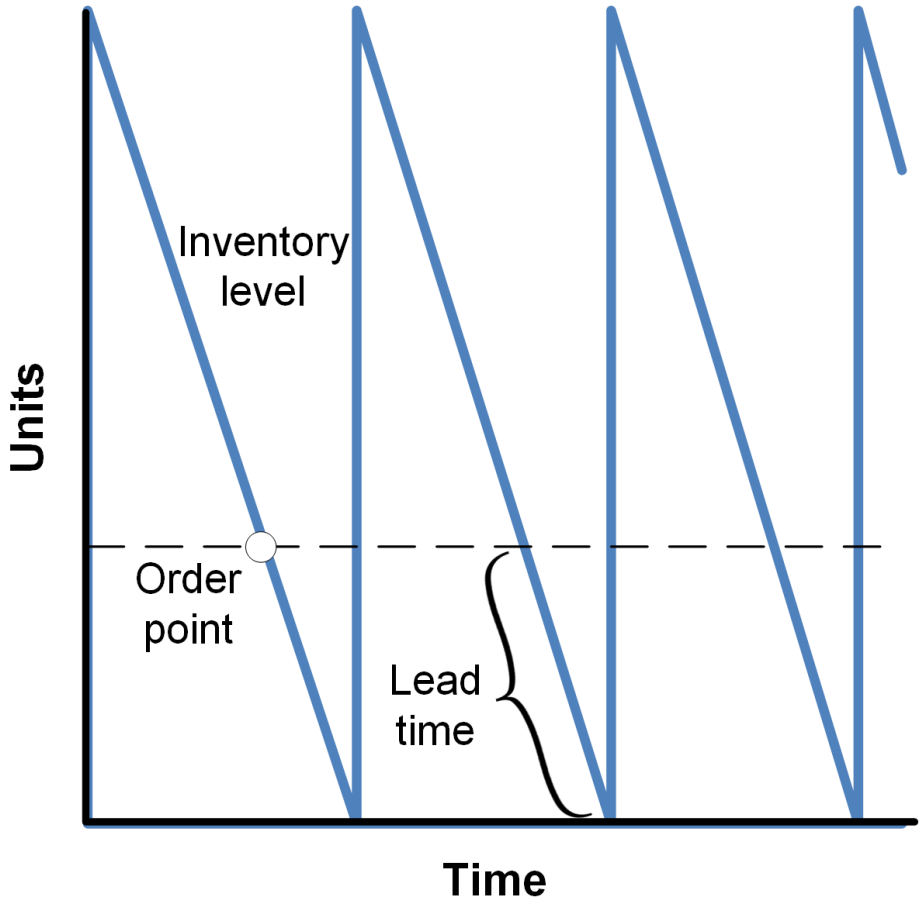
Independent demand
- Fixed order quantity
- Fixed order period

Dependent demand
- Components
- Kits

Dual demand
- Service
- Components

Fixed Order Quantity

- Uses an order point to trigger replenishment.
- Quantity of order remains the same.
- Time between orders (order period) may vary.



Order Point

Demand:

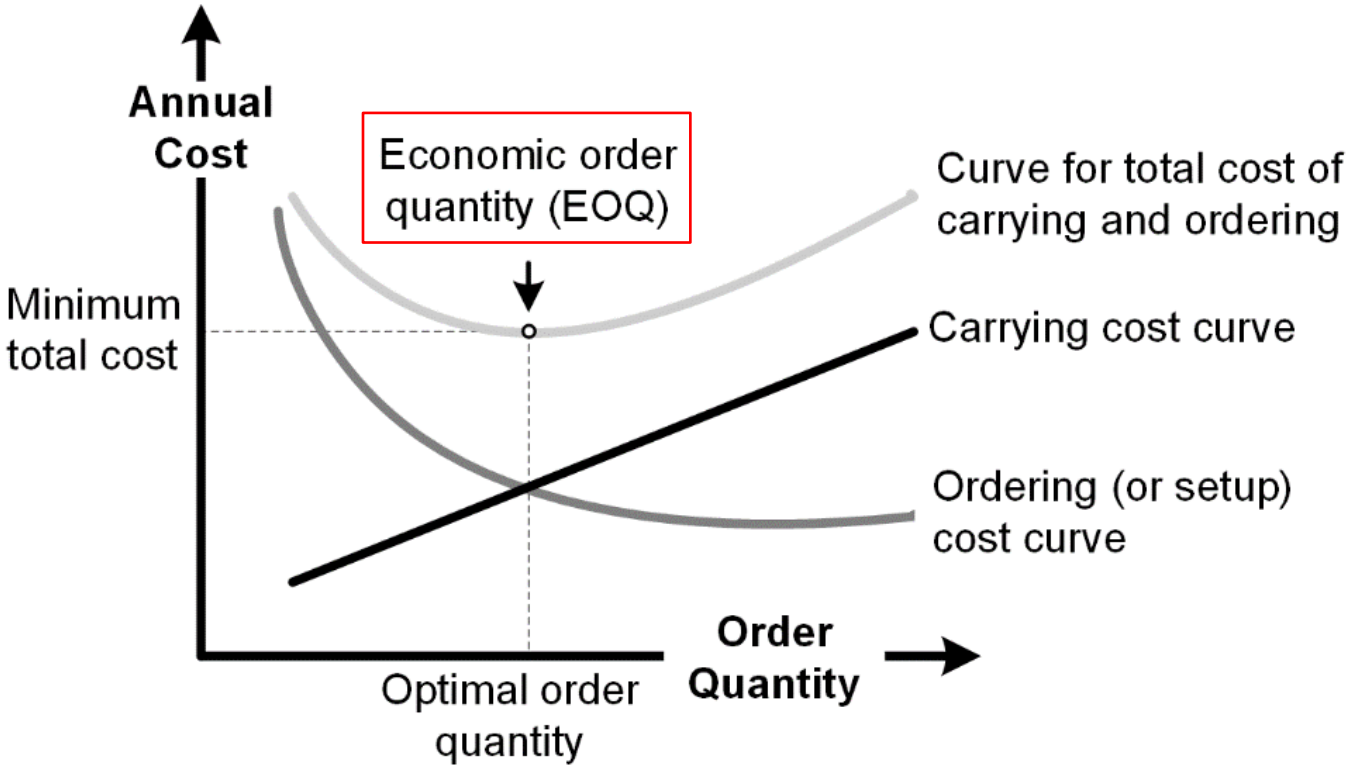
- Historical data
- Forecasts
- Analysis of current trends

Lead time:

- Inventory review
- Prepare and submit orders
- Supplier reviews and processes
- Transit time
- Receipt, check, and stock

Order Point = Anticipated Demand (D) × Lead Time (L)

Economic Order Quantity (EOQ)



$$EOQ = \sqrt{\frac{2AS}{IC}}$$

where:

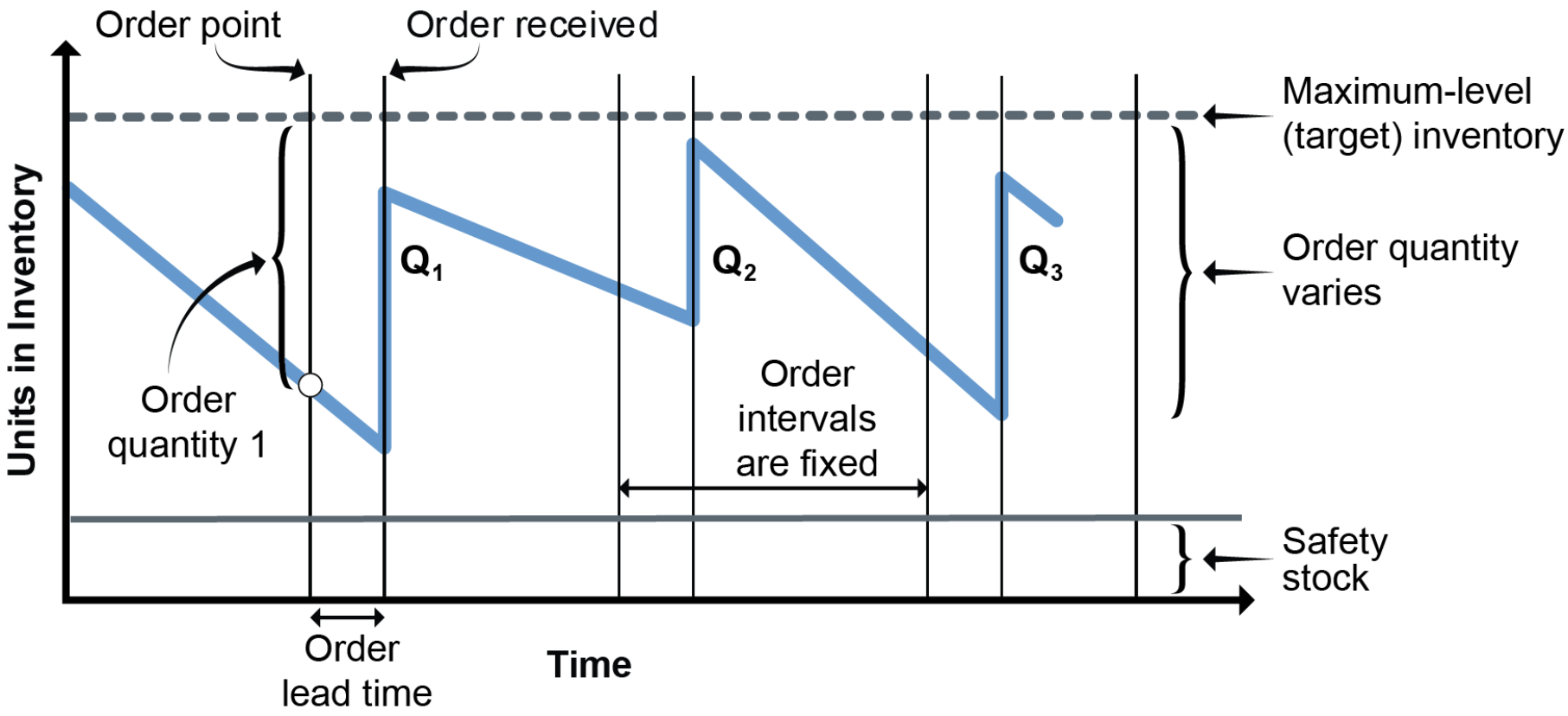
A = Annual usage in units

S = Ordering (or setup) costs in a currency amount

I = Annual carrying cost

C = Unit cost

Fixed Order Period



Source: *APICS Certified Supply Chain Professional Learning System, Version 4.0*

Min-Max Systems

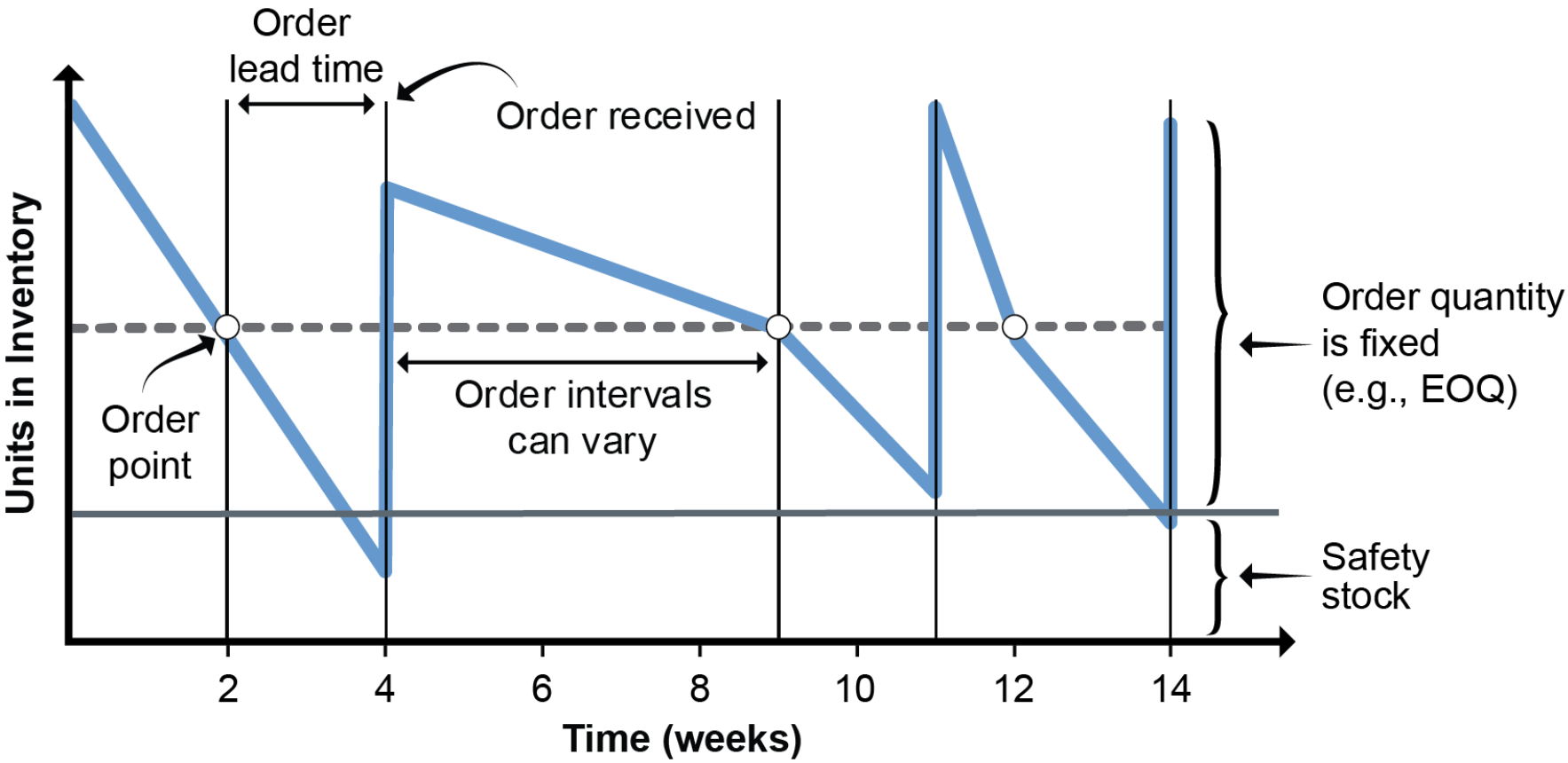
- Type of order point replenishment system
- Hybrid approach to inventory control
- Variable order quantity

- Minimum (min) is the order point.
- Maximum (max) is the “order up to” inventory target level.

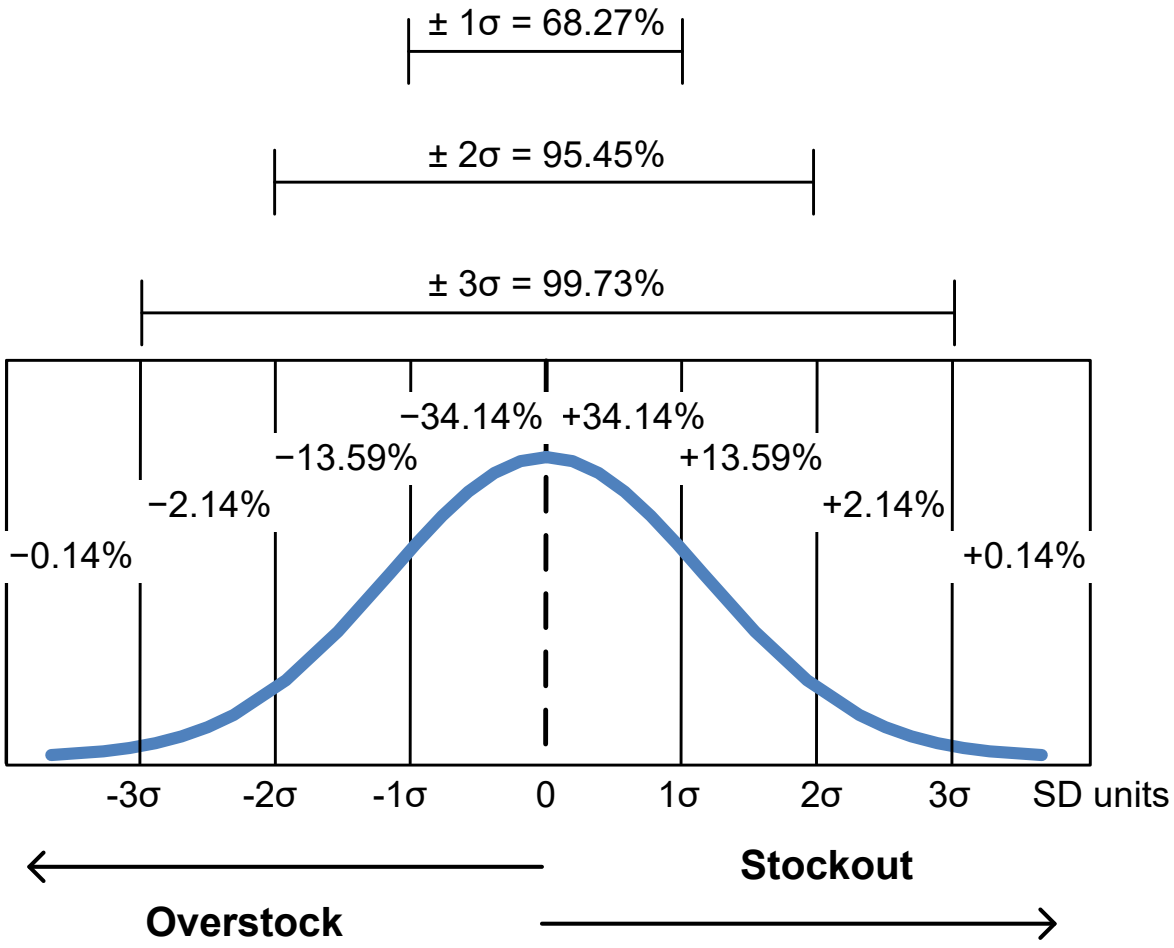
Just in Time (JIT)

- Aims at reducing waste
- Works to reduce uncertainty of what to produce or what and how much to order

Effect of Uncertainty on Reorder Frequency



Standard Deviations in a Normal Distribution



Calculating Standard Deviation in Units

Week	Forecast	Actual	Absolute Deviation	Actual – Mean	(Actual – Mean) Squared
1	1,000	1,100	100	24	576
2	1,000	950	50	–126	15,876
3	1,000	1,150	150	74	5,476
4	1,000	1,400	400	324	104,976
5	1,000	1,000	0	–76	5,776
6	1,000	900	100	–176	30,976
7	1,000	920	80	–156	24,336
8	1,000	1,300	300	224	50,176
9	1,000	990	10	–86	7,396
10	1,000	1,050	50	–26	676
Sum		10,760	1,240		246,240
Mean		1,076			
Sum of (Actual – Mean)^2/n – 1					27,360
Standard deviation (square root of line above)					165.4

n = 10-week period

*If using a sample, use **n – 1** instead.

Mean Absolute Deviation

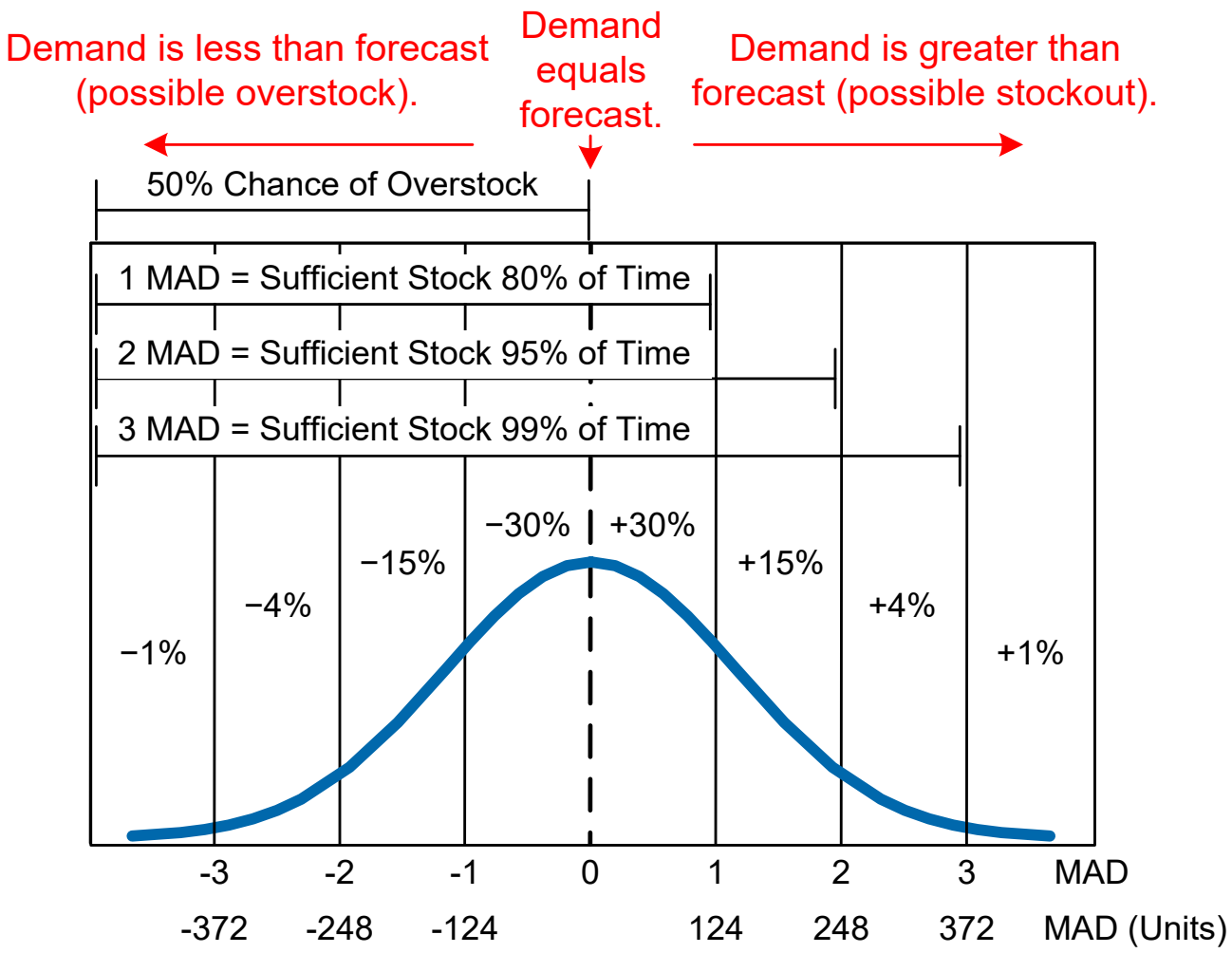
$$MAD = \frac{\sum |A - F|}{n}$$

Where:

- $\sum |A - F|$ = Total of absolute forecast errors for the periods
- n = Number of periods

Week	Forecast	Actual	Absolute Deviation
1	1,000	1,100	100
2	1,000	950	50
3	1,000	1,150	150
4	1,000	1,400	400
5	1,000	1,000	0
6	1,000	900	100
7	1,000	920	80
8	1,000	1,300	300
9	1,000	990	10
10	1,000	1,050	50
Sum			1,240
Mean absolute deviation (sum absolute deviation/*n*)			124

Normal Distribution Curve for MAD



Calculating Safety Stock from Service Level

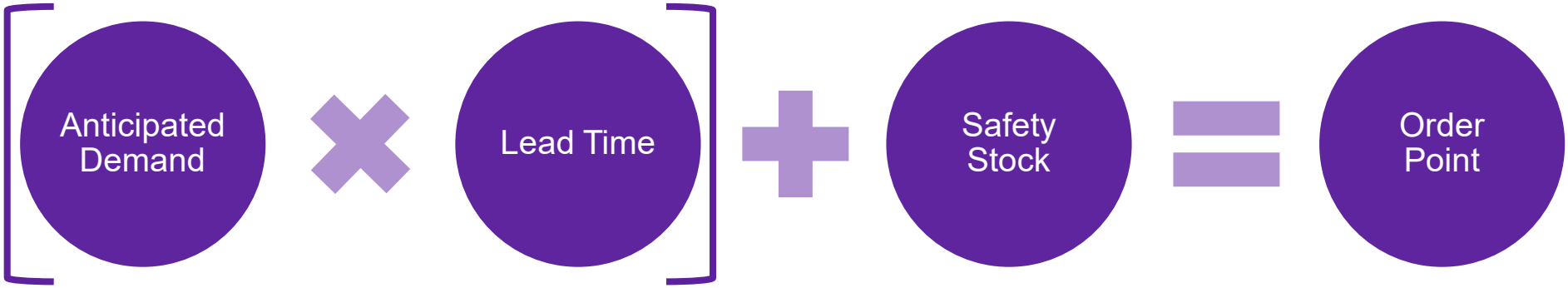
Safety Factor Table

Percentile Customer Service Level	SD Units × Factor Below	MAD Units × Factor Below
85.00	1.04	1.30
89.44	1.25	1.56
90.00	1.28	1.60
93.32	1.50	1.88
95.00	1.65	2.06
97.72	2.00	2.50
98.00	2.05	2.56

For example:

For 90% service level, using SD, the safety stock level should be:
165.4 x 1.28 = **212**

Calculating Safety Stock: Order Point



Either standard deviation or MAD may be used, but remember that standard deviation is considered to be more accurate.

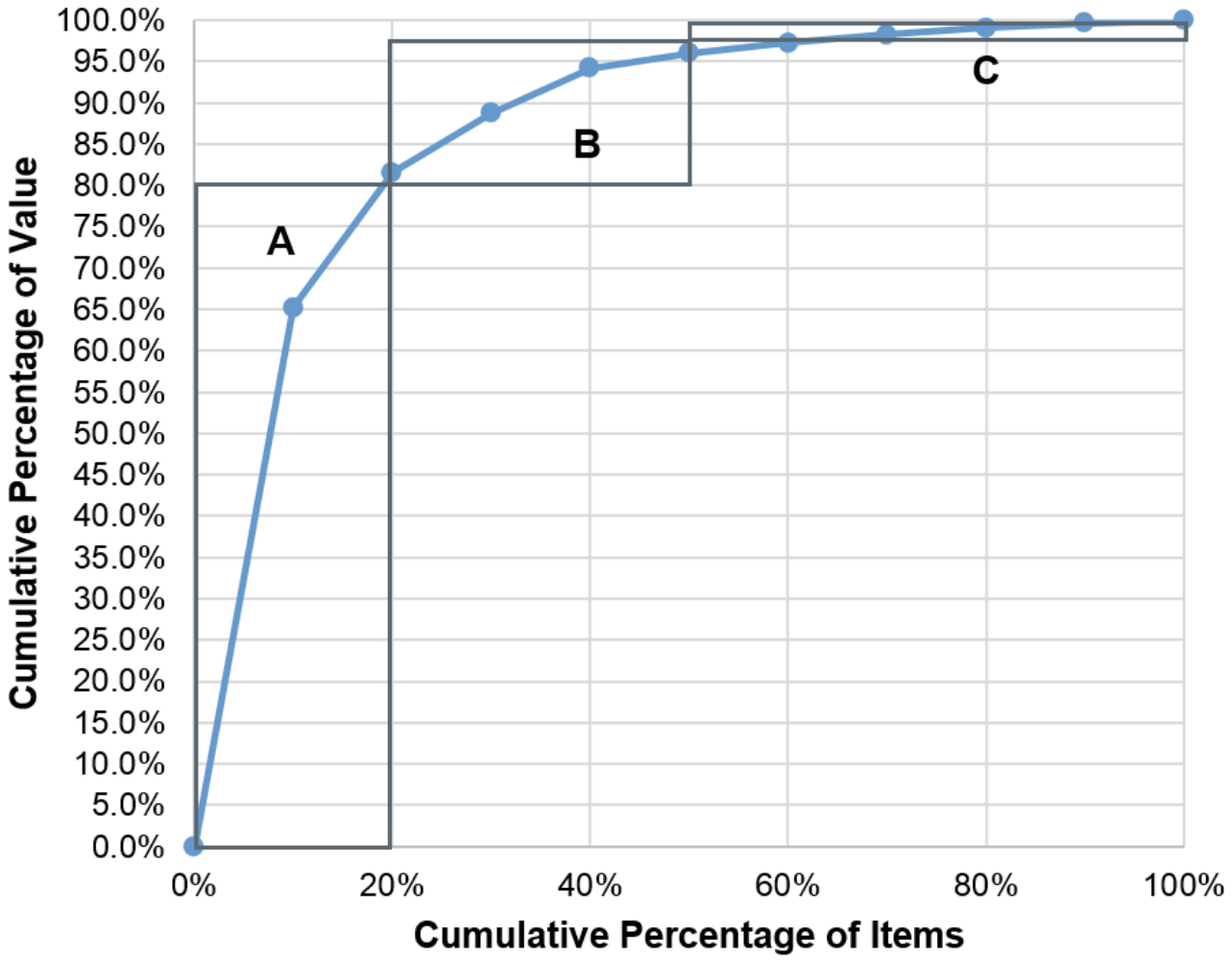
Vendor-Managed Inventory (VMI)

- Increases the role of supplier
- Can lead to stronger, more strategic relationships
- Decreases vulnerabilities and enhances opportunities

Consignment Inventory

- Consignment is an issue of ownership of stored inventory.
- The customer does not assume ownership of the goods upon receipt.
- Customer pays for the goods only when they are withdrawn from inventory.
- Advantage to buyer = avoids investing capital in stock.
- Advantage to seller = guarantees seller's products (vs. competitors) are used in process.

ABC Analysis of Inventory



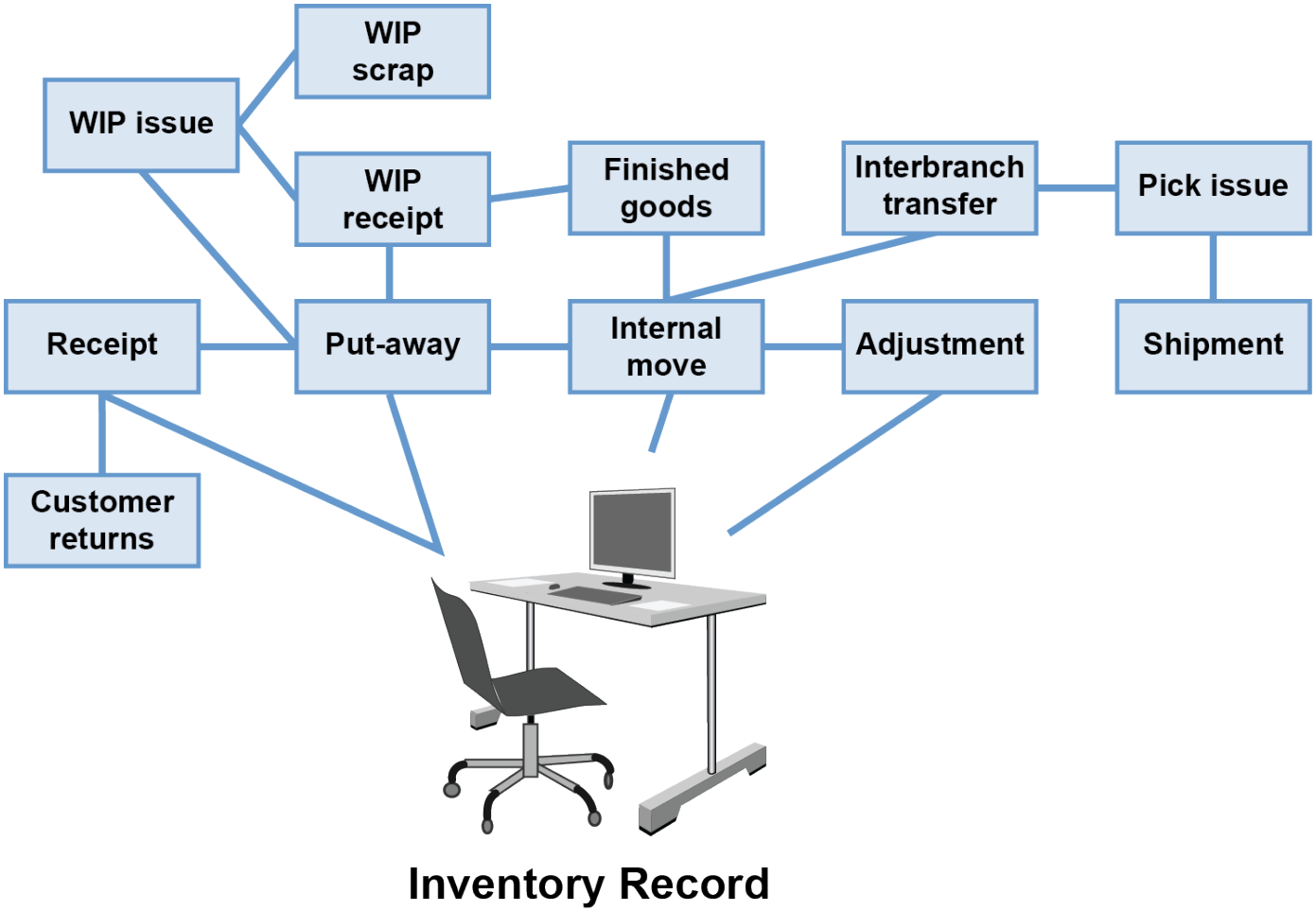
ABC Analysis by Revenue

Item Code	Annual Revenue	% Annual Revenue	% Cumulative Revenue	% Items	ABC Class
01A	40,000	40.0	40.0	9	A
14V	20,000	20.0	60.0	18	A
78Y	10,000	10.0	70.0	27	A
98H	8,000	8.0	78.0	36	B
09P	5,000	5.0	83.0	45	B
65T	4,000	4.0	87.0	55	B
23W	3,000	3.0	90.0	64	B
12Q	4,000	4.0	94.0	73	C
99M	3,000	3.0	97.0	82	C
88B	2,500	2.5	99.5	91	C
04Z	500	0.5	100.0	100	D
TOTAL	**US$100,000**	**100%**			

Dead stock (D):
(or slow-moving, inactive, or new with no sales history)

No sales during 12-month period

Inventory Transaction Points



Inventory Review Approaches

Periodic inventory review

Checked at designated intervals to see if order points have been triggered.

Continuous inventory review

Checked whenever:

- A change in inventory level occurs.
- Order point is reached.
- Restocking order released.

Inventory Auditing

Approaches to cycle counting:

- ABC classification
- Zone method
- Just-before-order replenishment
- Demand order pick

GOAL: To measure, confirm, and improve, if necessary, inventory accuracy.

Inventory Control Metrics

$$\text{Days' Inventory Outstanding (DIO)} = \frac{\text{Inventory on Hand}}{\text{Average Daily Use}}$$

$$\text{Weeks of Supply} = \frac{\text{Inventory on Hand}}{\text{Average Weekly Use}}$$

Reduction of inventory results in:

- Reduction in carrying cost
- Reduction in risk of excess inventory
- Reduction in risk of obsolete inventory
- Increase in available cash

Inventory Reduction Methods

- More accurate forecasting
- Reducing usage and lead times
- Recalculating order quantities
- Reducing safety stocks
- ABC classification
- Cycle counting
- Monitoring deliveries
- VMI or consignment

Calculating Inventory Turnover Rate

$$\frac{\text{COGS}}{\text{Average Inventory Valued at Cost During Period}}$$

$$\frac{\text{Sales Revenue}}{\text{Average Inventory Valued at Selling Price During Period}}$$

$$\frac{\text{Units Sold}}{\text{Average Unit Inventory During Period}}$$