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CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 6:
INVENTORY MANAGEMENT

APICS

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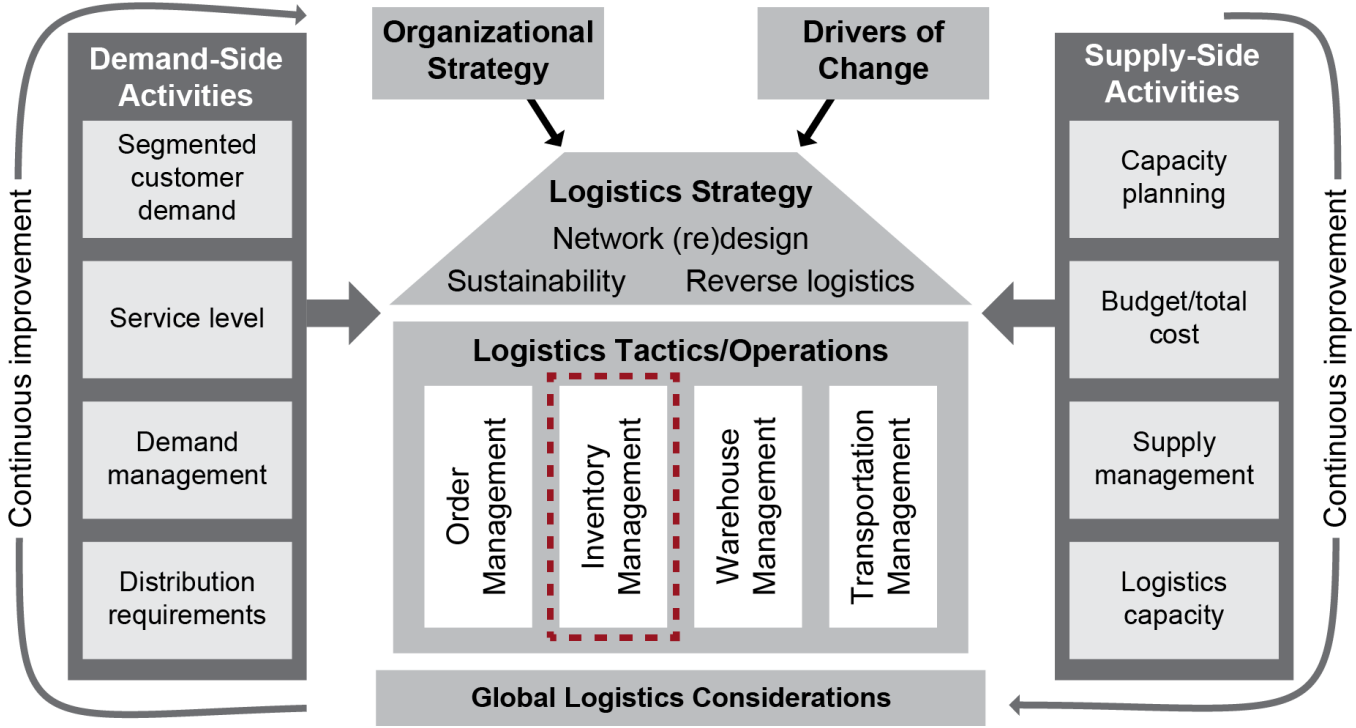
Module 6 Overview



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CERTIFIED IN LOGISTICS,
TRANSPORTATION AND DISTRIBUTION

MODULE 6, SECTION A: INVENTORY MANAGEMENT IN LOGISTICS

APICS

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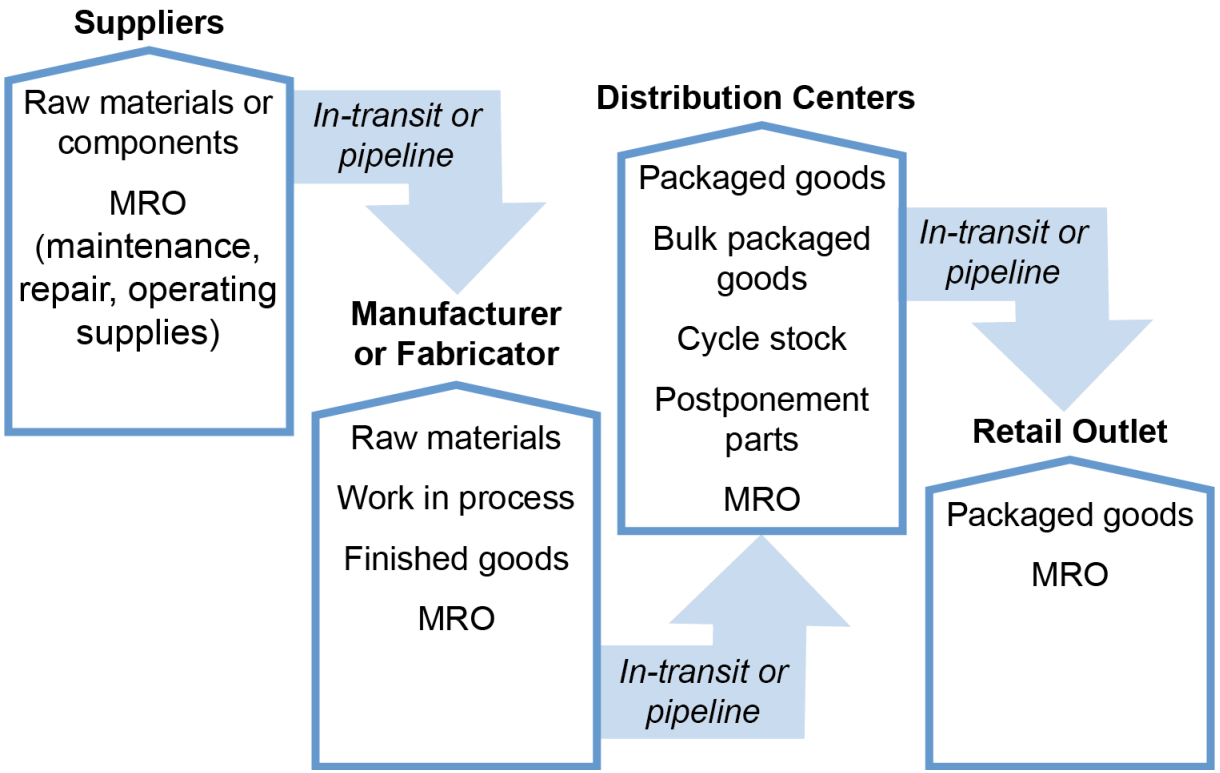
Inventory in the Supply Chain

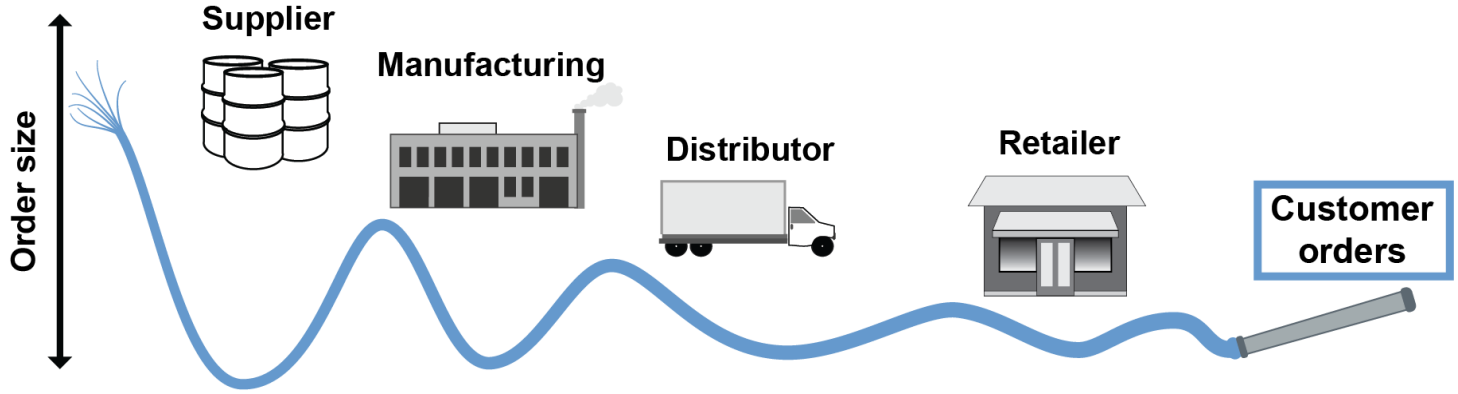
Inventory to support

- Production
- Supporting activities
- Customer service



Bullwhip Effect

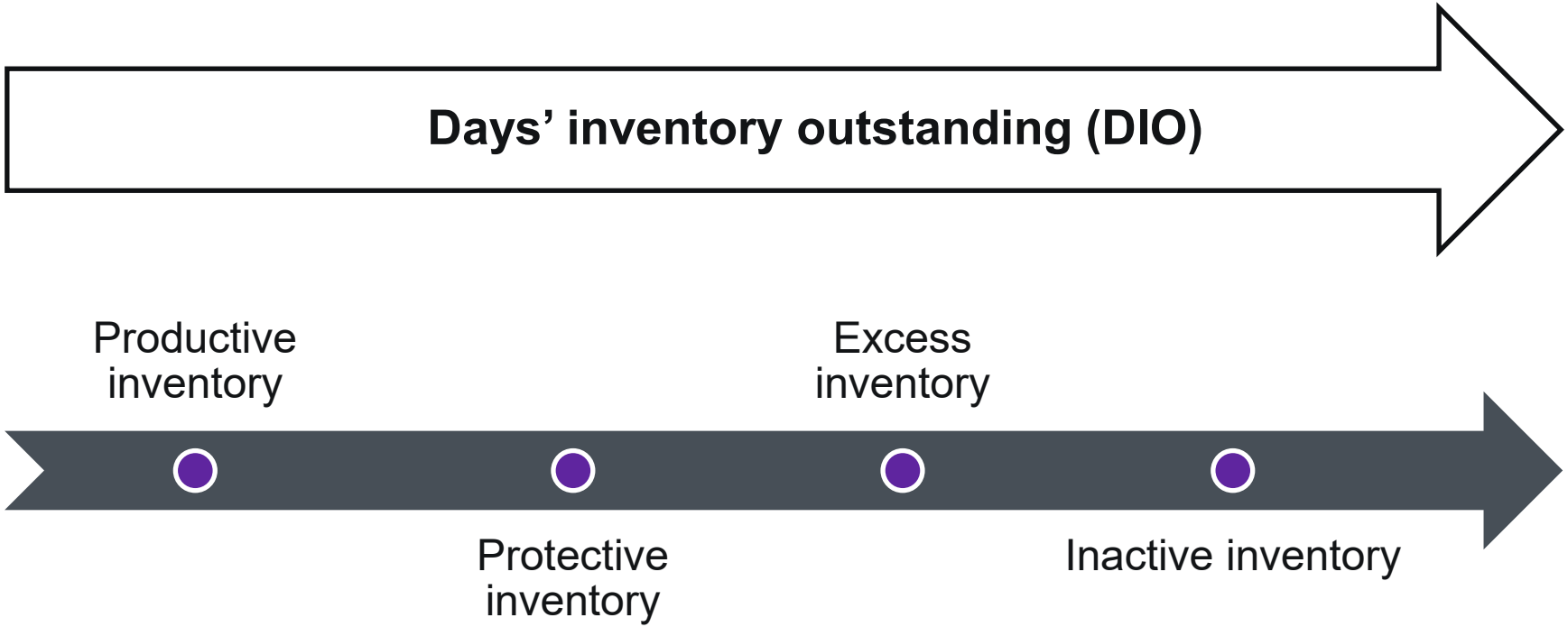
- Caused by repeated upstream communication and downstream logistics delays
- Primarily impacts make-to-stock environments



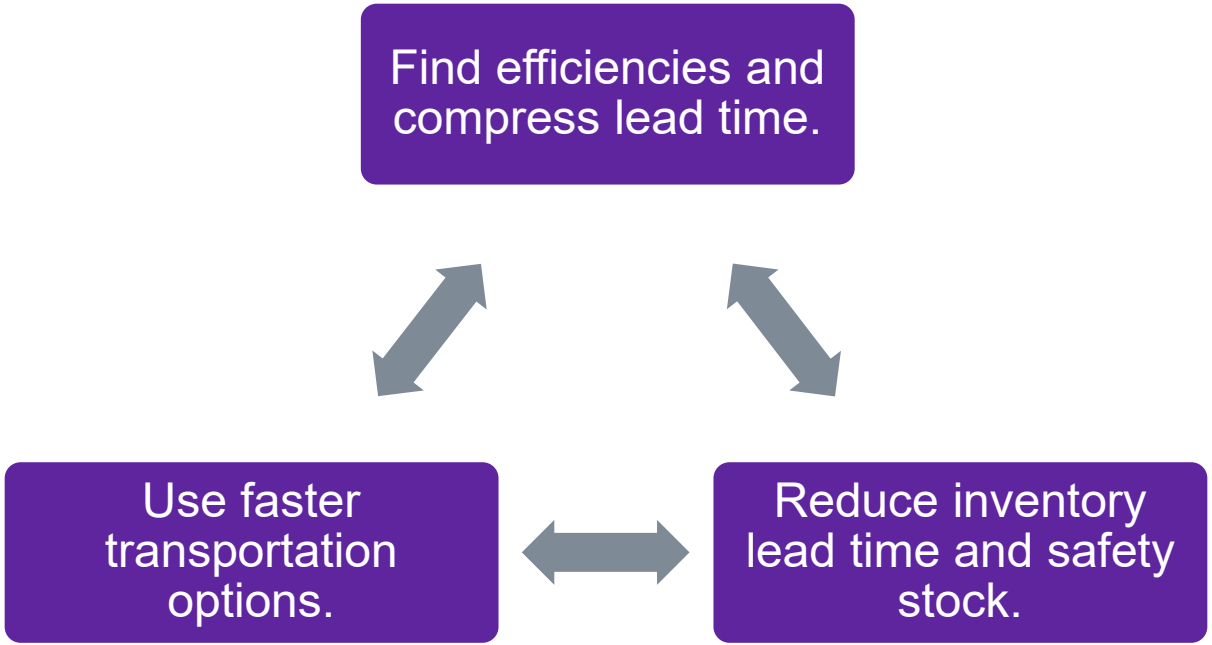
Stakeholder Perceptions of Inventory

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.

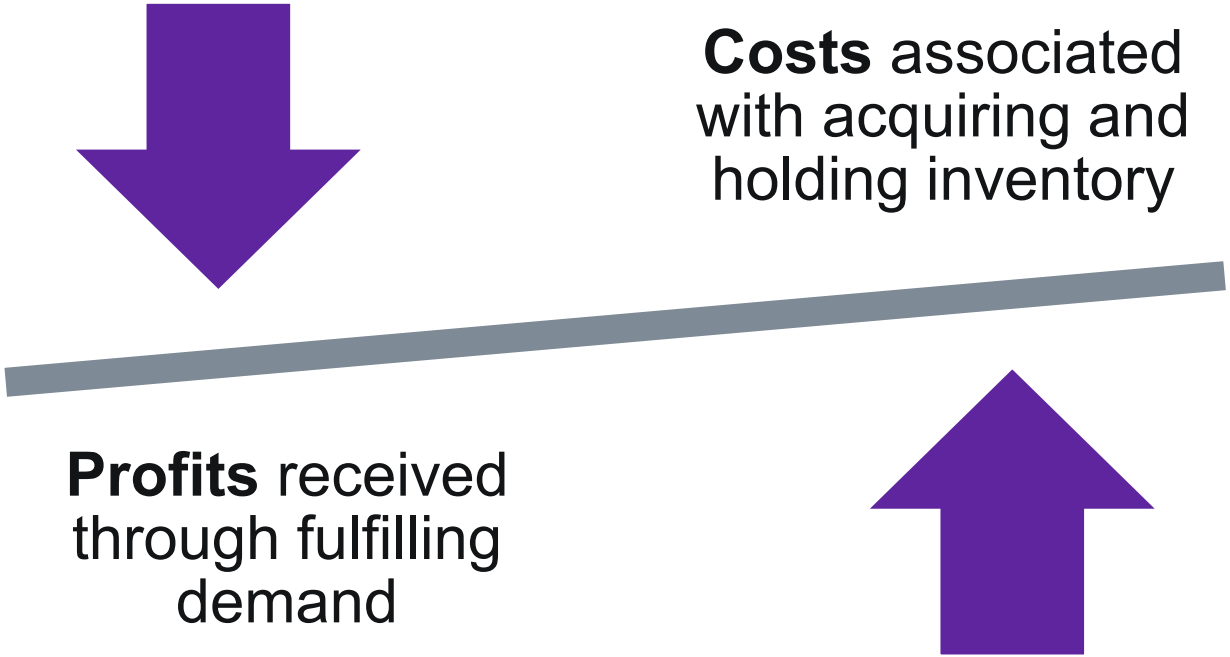
Inventory and Time



Faster Inventory Turns Means Less Cash Investment



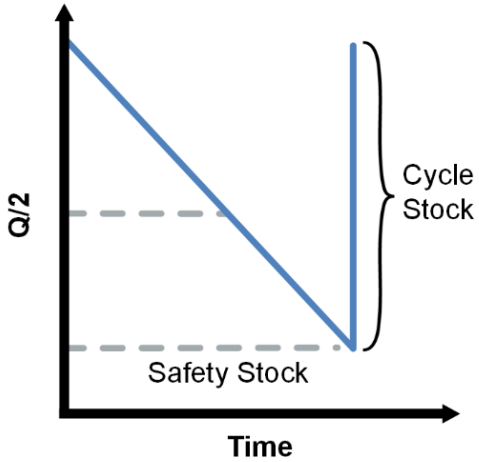
Demand Fulfillment



Cycle and Pipeline Stock

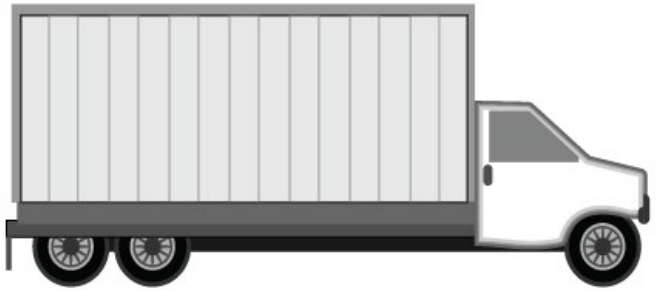
Cycle stock

Amount of inventory required to satisfy normal demand

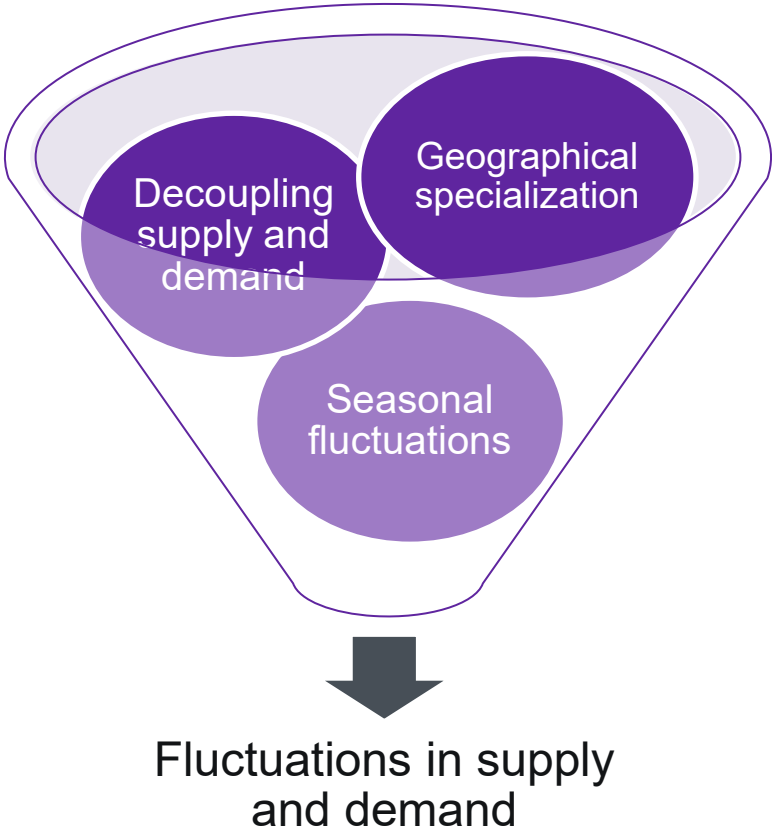


Pipeline stock

Amount of inventory in the transportation network and distribution system



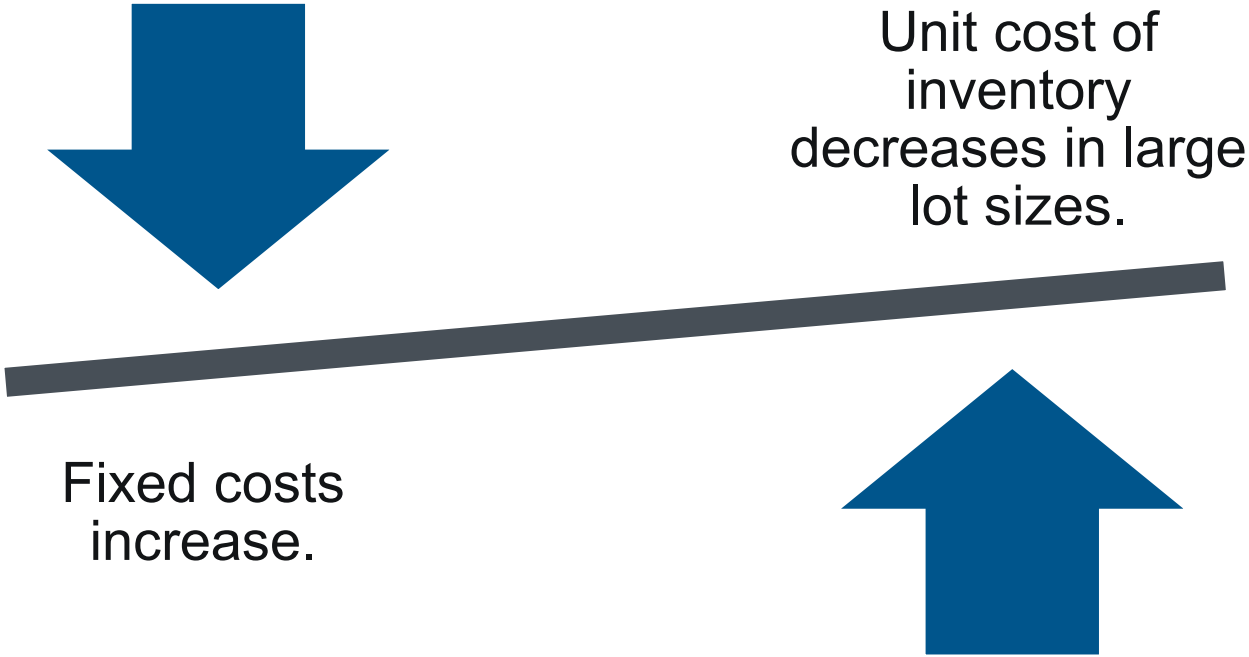
Topic 2: Functions of Inventory



Safety Stock and Hedge Inventory

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

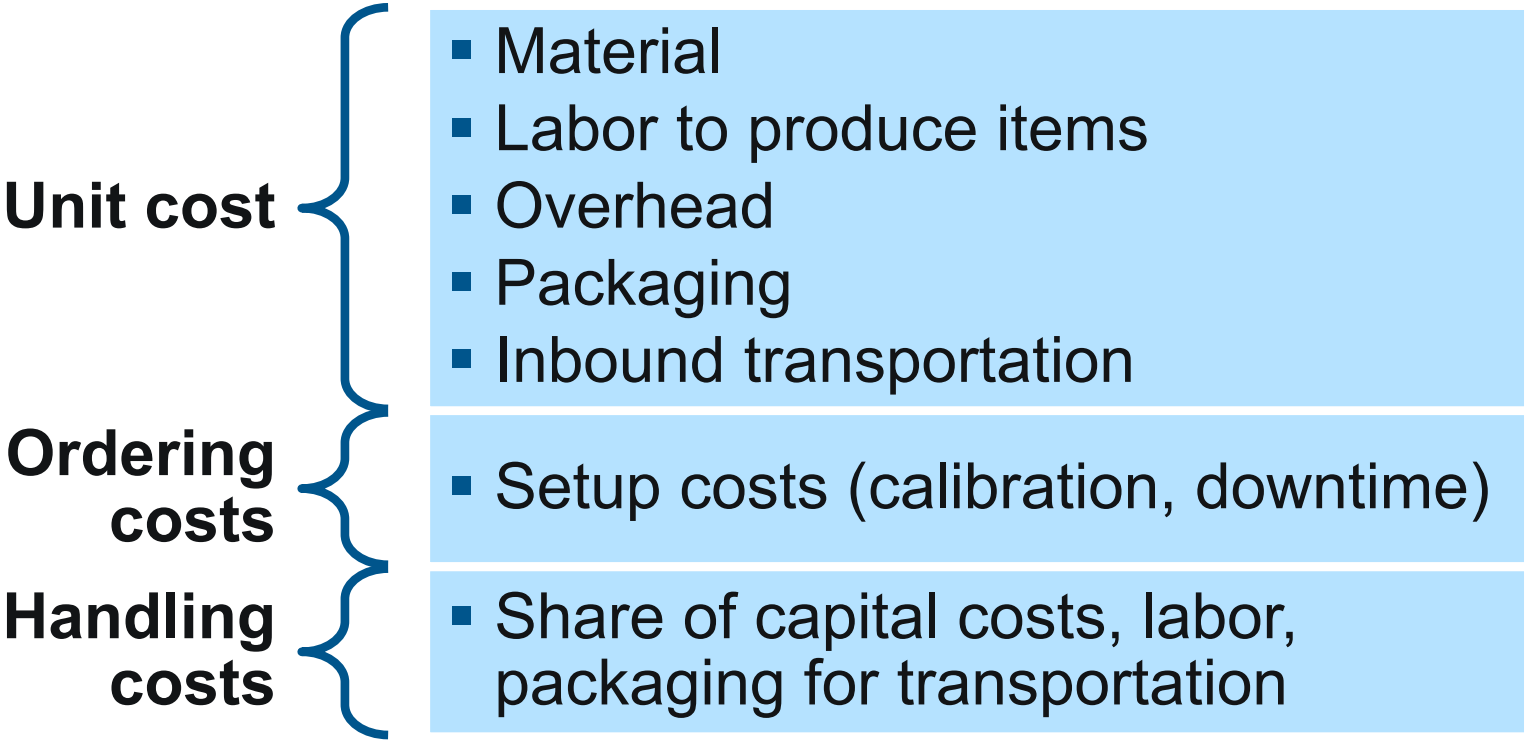
Economies of Scale



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

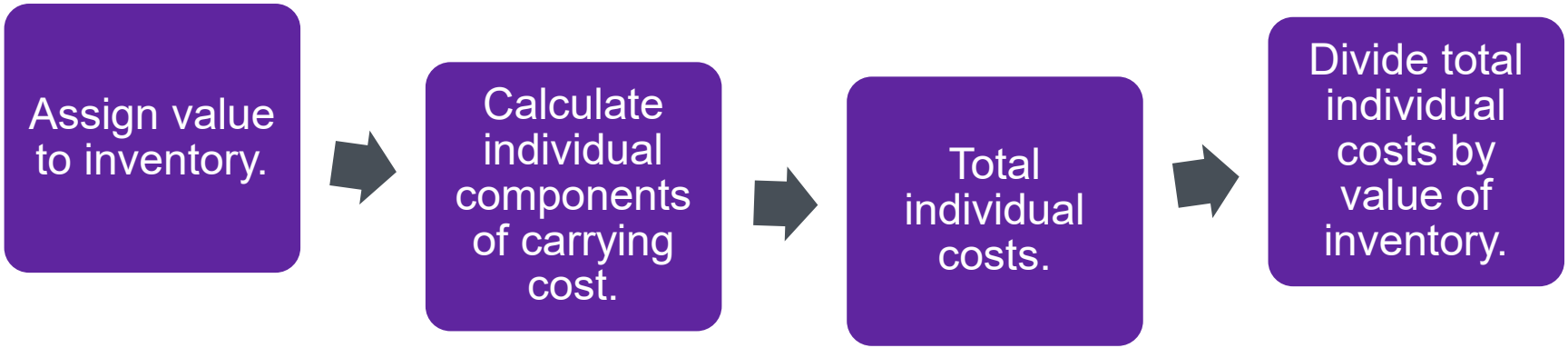


Carrying Costs

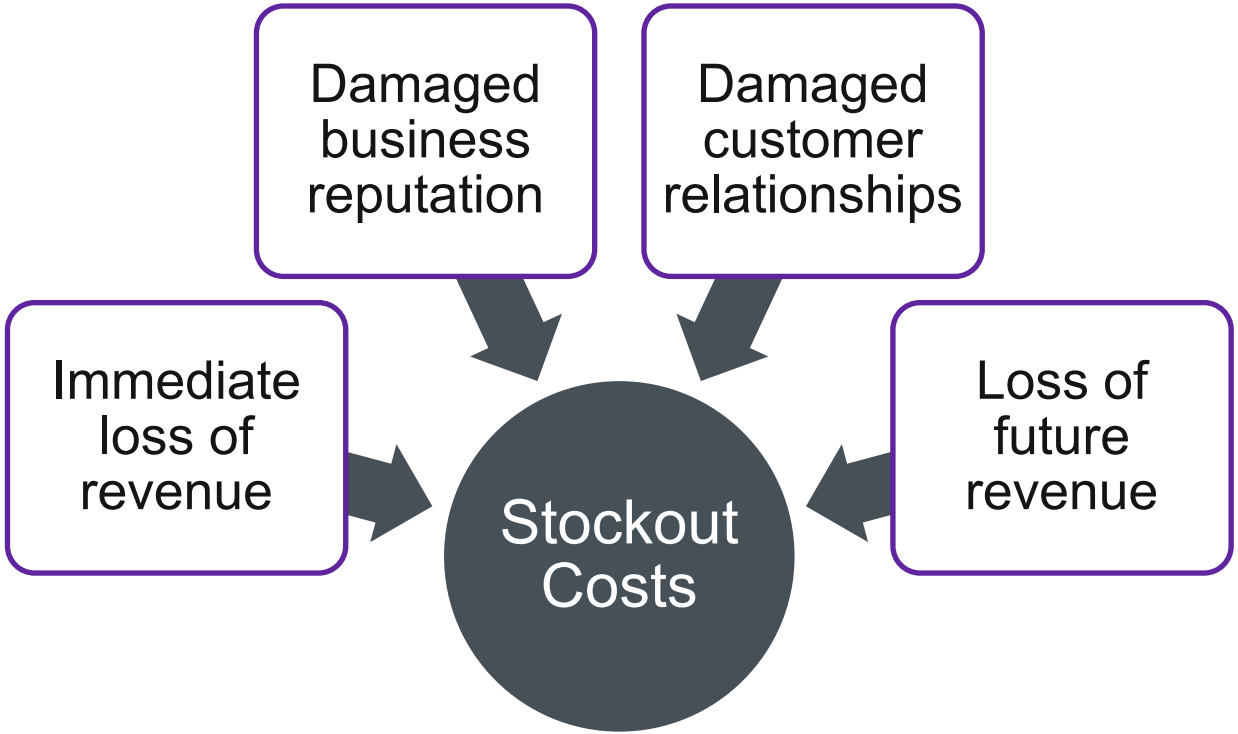
"The cost of holding inventory, usually defined as a percentage of the dollar value of inventory per unit of time (generally one year)."

Calculating Carrying Cost

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



Stockout Costs



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

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Topic 1: Determining When and How Much to Order

Demand Types

Independent demand

- Fixed order quantity
- Fixed order period

Dependent demand

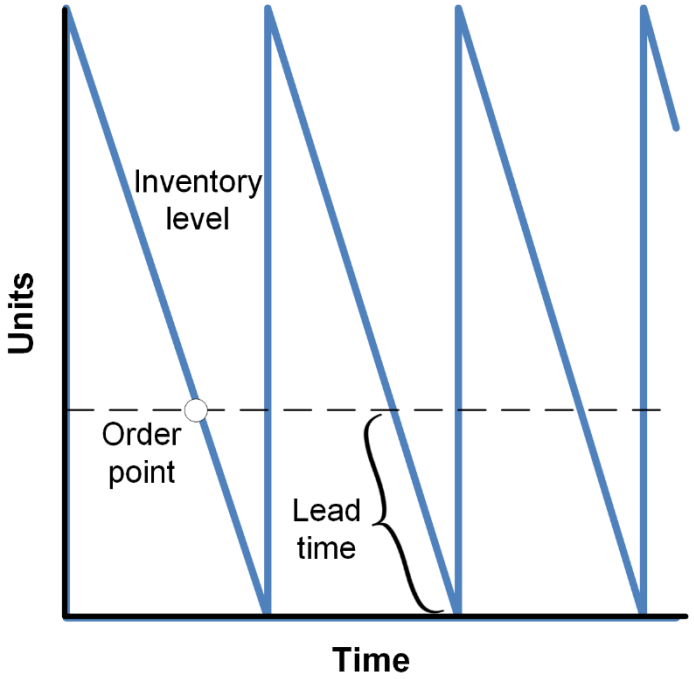
- Components
- Kits

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

$$\text{Order Point} = \text{Anticipated Demand (D)} \times \text{Lead Time (L)}$$

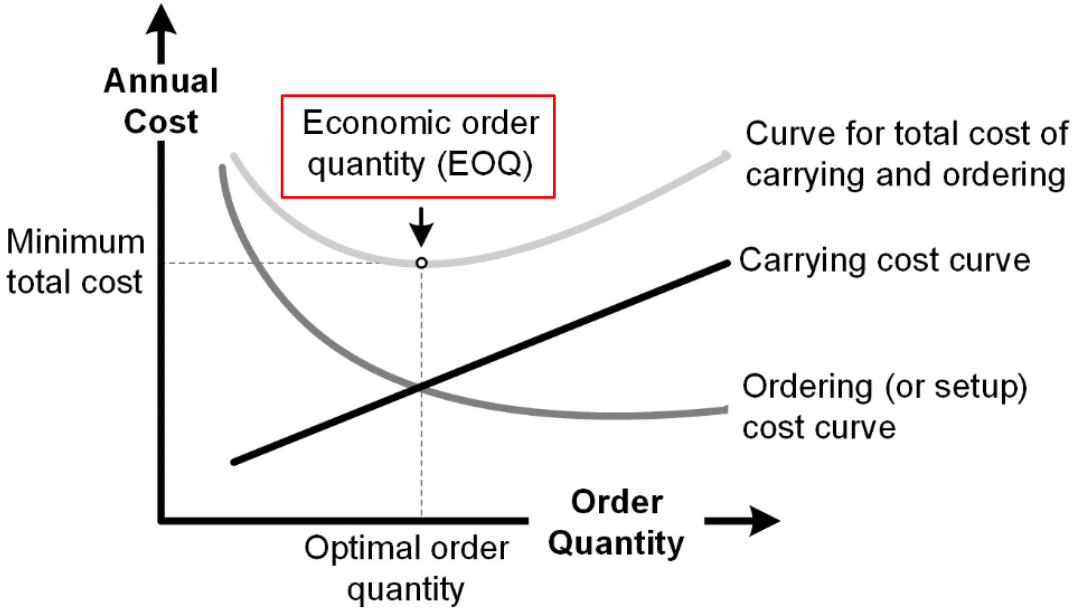
Demand:

- 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

Economic Order Quantity (EOQ)



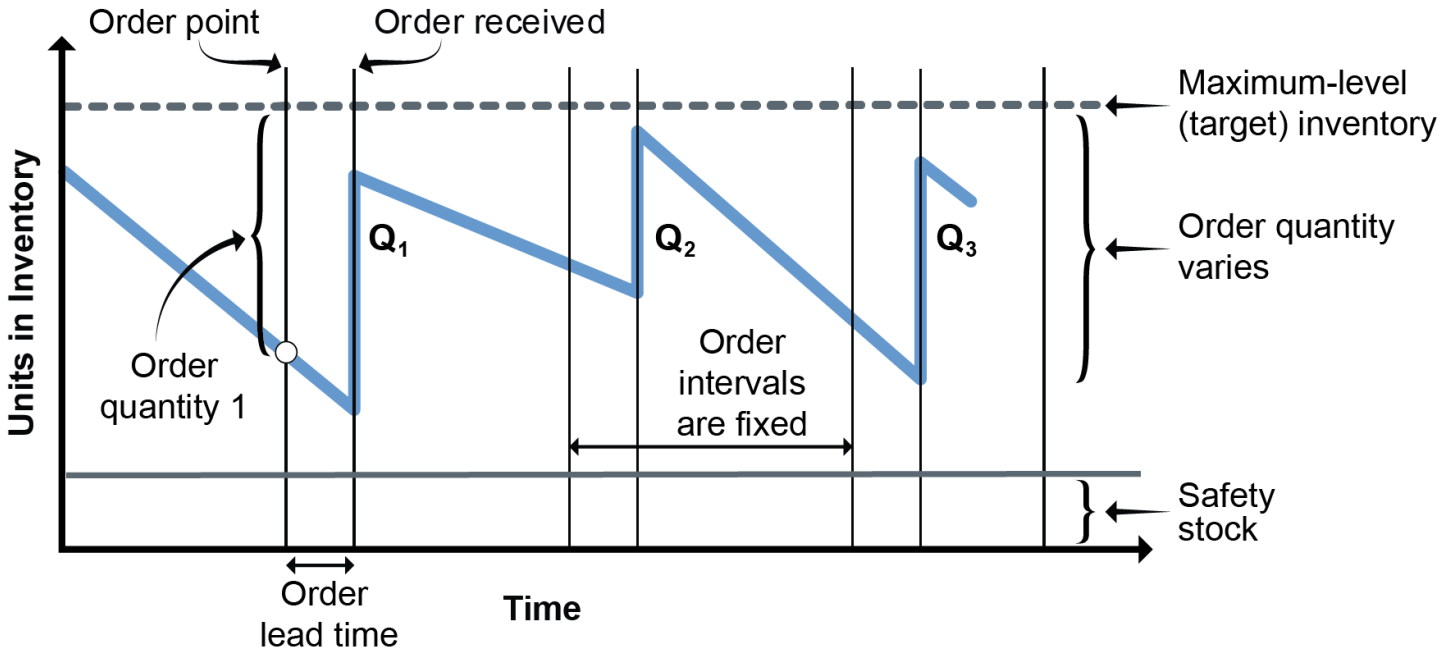
Source: *APICS Certified Supply Chain Professional Learning System, Version 4.0*

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

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

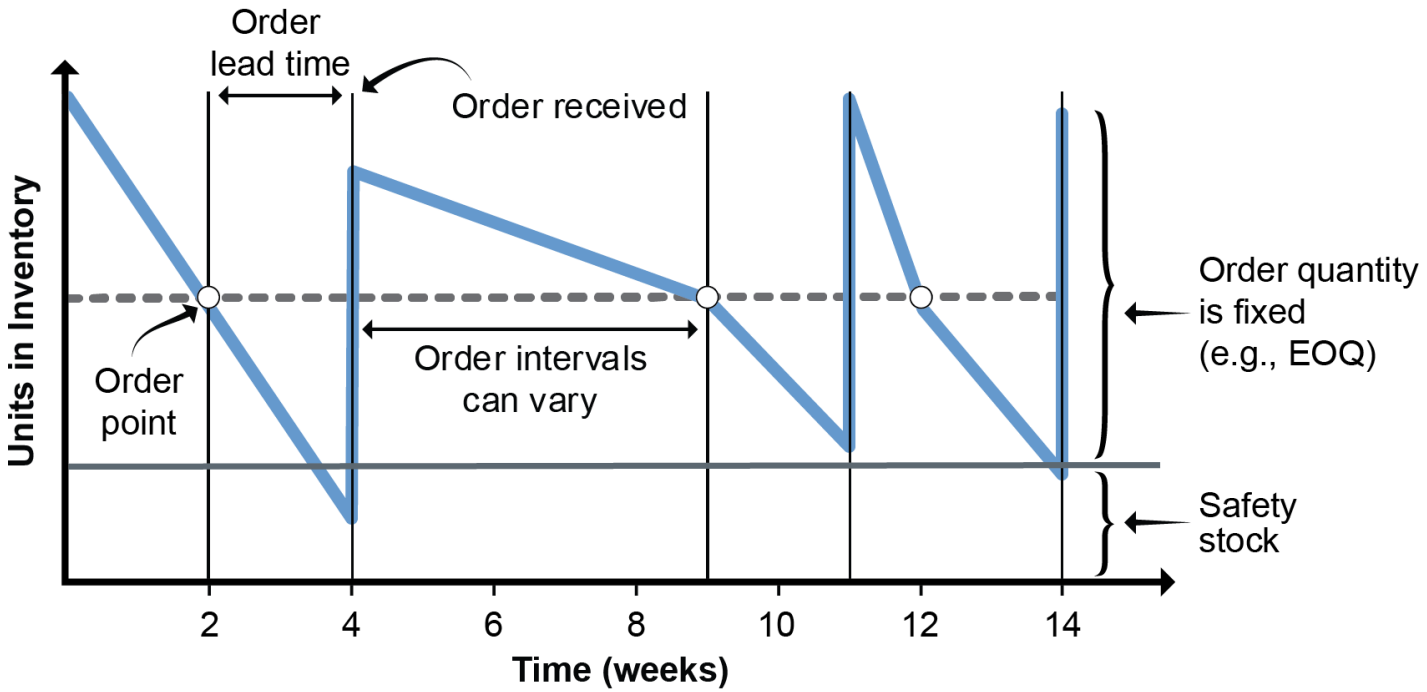
- Type of order point replenishment system
- Hybrid approach to inventory control
- Variable order quantity

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

Just in Time (JIT)

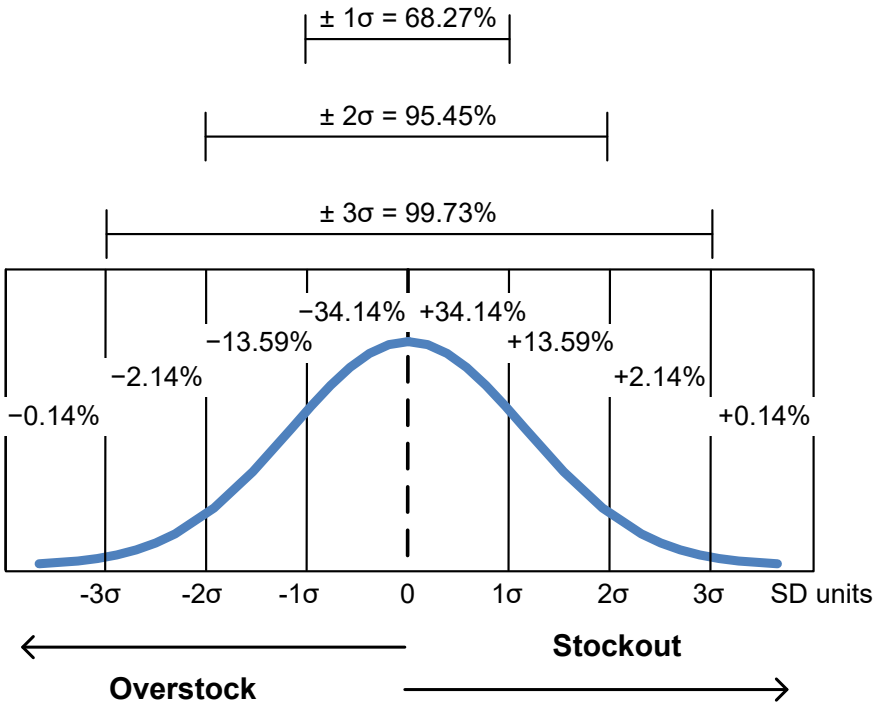
- Aims at reducing waste
- Works to reduce uncertainty of what to produce or what and how much to order

Effect of Uncertainty on Reorder Frequency



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

Standard Deviations in a Normal Distribution



Calculating Standard Deviation in Units

- This example: n = 10-week period
- If a using a complete set of data, use n
- If using a sample to represent the whole, use $n - 1$

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

Mean Absolute Deviation

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

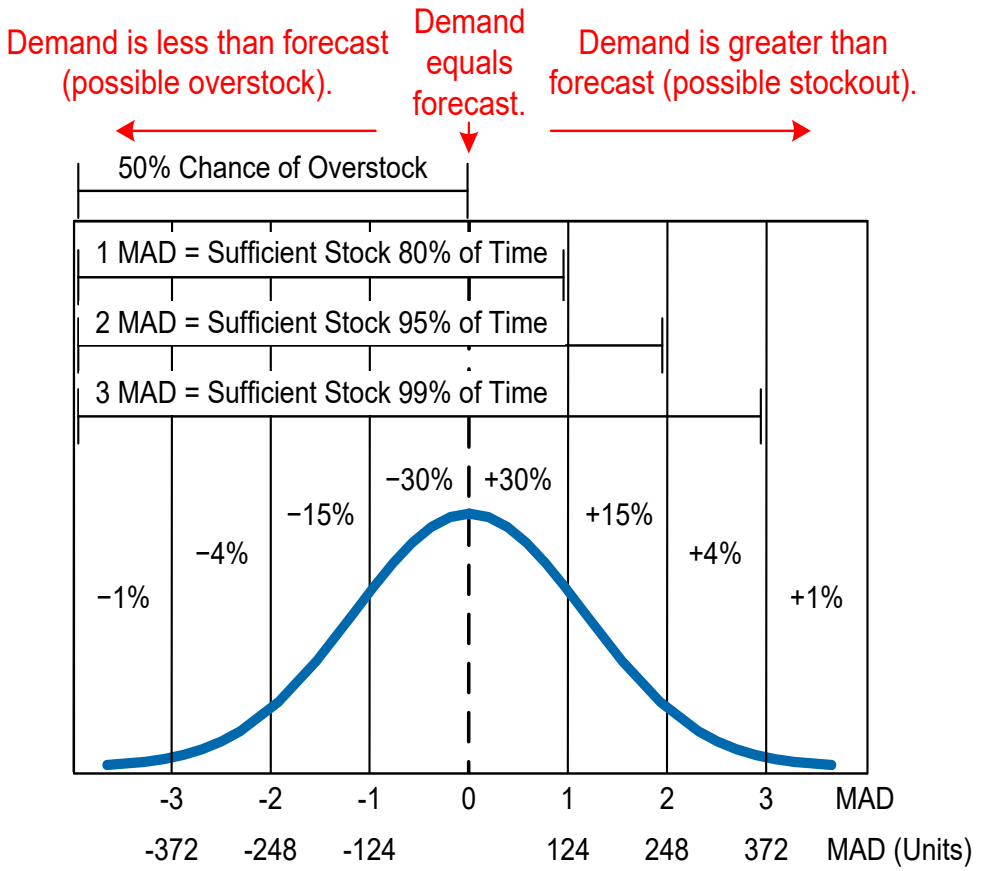
Where:

- $\sum|A - F|$ = 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

- +/− 1 MAD: 60% of time
- +/− 2 MAD: 90% of time
- +/− 3 MAD: 98% of time



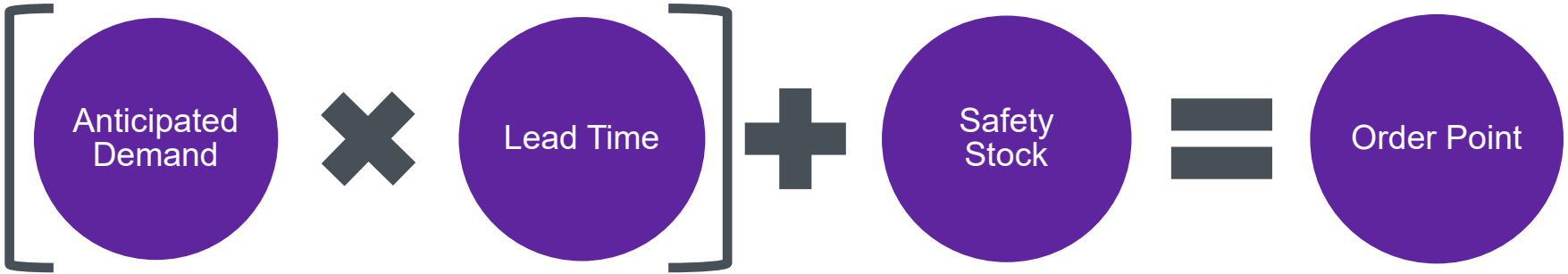
Calculating Safety Stock from Service Level

- Safety factor table:
- For example, for 90% service level, using SD, safety stock level should be:
  165.4 SD in units x 1.28 = 212 units

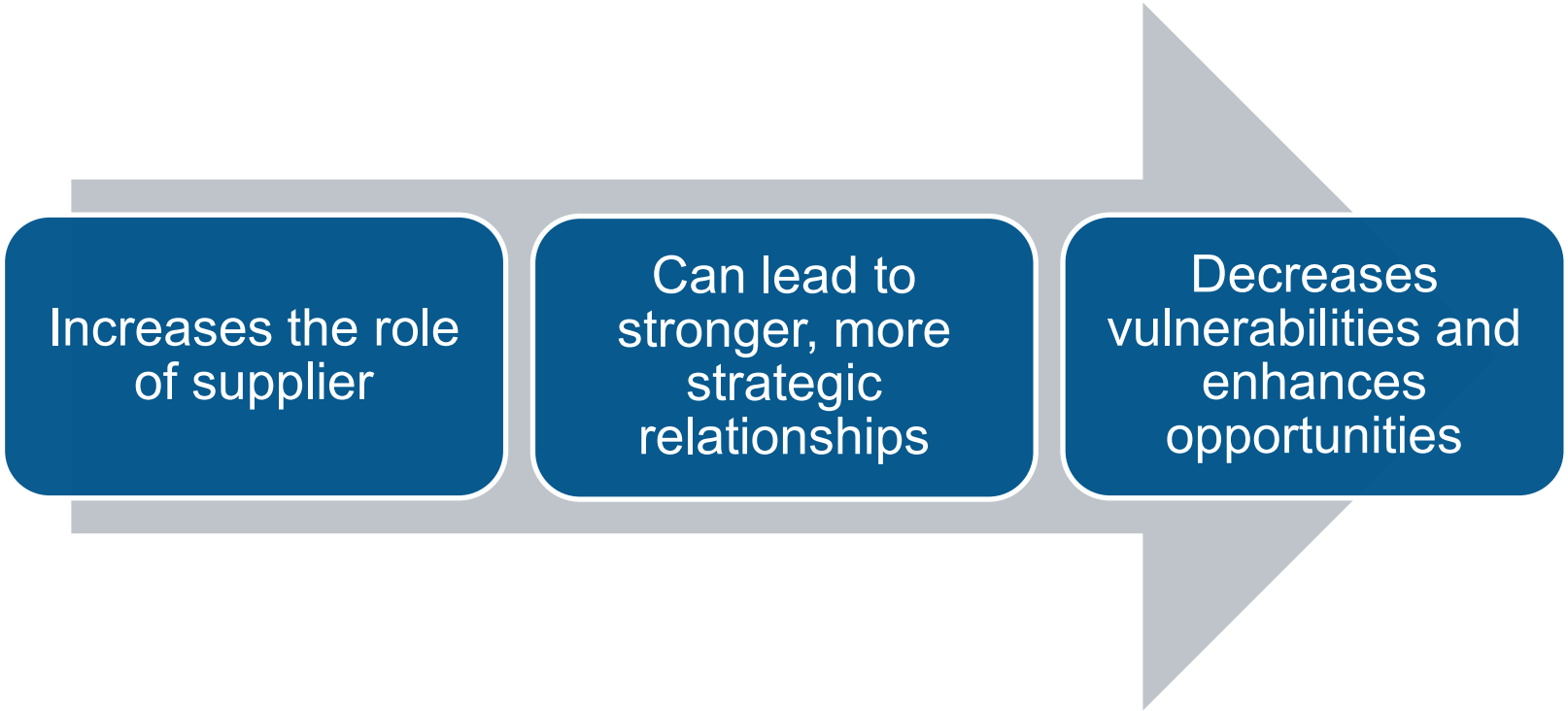
Percentile Customer Service Level	SD Units × Factor Below	MAD Units × Factor Below
85.00	1.04	1.30
89.44	1.25	1.56
90.00	1.28	1.60
93.32	1.50	1.88
95.00	1.65	2.06
97.72	2.00	2.50
98.00	2.05	2.56

Calculating Safety Stock: Order Point

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



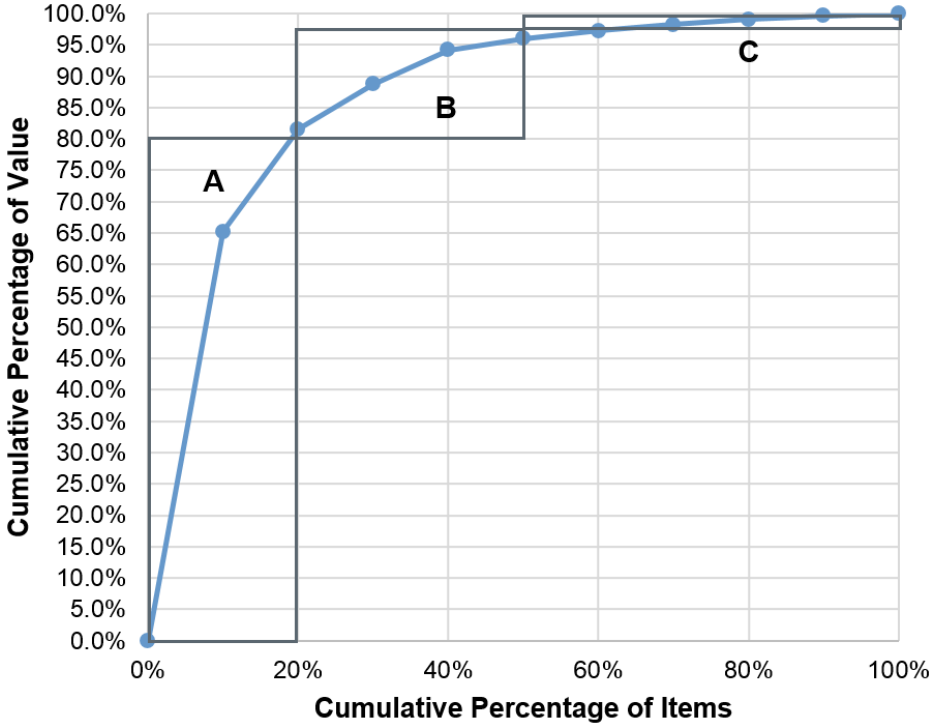
Vendor-Managed Inventory (VMI)



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



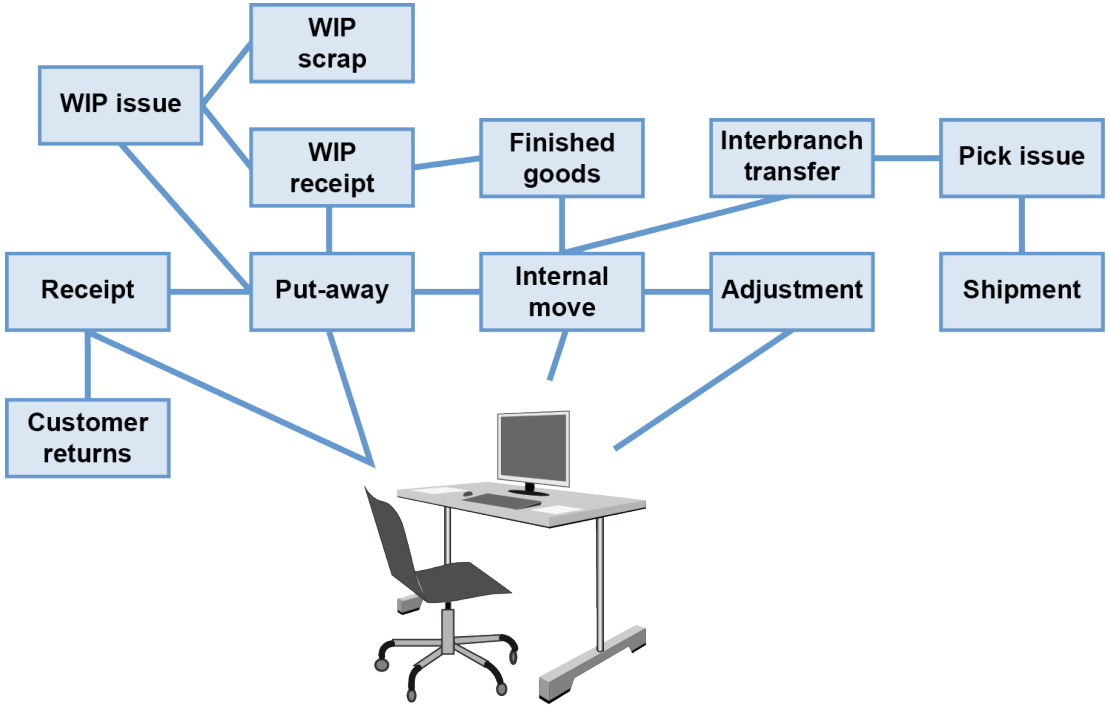
ABC Analysis by Revenue

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



Source: David F. Ross. *Distribution Planning and Control—Managing in the Era of Supply Chain Management.* Used with permission.

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

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

Approaches to cycle counting:

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

Inventory Control Metrics

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

Inventory Turnover =

- $$\frac{\text{COGS}}{\text{Average Inventory Valued at Cost During Period}}$$
- $$\frac{\text{Sales Revenue}}{\text{Average Inventory Valued at Selling Price During Period}}$$
- $$\frac{\text{Units Sold}}{\text{Average Unit Inventory During Period}}$$