STRATEGIC INVENTORY MANAGEMENT

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- Drivers of Inventory
- Measuring Inventory Performance

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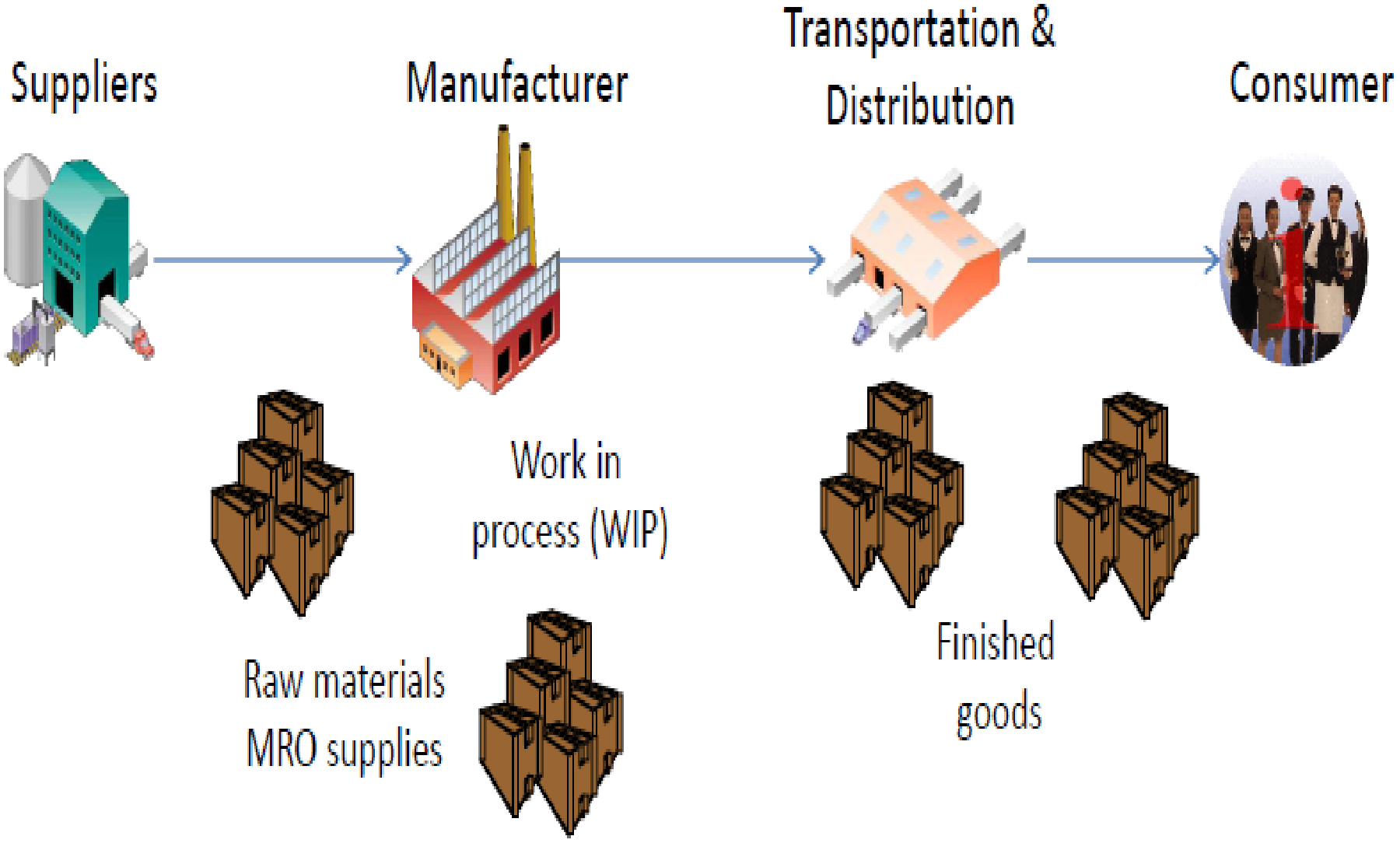
WHY DO WE NEED INVENTORIES?



WHY DO WE NEED INVENTORIES?

- Safety Stock
- Cycle Stock / Lot-Size Stock
- Transportation (Pipeline) Stock
- Pre-Build Stocks
- Hedging Stocks

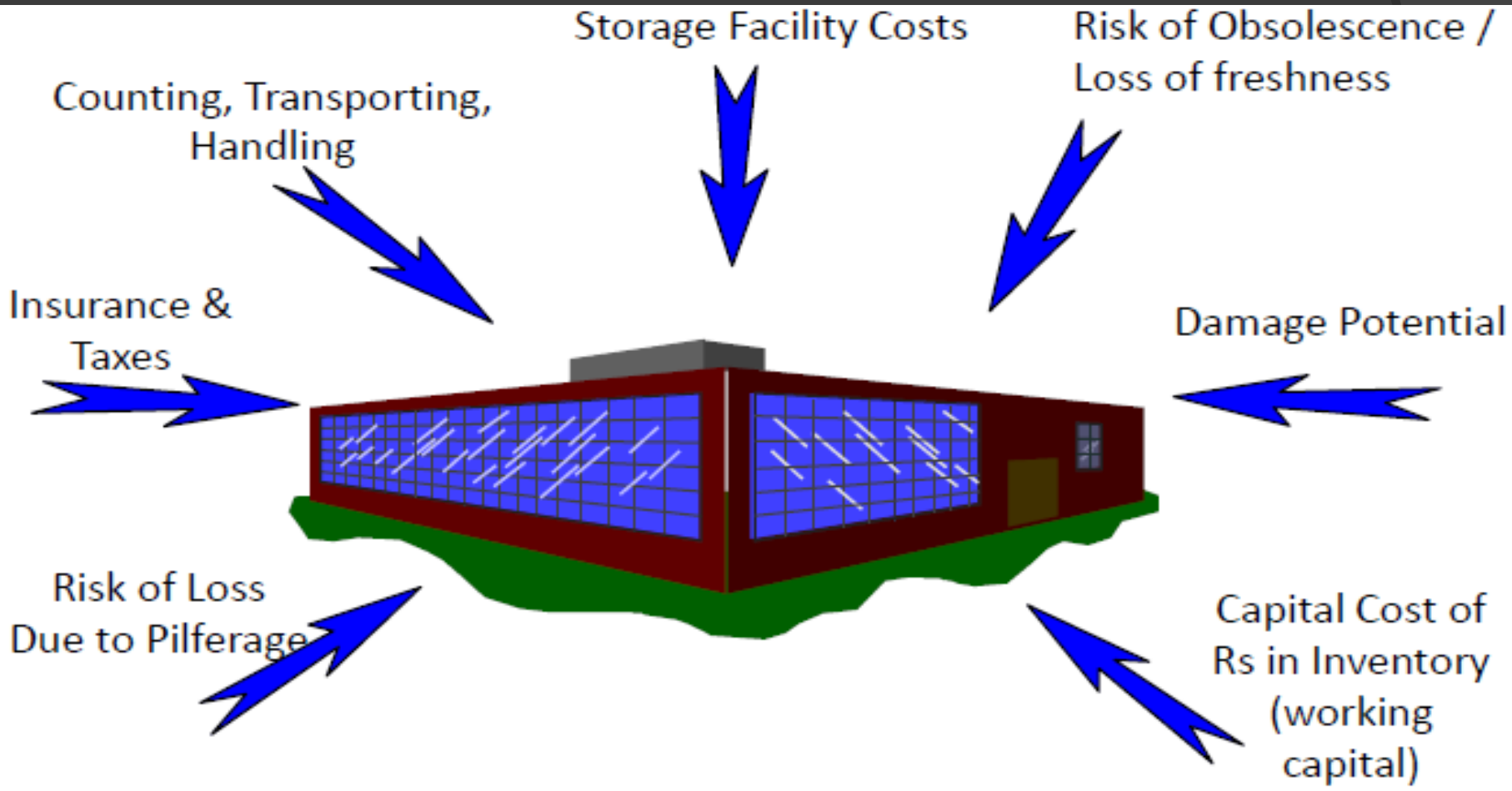
Inventory is a necessary evil !

- **Even in a perfectly run business**
- Safety stocks are needed because customer demand cannot be forecast accurately, or because of unreliable supply
- Cycle stocks are needed because manufacturing cannot produce small runs economically
- Pre-Building is needed because manufacturing has capacity limitations

Inventory decouples portions of supply chain, allowing them to work efficiently

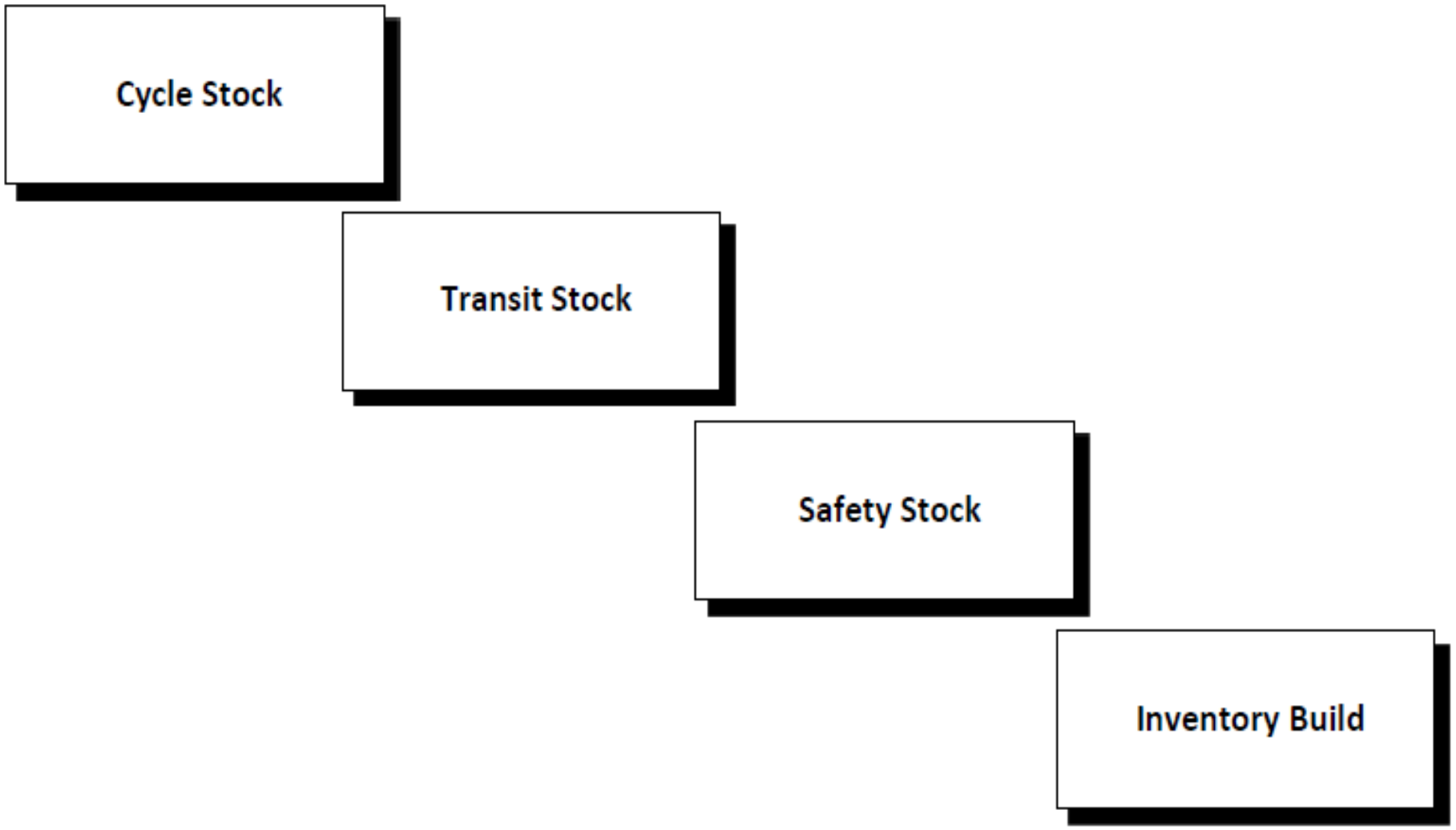
COST OF INVENTORY

Holding a lot of stock allows you to service your customers reliably, so why reduce it?



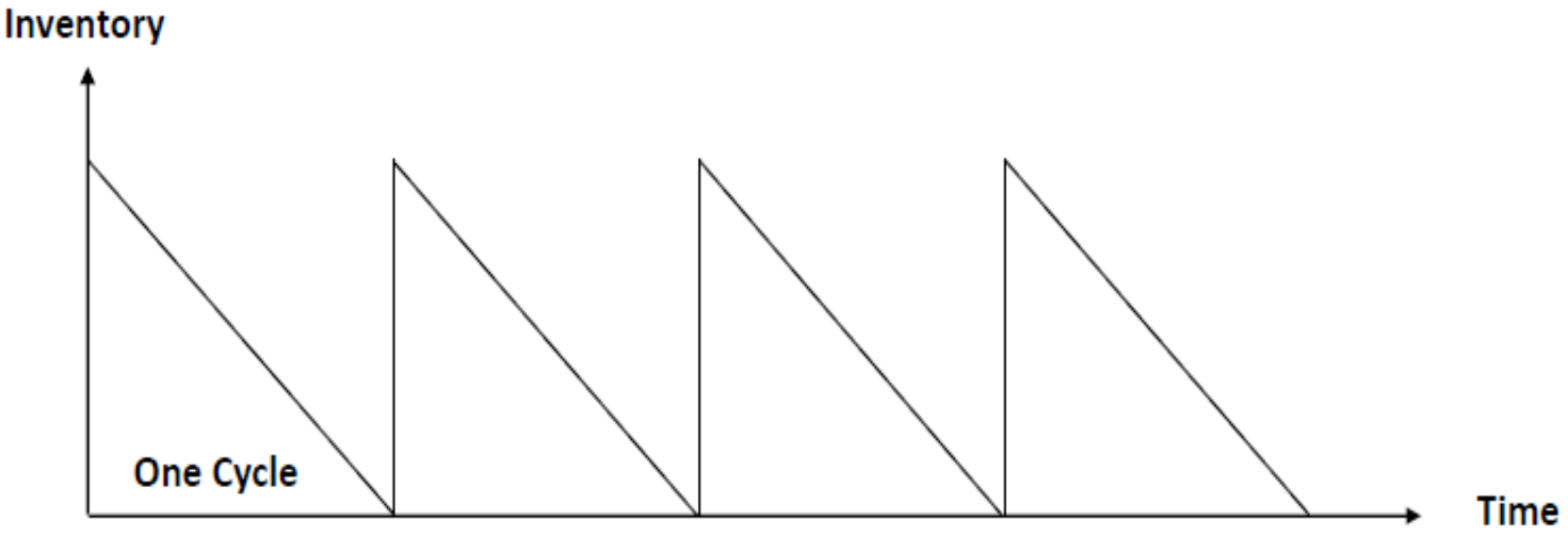
Inventory Components

Finished goods inventory is made up of four components:



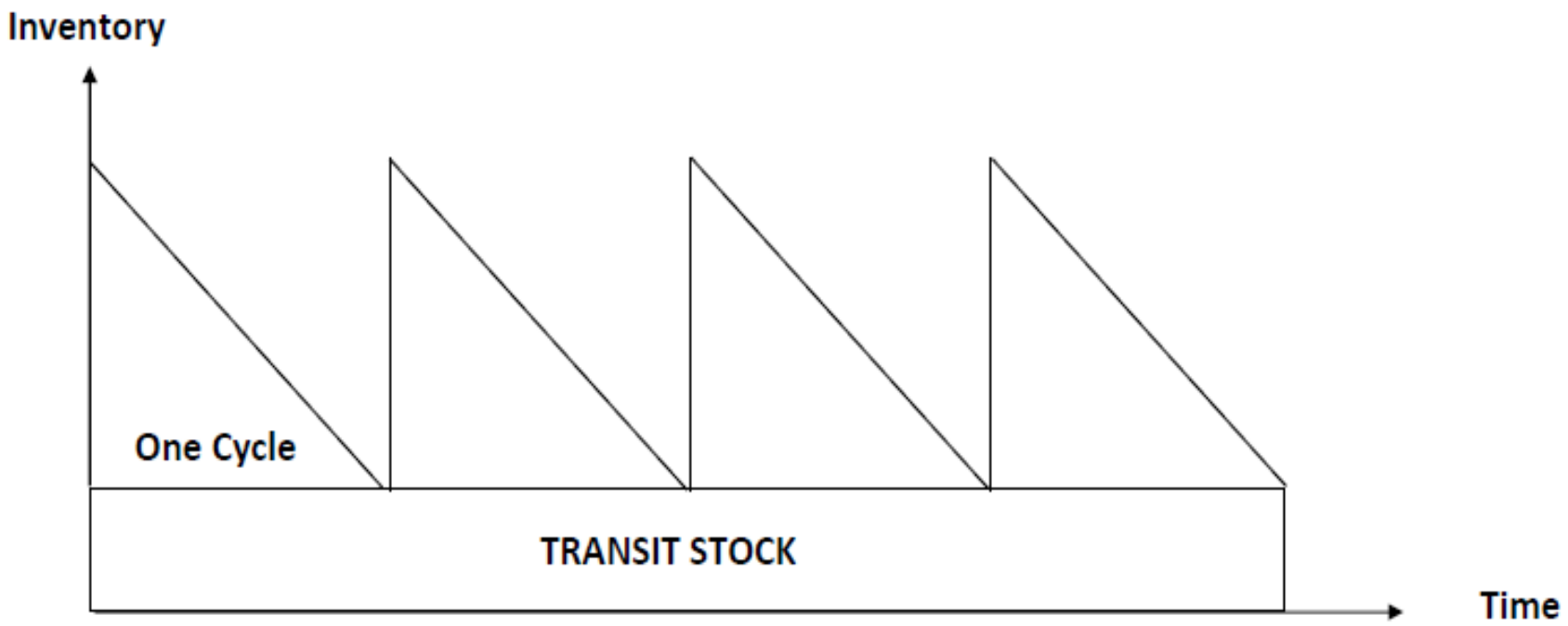
CYCLE STOCK

Cycle Stock is the active inventory component which covers customer demand between replenishment cycles.



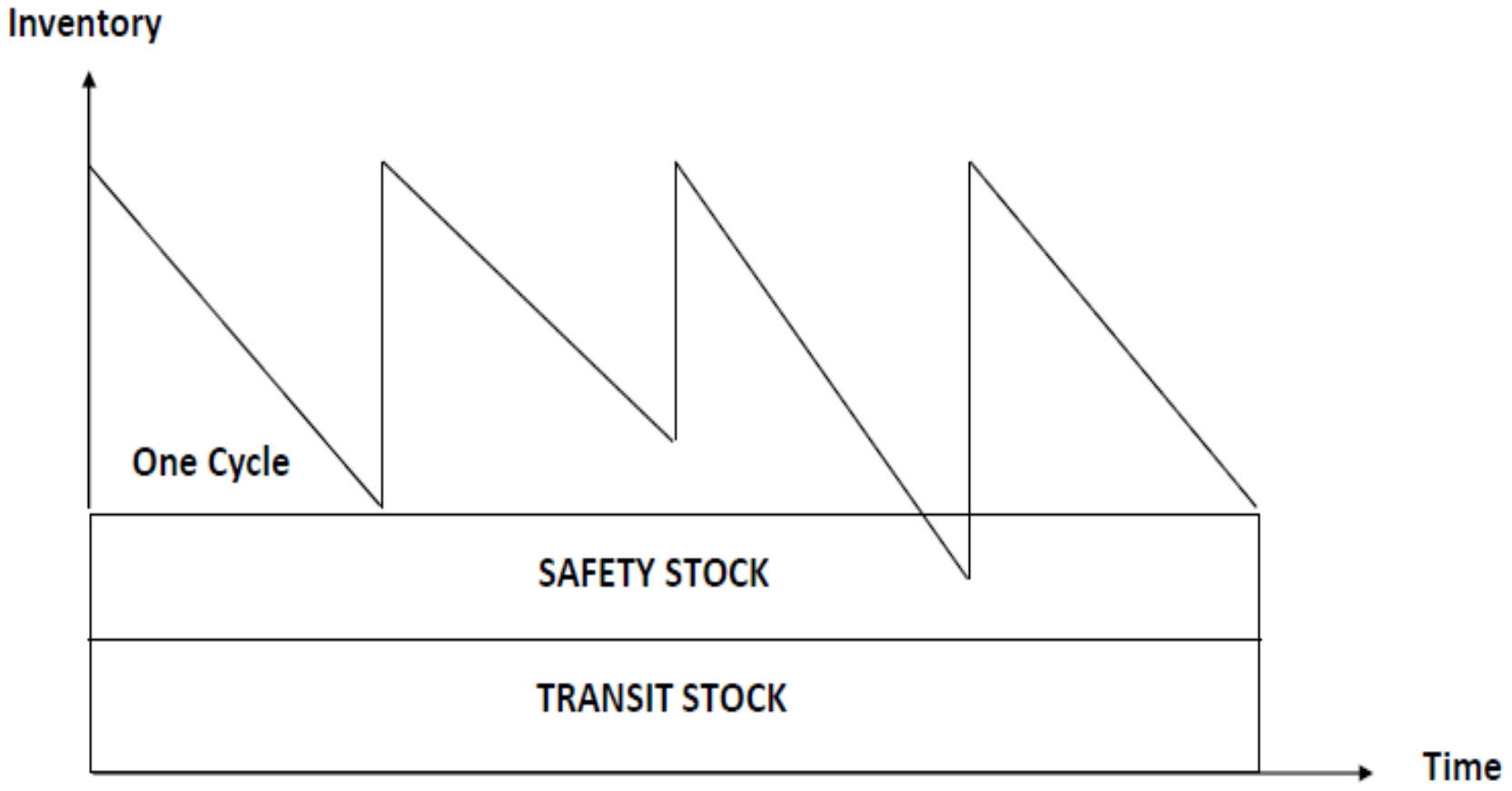
TRANSIT STOCK

Transit stock consists of products moving from one stocking location to the other



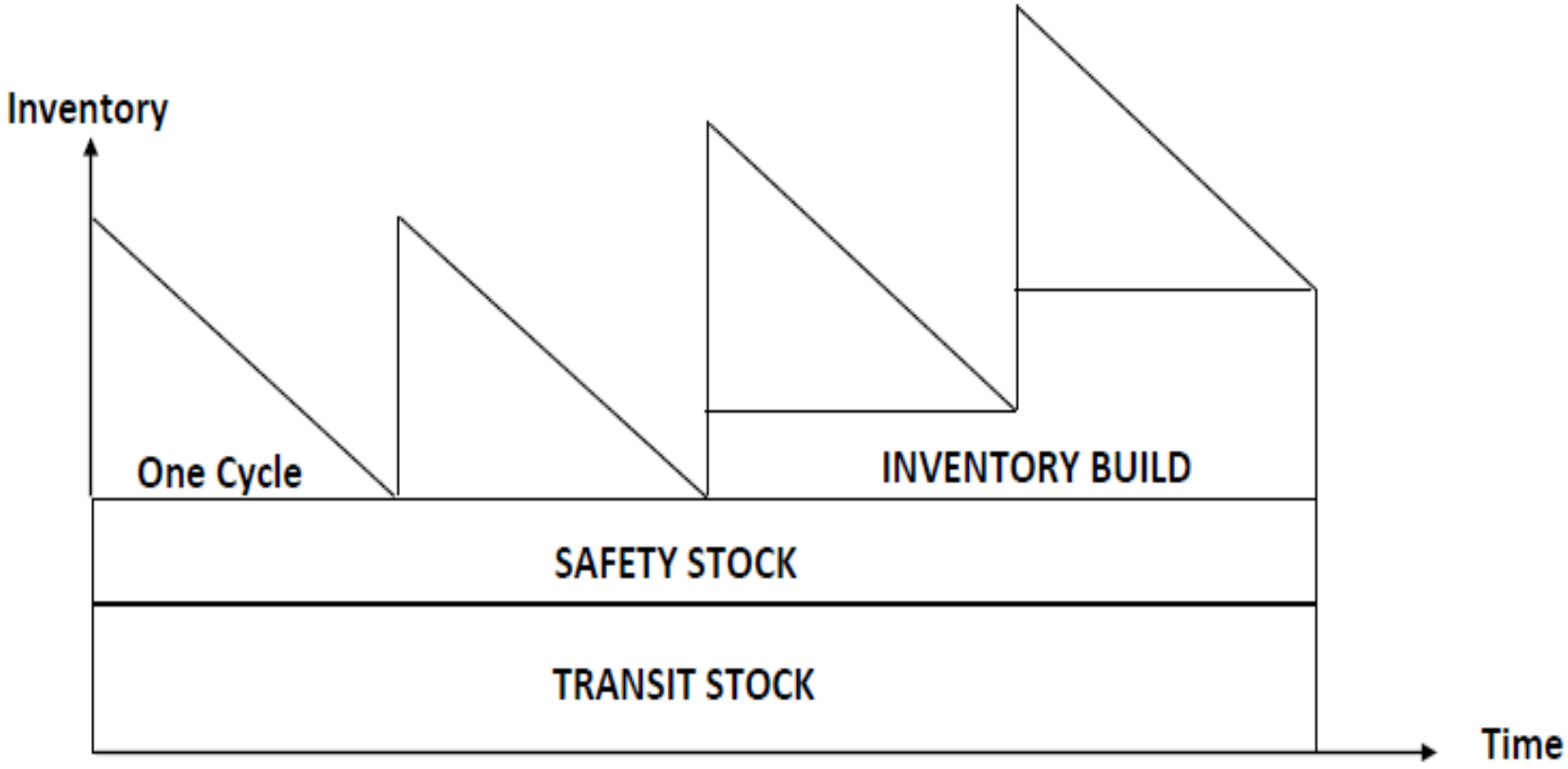
SAFETY STOCK

Safety stock protects against uncertainty in customer demand and supply chain variations.



INVENTORY BUILD

Inventory Build is inventory required to maintain customer service in addition to normal requirements (safety stock, transit stock and cycle stock) as a result of upcoming demand that exceeds upcoming capacity over a limited period of time.

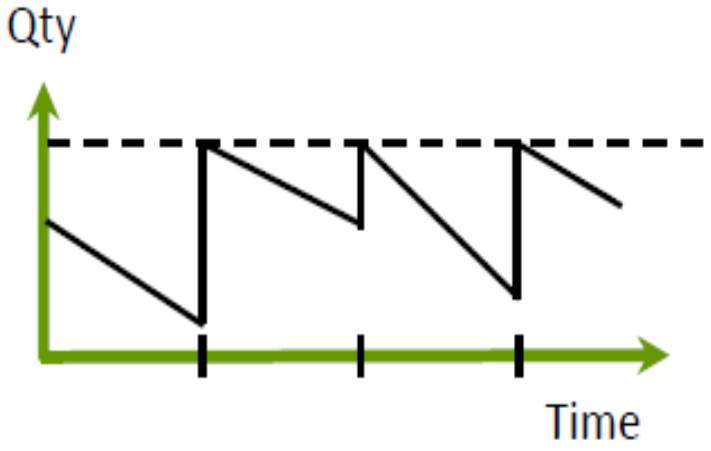


REORDER MECHANISM

- **For near stable demand, two reorder mechanisms are mostly used. Where a forecast exists, forecast quantity replaces the average demand**

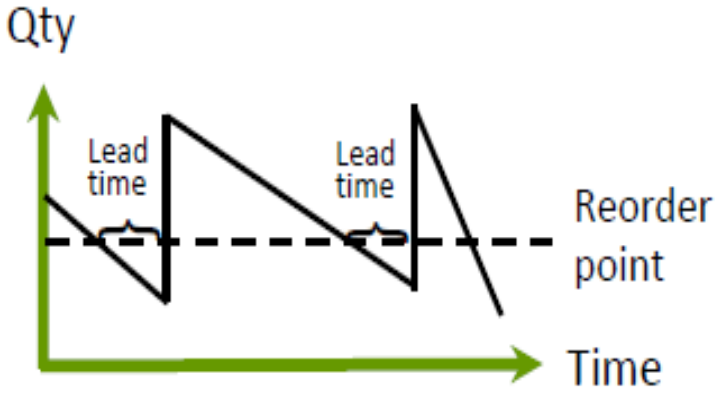
Fix Periodic Review – Reorder Time

- Order a variable quantity "x" such that maximum inventory limited to "S" when a pre-fixed time "t" has been reached

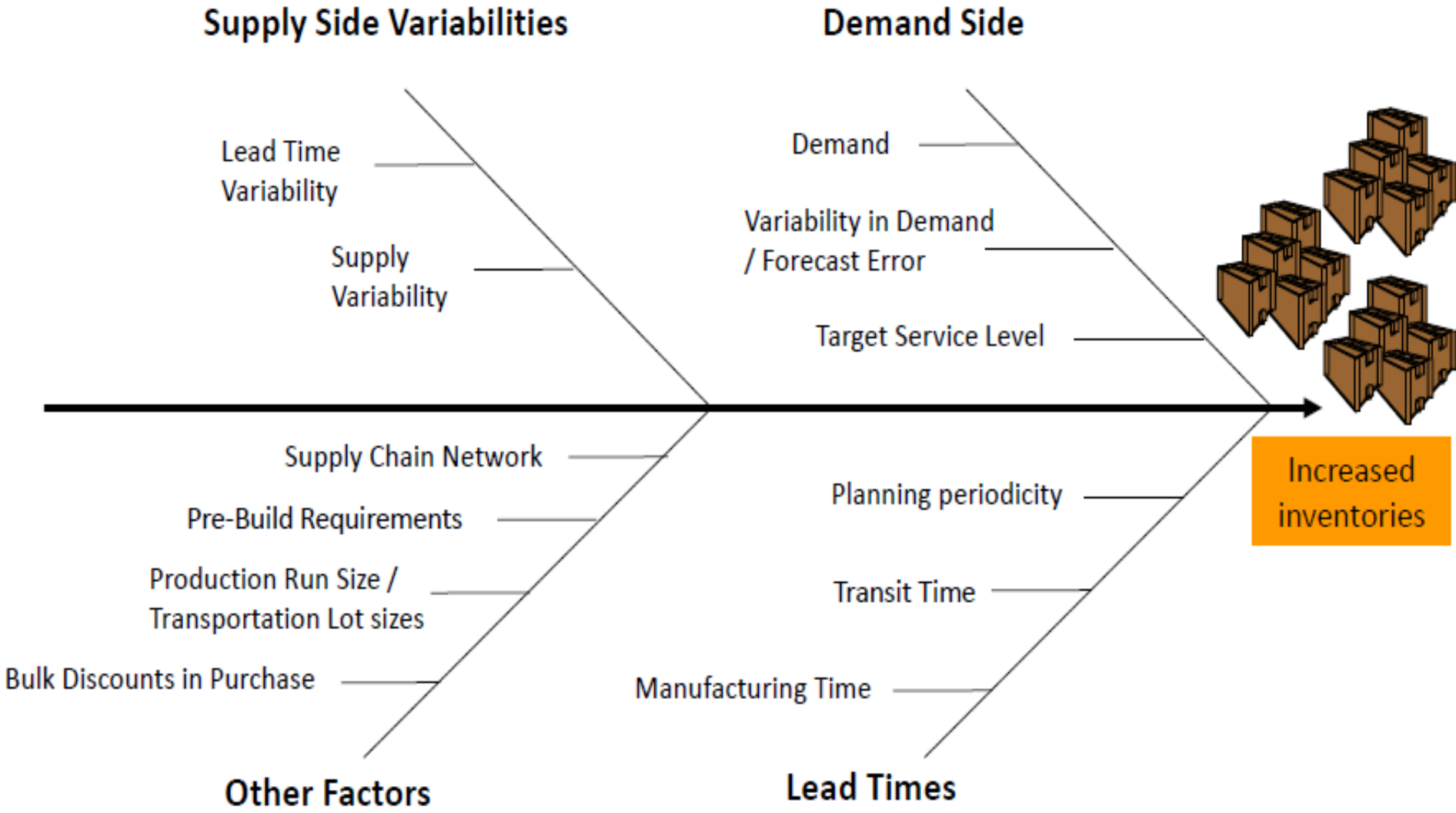


Fix Order Quantity – Reorder Point

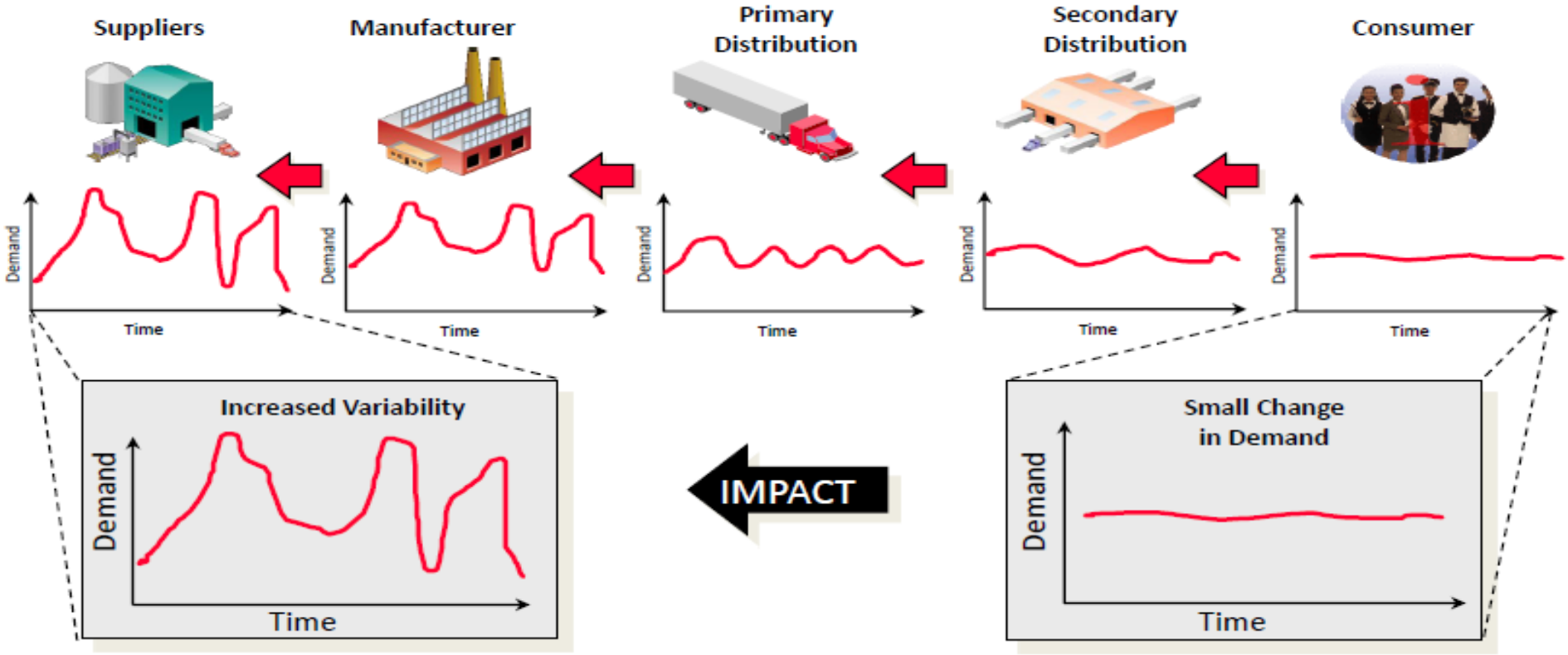
- Order fixed amount "Q" when a preset reorder level "s" has been reached



WHAT DRIVES INVENTROY?



THE ROLE OF INFORMATION – BULL – WHIP EFFECT



Supplier : KMM demand increased to much, please dispatch 300 Kg today only and keep 500 in stock.

AFD : We need to provide Kesar without fail, please builtup stock of KMM flavour

Distributor / Marketing : Please provide Kesar milk urgently, demand in increasing

Retailer : We require Kesar milk 5 trays tomorrow

Consumer : I want Kesar milk, but not in stock

MEASURING INVENTROY PERFORMANCE

Service Levels

- ***Cycle service level***
  - The % of cycles where we serviced all orders for a material
  - Cycle Service level of 90% means that in a given cycle there is a stock out probability of 10%
  - It also means that out of N cycles there will be 10% with stock outs
  - Number of stock out units is not relevant in this type of service level

- ***Order Fill rate***
  - The percentage of ordered quantity that was serviced in time
  - Service level of 90% means 90% demand fulfilled from stock on hand
  - Fill rate measures number of stock out units
  - All cycles may have stock outs and still achieve fill rate of 90%

Eg. of Cycle Service Level and Order Fill Rate

Sr No	Order Placed	Order Serviced	Cycle Service Level (In %)	Order Fill Rate
1	50	50	1	100
2	30	30	1	100
3	65	50	0	77
4	55	50	0	91
5	35	35	1	100
6	40	40	1	100
7	50	50	1	100
8	45	45	1	100
9	**OVERALL PERFORMANCE**		**75%**	**96%**

MEASURING INVENTROY PERFORMANCE

Inventory Levels

- **Days of Supply (DOS)**
- If no new supplies are provided, till how many days will the existing stocks last

Inventory DOS = Stock on Hand / Average Daily Demand

- There is also a measure ‘Inventory Turnover’ which is reverse of DOS
- Inventory Turns measures the number of times material is turned over in an year
- Inventory Turn = Annual Demand / Stock on Hand

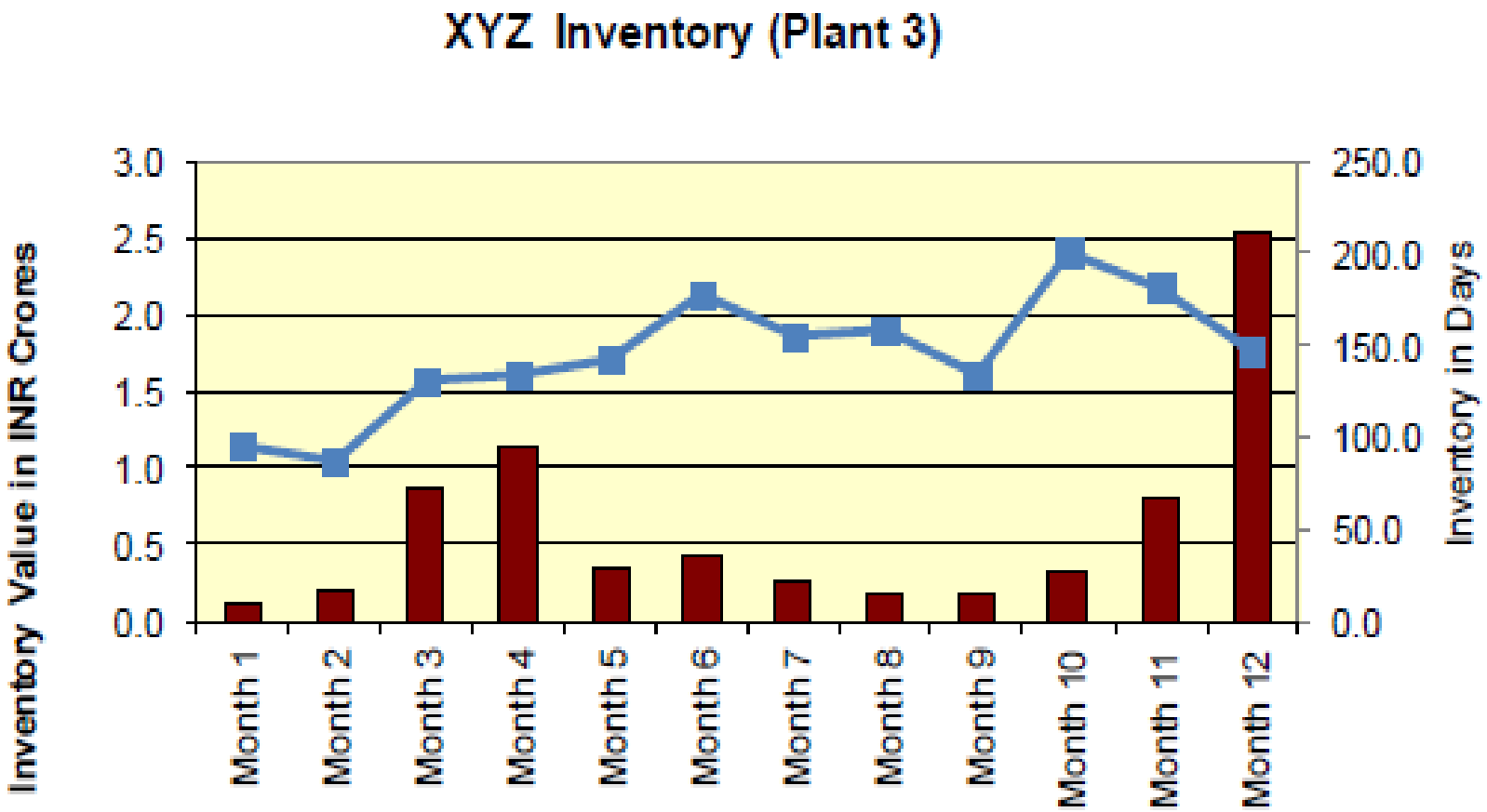
Eg. of Days of Supply and Cost of Working Capital

DAYS OF SUPPLY				
SKU	**Quantity in Stock**	**Monthly Demand**	**Daily Demand**	**Days of Supply (DOS)**
	A	B	C=B/30	D=A/C
A	40	30	1	40
B	90	40	1.33	67.67
C	20	50	1.67	11.98
D	**150**	**120**	**4**	**119.65**

INVENTORY TURNOVER RATIO				
SKU	**Quantity in Stock**	**Monthly Demand**	**Annual Demand**	**Inventory Turnover**
	A	B	C=B*12	D=C/A
A	40	30	360	9
B	90	40	480	5.33
C	20	50	600	30
D	**150**	**120**	**1440**	**9.6**

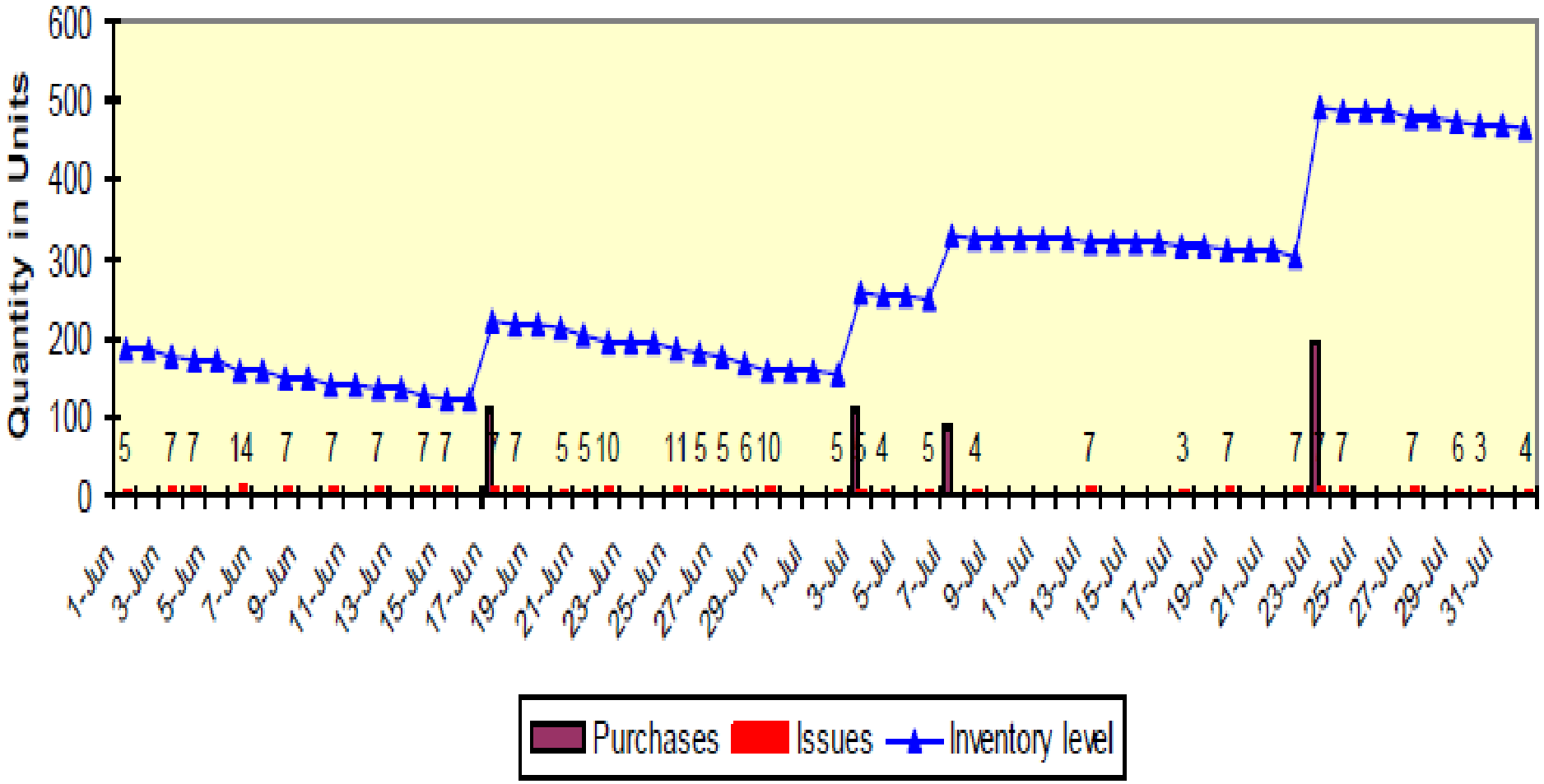
ANALYSING INVENTROY PERFORMANCE

Periodic Performance comparison



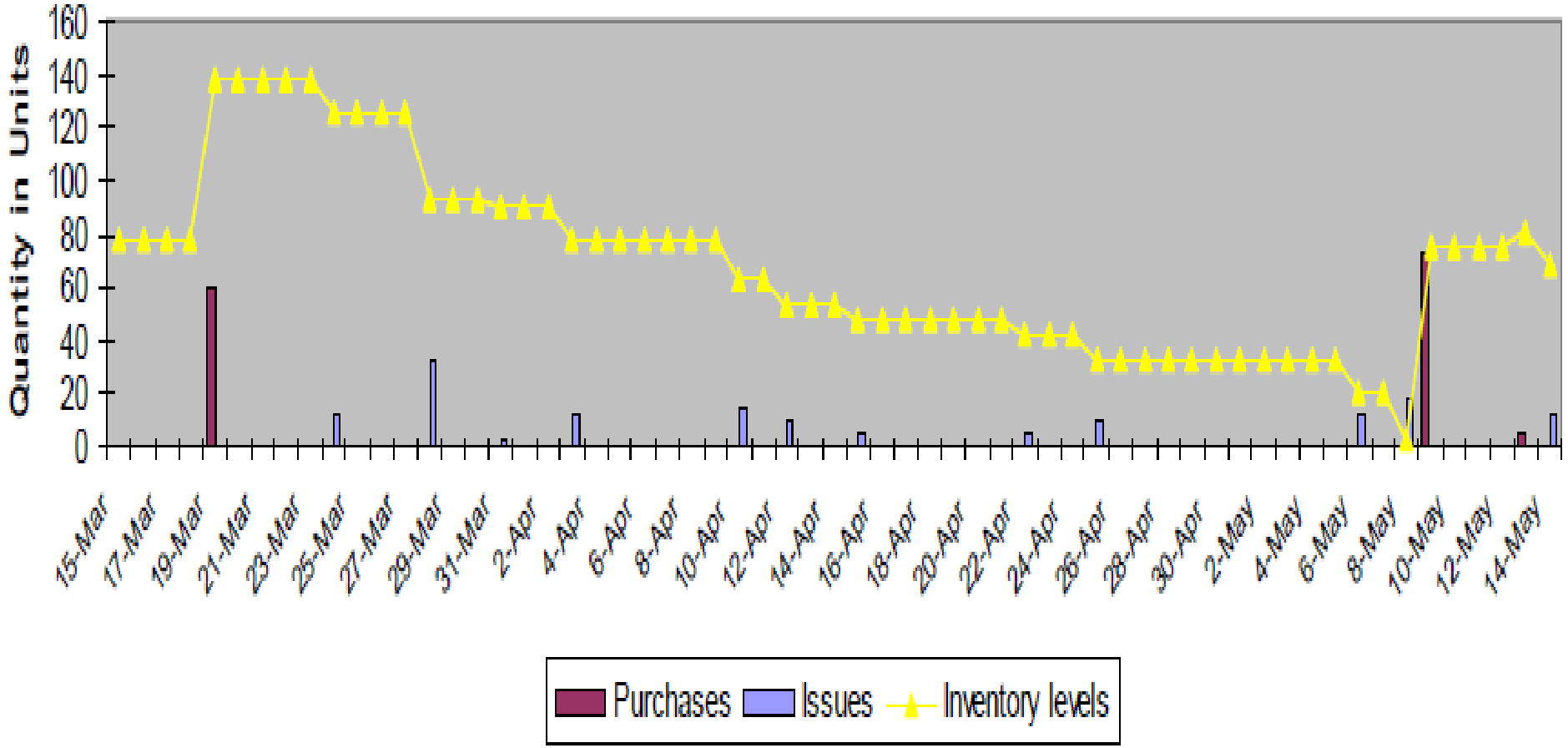
ANALYSING INVENTROY PERFORMANCE

TRIPLE PLAY CHART – EXAMPLE 1

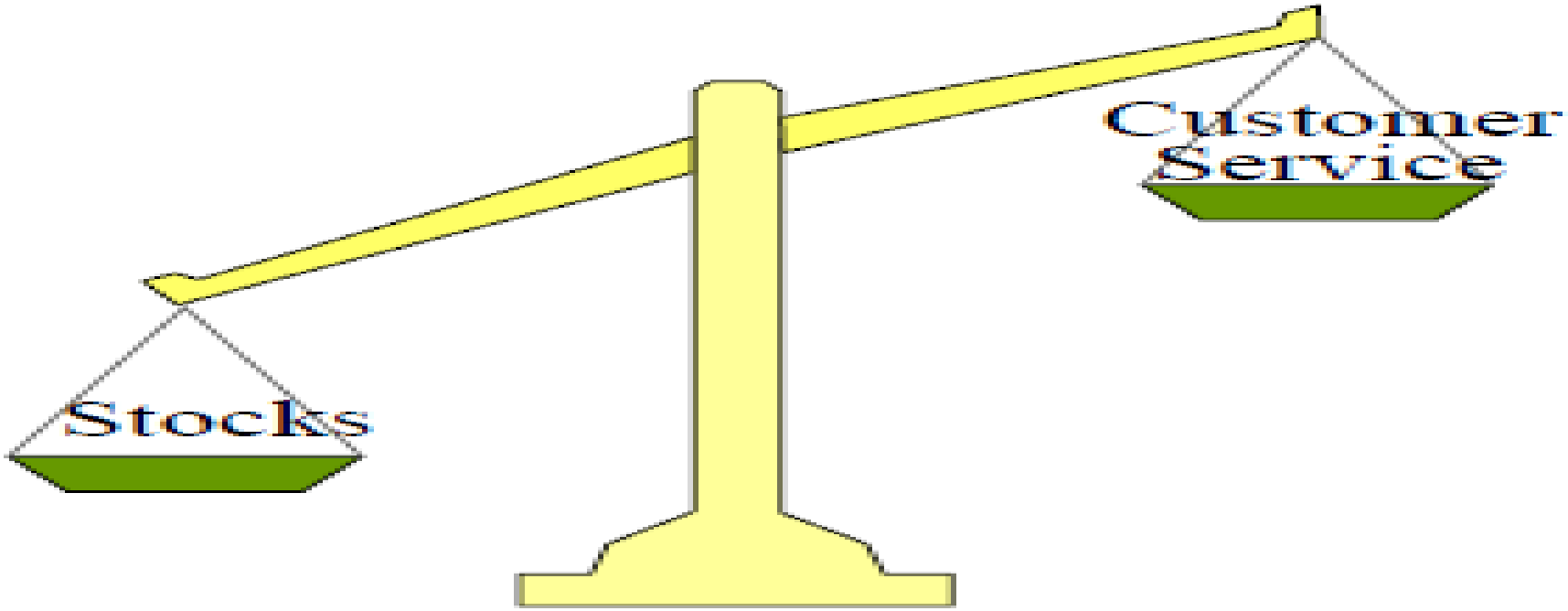


ANALYSING INVENTROY PERFORMANCE

TRIPLE PLAY CHART – EXAMPLE 2



INVENTORY MANAGEMENT IS A TIGHT BALANCE



HIGHER STOCKS WILL IMPROVE YOUR CUSTOMER SERVICES

&

LESSER STOCKS LEADS TO STOCKOUTS AND HENCE CUSTOMER SERVICE LEVEL GOES DOWN

CUSTOMER CENTRICITY

IS CUSTOMER AT THE CENTER OF SUPPLY CHAIN DESIGN???

We can sell
100

SALES

We can move
500

DISTRIBUTION

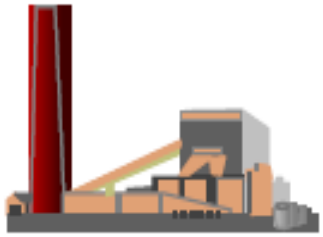
The promotion will sell
200

MARKETING

We have a budget of
400

FINANCE

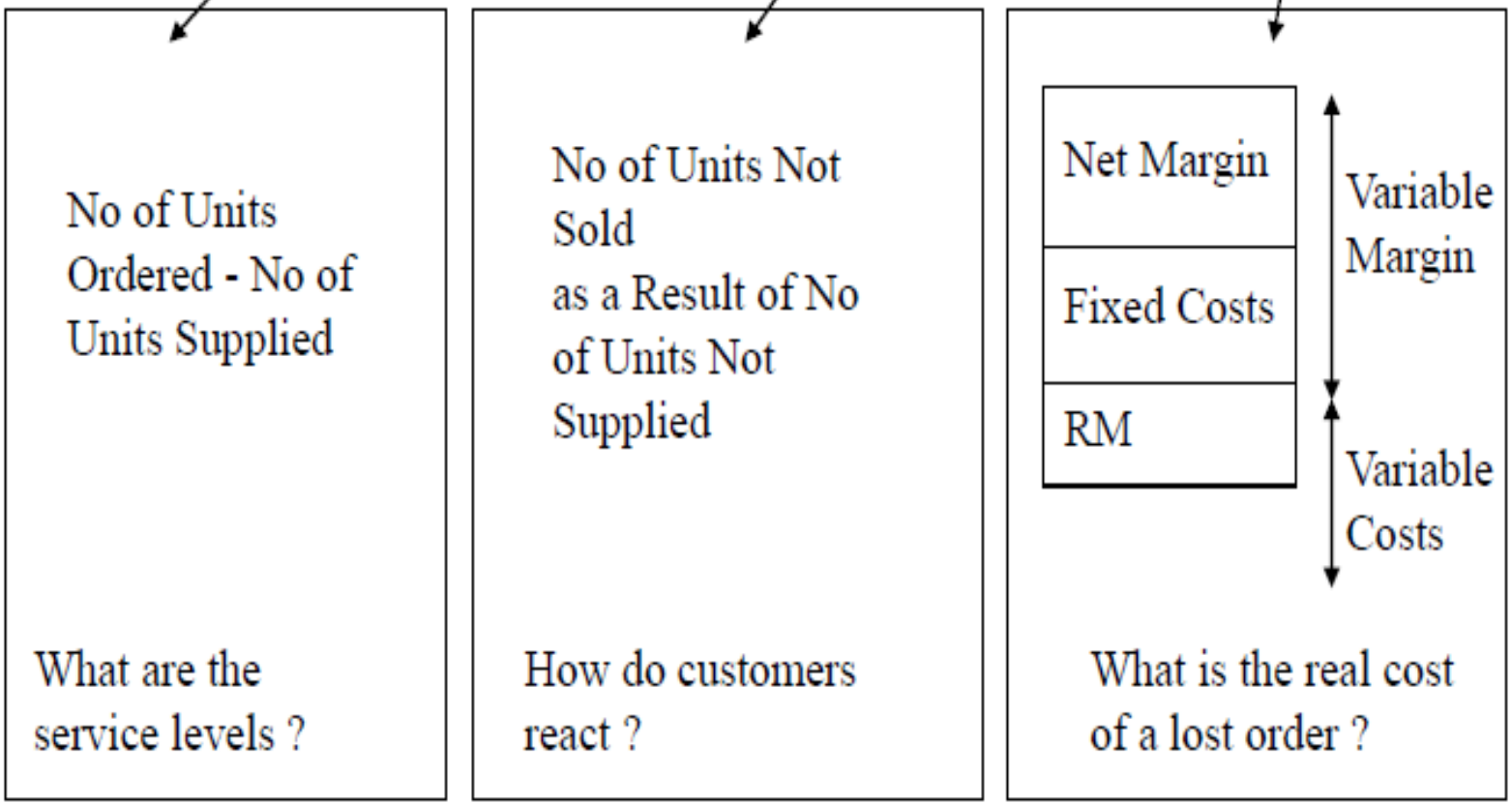
We should produce
150



PRODUCTION

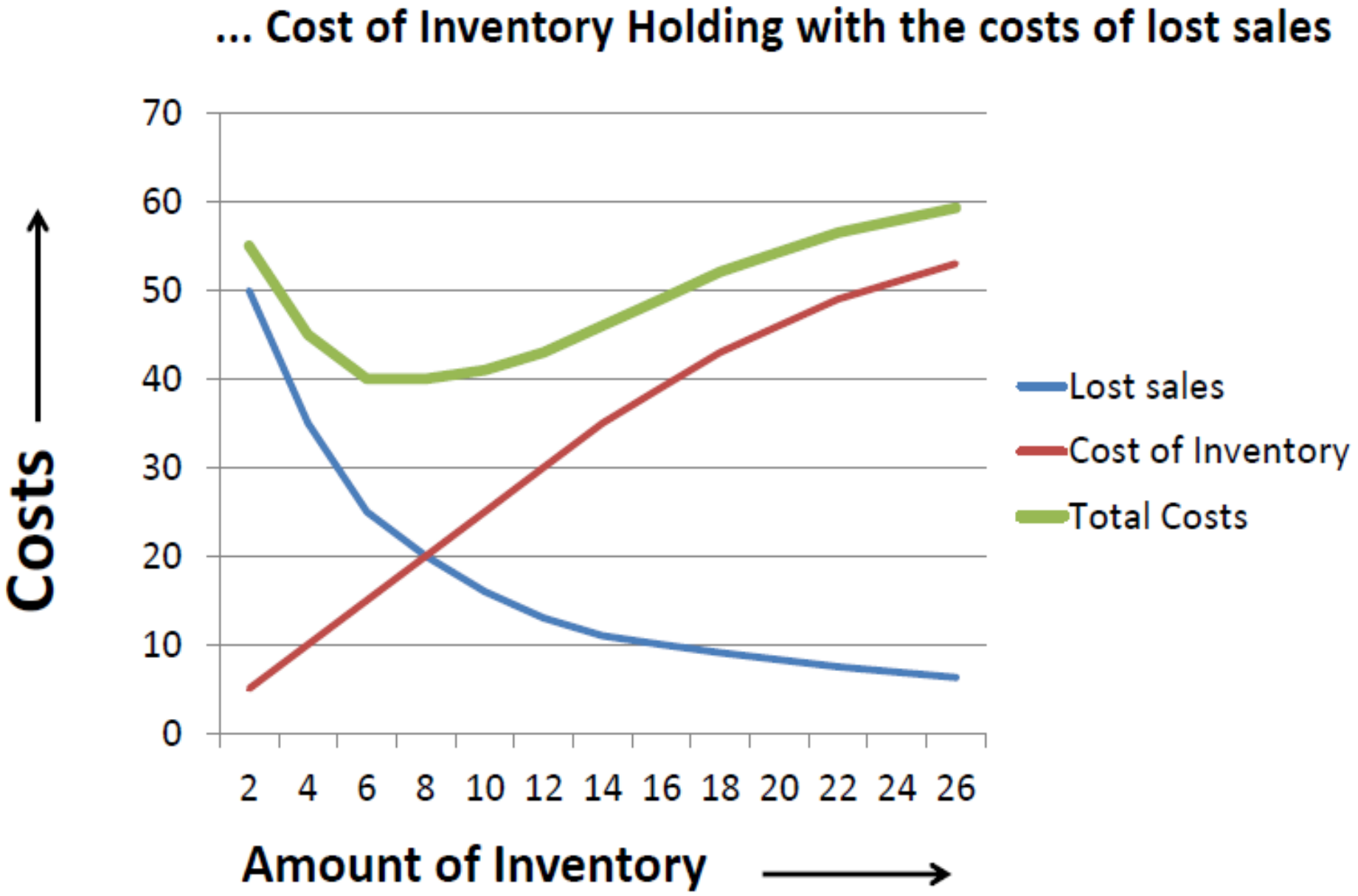
COST OF LOST SALES (COLS)

COLS = No. UNITS NOT SUPPLIED X ELASTICITY X MARGIN per UNIT



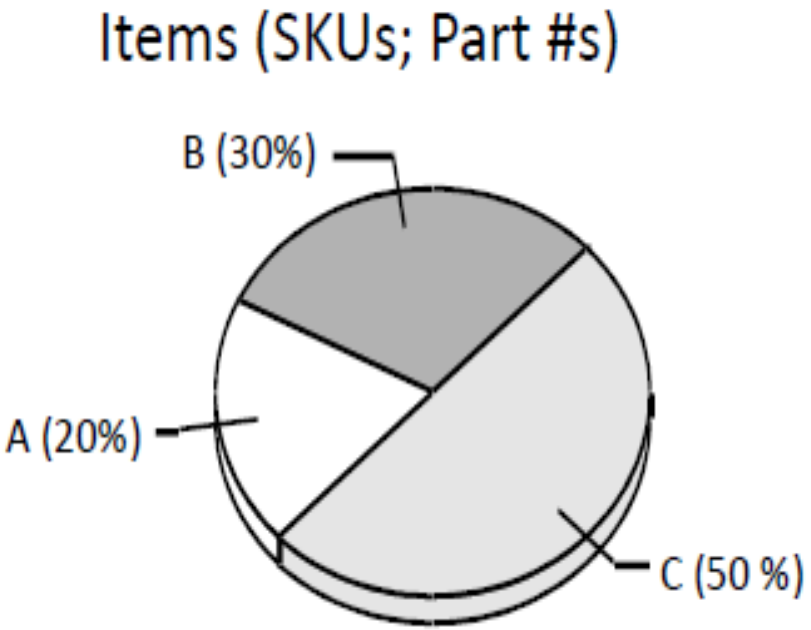
Organizations need to decide the customer service levels based on the Cost of Lost sales/ Cost of Inventory and their strategic needs

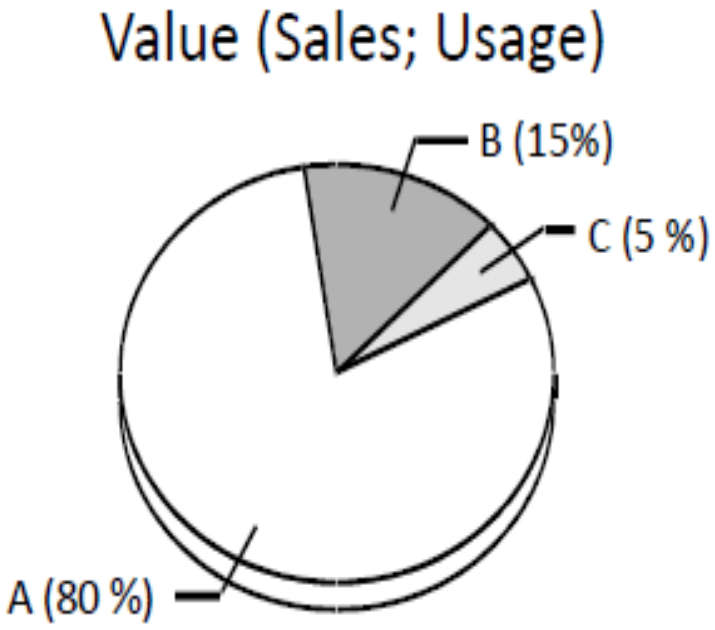
INVENTORY MANAGEMENT IS ABOUT BALANCING..



ABC Classification

ABC analysis is an application of the Pareto principle and is a simple, yet effective tool used to classify and manage inventories





	A	B	C
% of items:	20	30	50
% of value:	80	15	5

FMS/FSN Classification

- **FMS categorization is based on how frequently an item is being ordered**
  - Fast: Being used very frequently
  - Medium: Being used intermittently
  - Slow: Used very infrequently

- **This is sometimes also referred to as Runner, Repeater, Stranger**

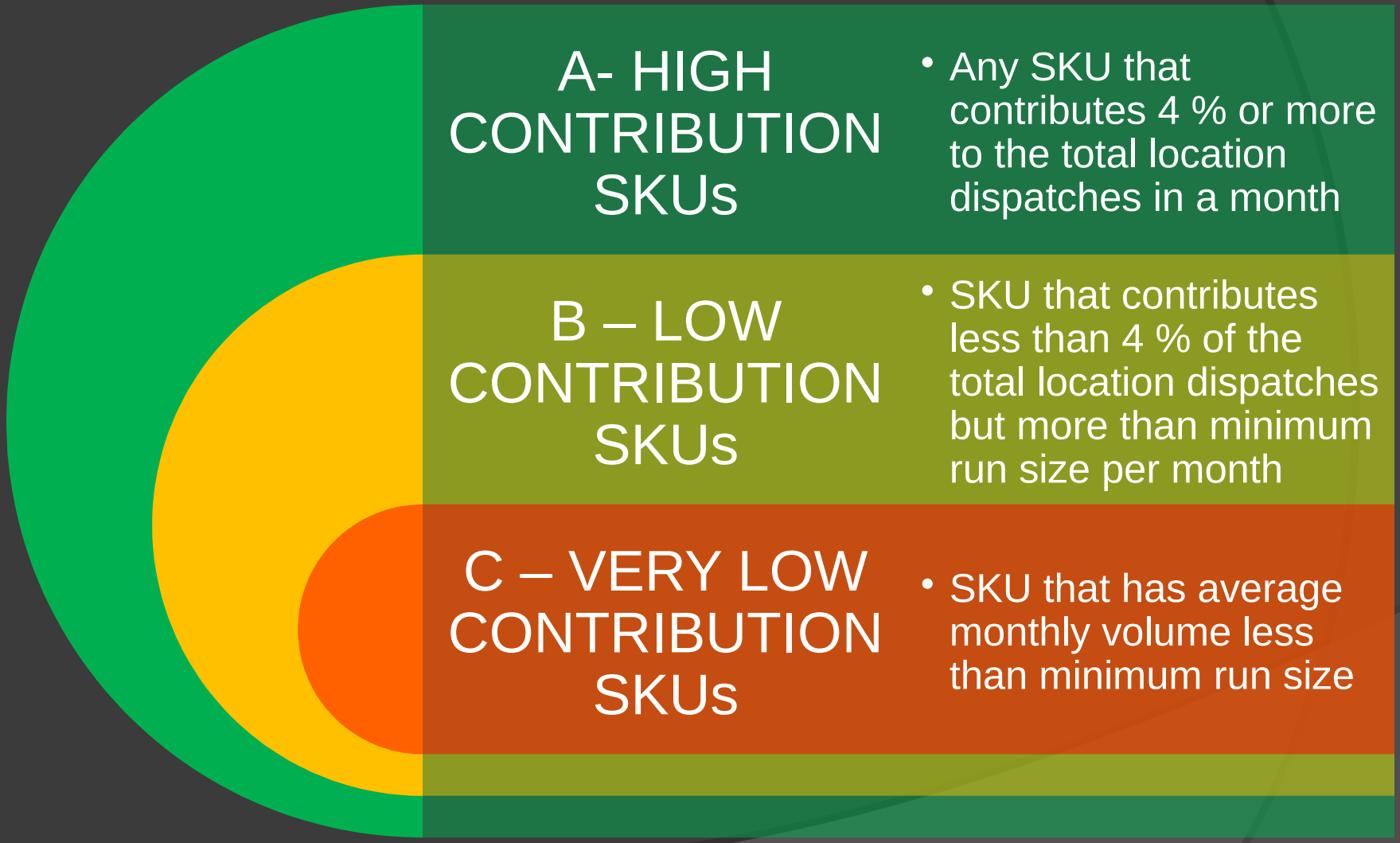
- **Sample FMS Categorization**
  - F : SKUs with more than 150 Orders/year
  - M : SKUs with more than 25 Orders/year but less than 150 Orders/Year
  - S : SKUs with more than 5 Orders/year but less than 25 Orders/Year

VED Classification

- **VED categorization is based on how critical a component is for the customer**
  - Vital: Of critical importance for the customer/production
  - Essential: Being used intermittently
  - Desirable: Used very infrequently

An example of mixed classification developed for a hospital

A mixed classification used at a foods company



INVENTORY PLANNING STRATEGIES

Multiple approaches to planning inventories are possible :

- Push based = The anticipated quantity that customers will order at some time in the future (forecast-based)
- Pull based = A quantity that equals the difference between a fixed target inventory and current inventory (replenishment-based)
- Make-to-order = The exact quantity the customer orders to be made after the customer order

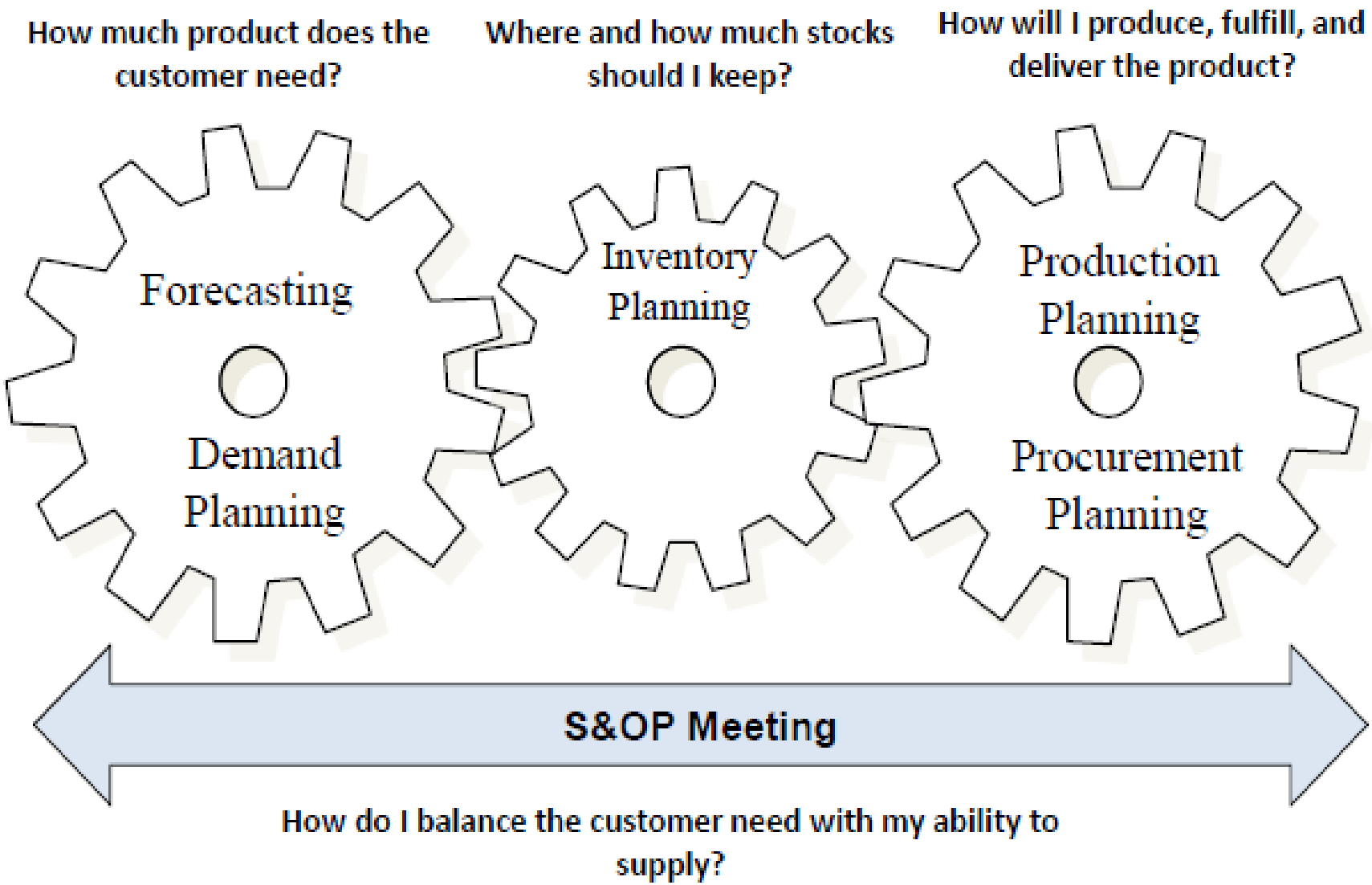
While a Pull based strategy is more customer centric and preferred for in-factory (or nearby) operations, Forecast based planning is needed for scenarios with long lead times and/or intermittent supplies (due to lot sizing/truck load building).

3 levels of planning

- Annual/Quarterly
- Monthly/Weekly
- Weekly/Daily

- What decisions should each of these drives?

Key components of Integrated Supply Chain Planning



Building Blocks of Planning Process

Planning Horizon

- The complete period for which the planning is being done. Typically determined by the longest production/procurement lead time.

Planning Bucket

- Planning bucket is the smallest period for which forecast/demand is being estimated. This should ideally remain same across the supply chain.

Planning Product

- The lower most product entity that is being planned for. Typically, Annual / quarterly planning can be done at higher levels. For execution the last level of details are required

Sources of Demand

- Quite often demands from different sources needs to be treated differently. E.g sales channels, geographies, Emergency/normal needs

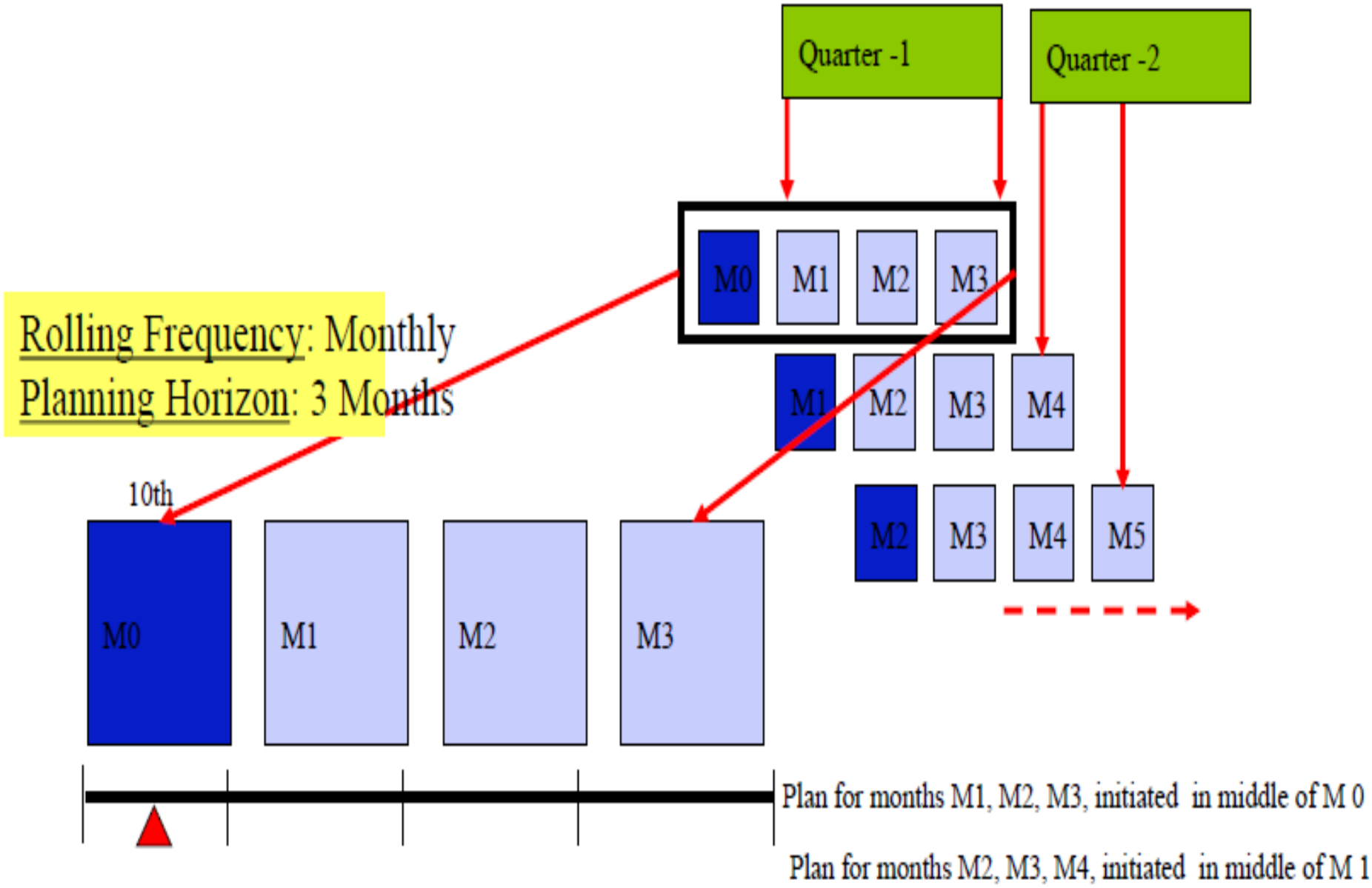
GRANULARITY – WHAT IS THE BEST PLANNING GRANULARITY?

Product Categorization	
Product Line	Widgets
Product Category	Premium Widgets
Product Sub Category	Customizable Widgets
Model	Widget 1

Location Categorization	
Nation	India
Region	Region-1
Warehouse	Pune
SBU	SBU 8
Area	Mumbai I
Sales Office	Andheri

Time Bucket
Year (s)
Quarter
Month
Fortnight
Ten Day
Week

A ROLLING PLAN



THE NEWSPAAPER BOY PROBLEM

FORECASTING

If you forecast, you can be wrong.

But, if you do not forecast, you will always be wrong

WHERE DO WE USE FORECASTS?

LEVEL OF FORECAST	TYPICAL PURPOSE
Five – Year Forecast	Strategic Planning Long Range Planning
Annual Forecasts	Brand marketing plans Cash planning, revenues, profits, interest rates Sales territory sizing and quota Manpower planning Short term capacity planning
Monthly Forecasts	Production planning Purchasing
Weekly Forecasts	Production scheduling Procurement, production and inventory Deployment

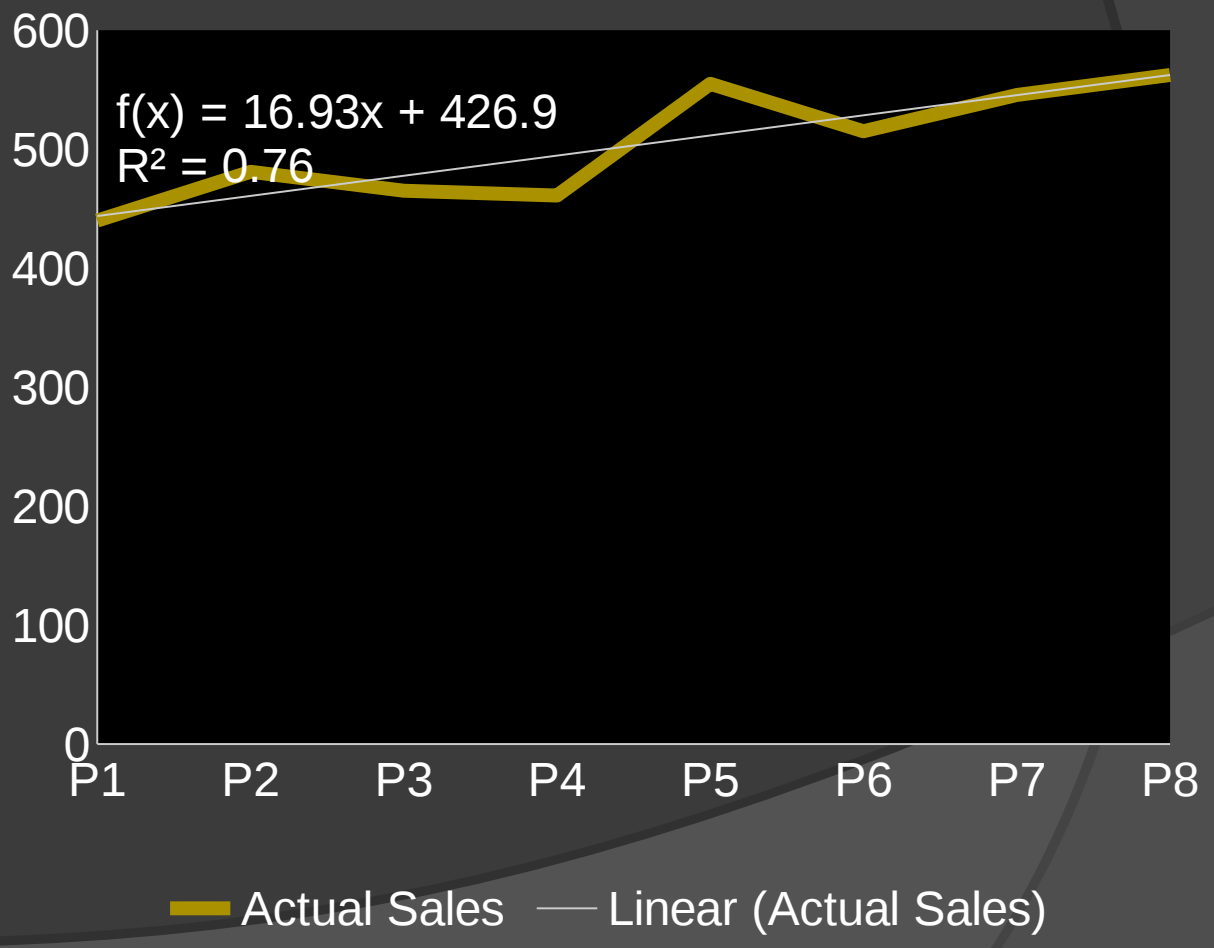
OPERATION FORECASTING

FORECASTING TECHNIQUES

1. TIME SERIES
2. CASUAL METHODS
3. QUALITATIVE METHODS

Forecasting Techniques — Time Series

SKU	
Period	Actual Sales
P1	440
P2	481
P3	465
P4	461
P5	555
P6	515
P7	545
P8	562



MOVING AVERAGES METHOD

- Moving average of last ‘x’ observations used to forecast for the next period

- Two types of moving average methods
  - Simple moving average
  - Weighted moving average

- Frequently used, due to Ease-of-use
  - Results however are not very reliable
  - Provides good results in stationary conditions; Poor ability to forecast under pattern change conditions
  - Lags in case of trend

INVENTORY MODELS

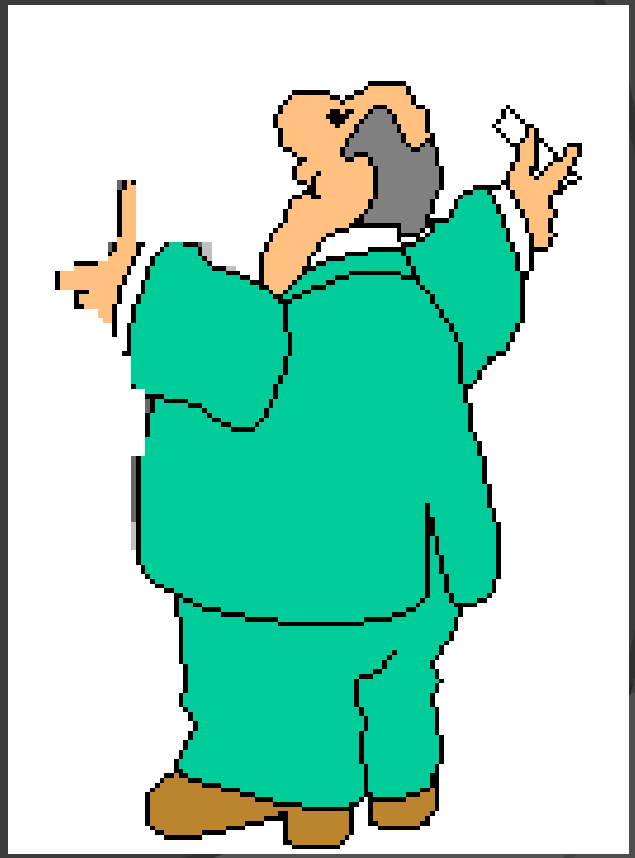
- Deterministic models
  - The Economic Order Quantity (EOQ) model
  - Sensitivity analysis
  - A price-break Model
- Probabilistic Inventory models
  - Single-period inventory models
  - A fixed order quantity model
  - A fixed time period model

Inventory Decision Issues

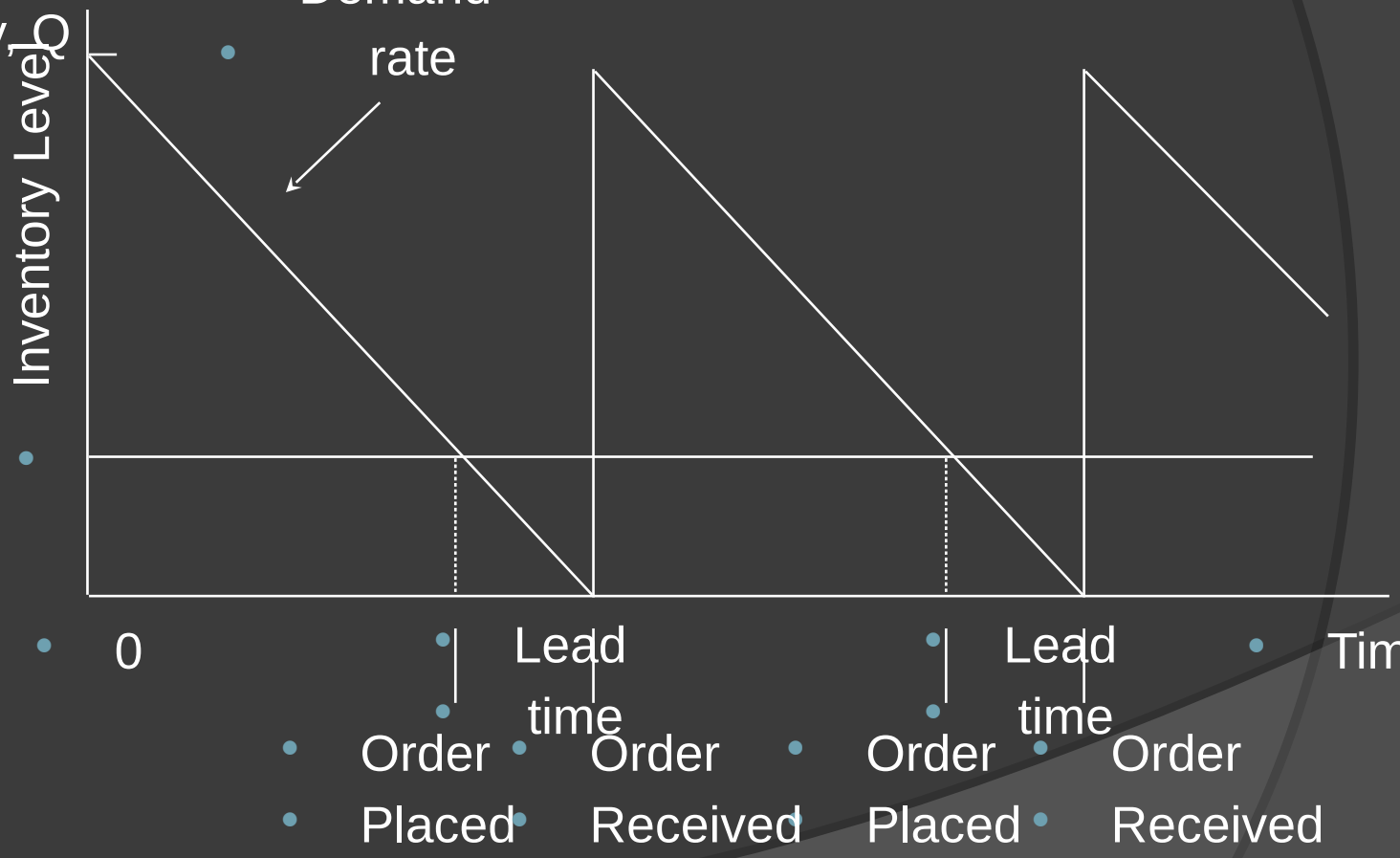
- Demand of various items
- Money tied up in the inventory
- Cost of storage space
- Insurance expense - risk of fire, theft, damage
- Order processing costs
- Loss of profit due to stock outs

Inventory Decision Questions

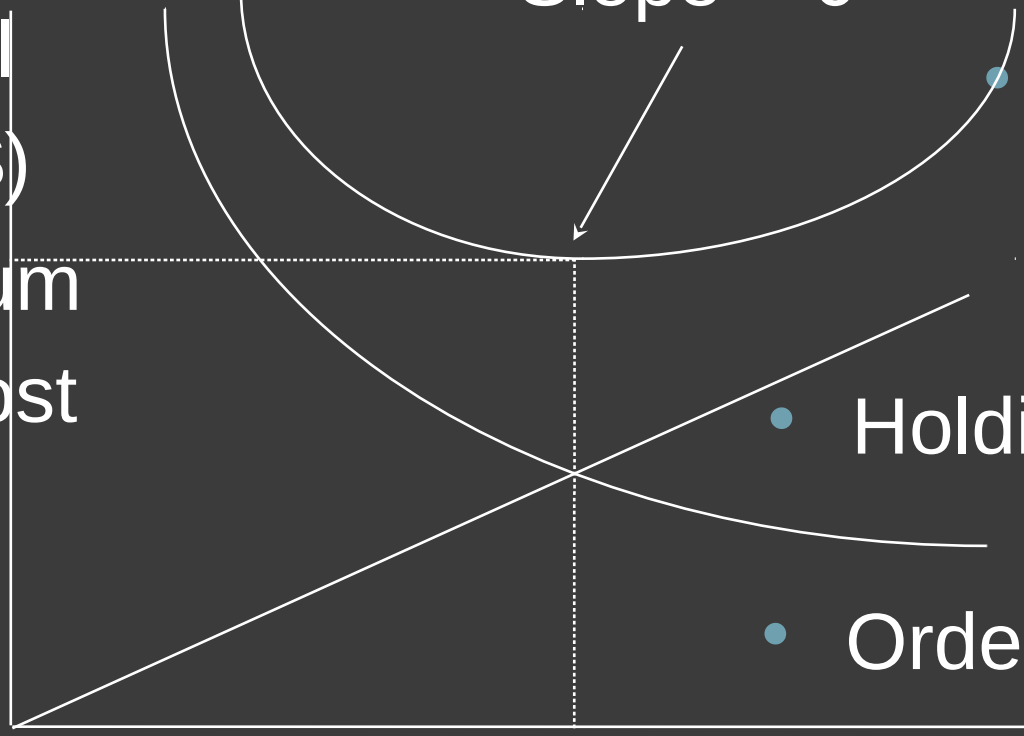
How Much?
When?



THE EOQ MODEL



The EOQ Model Cost Curves



- Annual
- cost ($)
- Minimum
- total cost

- Slope = 0
- Total Cost
- Holding Cost = HQ/2
- Ordering Cost = SD/
- Optimal order Q^*
- Order Quantity, Q

EOQ Cost Model

D - annual demand

Q - order quantity

S - cost of placing order

H - annual per-unit holding cost

$$Q^* = \sqrt{\frac{2DS}{H}}$$

Ordering cost = SD/Q

Holding cost = HQ/2

Total cost = SD/Q + HQ/2

Example

Example 1: R & B beverage company has a soft drink product that has a constant annual demand rate of 3600 cases. A case of the soft drink costs R & B $3. Ordering costs are $20 per order and holding costs are 25% of the value of the inventory. R & B has 250 working days per year, and the lead time is 5 days. Identify the following aspects of the inventory policy:

Calculate

a. Economic order quantity

b. Reorder point

c. Total annual cost

THANK YOU