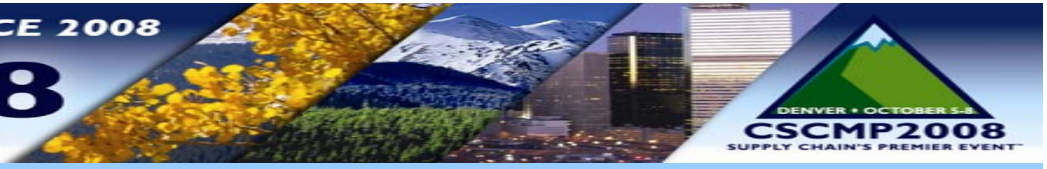
Beyond Pareto:

12 Standard Principles of Inventory and Forecasting

Thomas L. Freese, Principal
Freese & Associates, Inc.

CSCMP Council of Supply Chain Management Professionals

Freese & Associates, Inc.



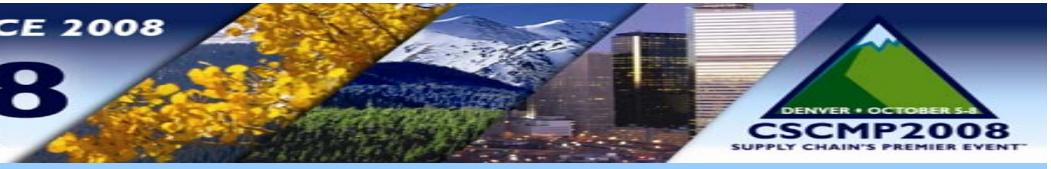
Twelve Steps

- Inventory
- Carrying costs
- Concepts
- Make-to-order or stock
- A B C
- Accuracy
- Cycle counting
- Reordering
- Valuation
- Safety stocks
- Demand Variability
- Inventory Reduction

Pareto Principle "the 80:20 rule"

- **"A minority of input produces the majority of results."**
- Vilfredo Pareto was an Italian economist who, in the early 20th century, studied the distribution of wealth in a variety of countries.
- The 80:20 rule originated when he discovered a common phenomenon: about 80% of the wealth in most countries was controlled by a consistent minority -- about 20% of the people. Pareto called this a "predictable imbalance." His observation eventually became known as either the "80:20 rule" or "Pareto's Principle".
- The 80:20 rule has been expanded far since it's first economic use. While one might quibble about the 80% or 20% (it is sometimes 60:40 or 90:10) the insight is broadly applied to leadership and management.
- The "80:20 rule" has become one of the best known "leadership shorthand terms" reflecting the notion that most of the results (of a life, of a program, of a financial campaign) come from a minority.

Inventory: The Asset No One Wants!



Inventory Management

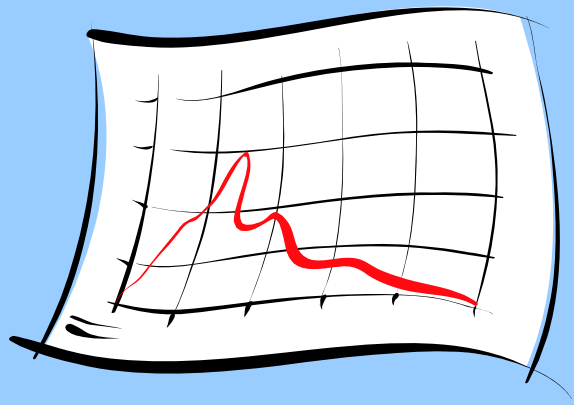
- Inventory and its Purpose
- Push & Pull Models
- Inventory Classifications
- Customer Service & Safety Stocks
- Inventory Carrying Costs
- Economic Order Quantities
- Dupont Model
- Postponement

Things Happen Planning Helps

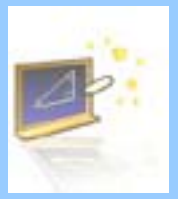
Dupont Model

Inventories impact financial performance in at least two ways: 1.) net profit margin and 2.) return on assets or return on investment

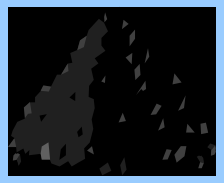
- Net Profit
- Asset Turnover
- Return On Assets
- Financial Leverage
- Return on Equity



EOQ
Economic Order Quantity

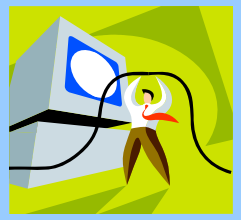

EOQ


identifies


Order Qty

By defining

+



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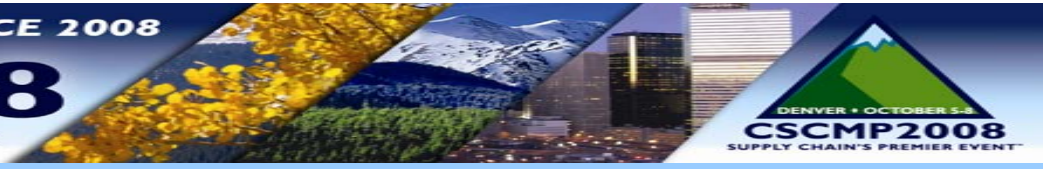
= the lowest total cost

Economic Order Quantity

$$EOQ = \sqrt{\frac{2PD}{CV}}$$

Where:

P = Cost of placing an order (total ordering & receiving costs)
D = Annual demand
C = Total inventory carrying costs as a %
V = Cost of a unit of inventory



Inventory Carrying Costs

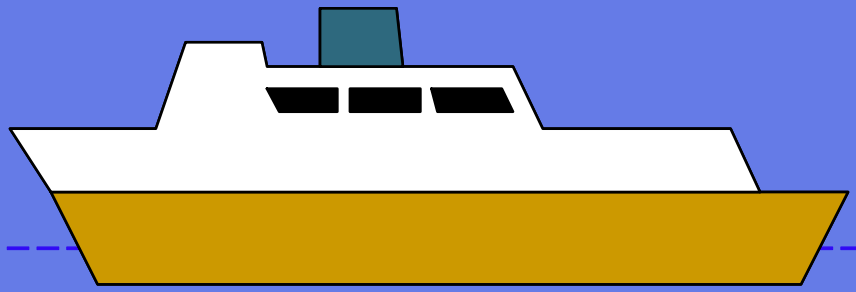
Inventory Carrying Cost Category

- Capital Costs
- Storage Space Costs
- Inventory Service Costs
- Inventory Risk Costs

Inventory Carrying Cost Components

- Inventory investment
- Warehouses
- Plant Warehouses
- Field Warehouses
- Other Warehousing
- Insurance
- Liability
- Obsolescence
- Damage
- Shrinkage
- Relocation Costs

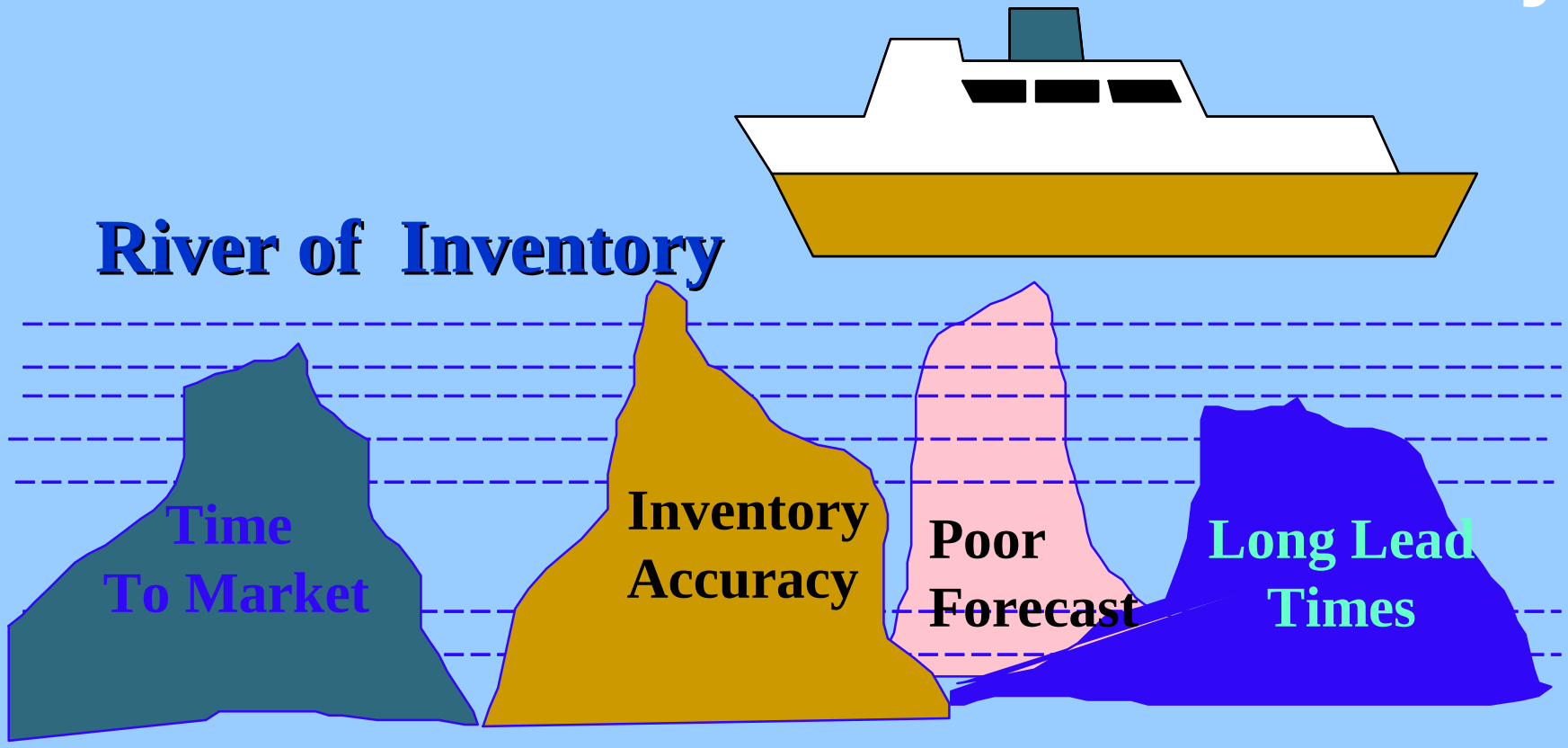
The River of Inventory



A Business Utilizes a River of Inventory

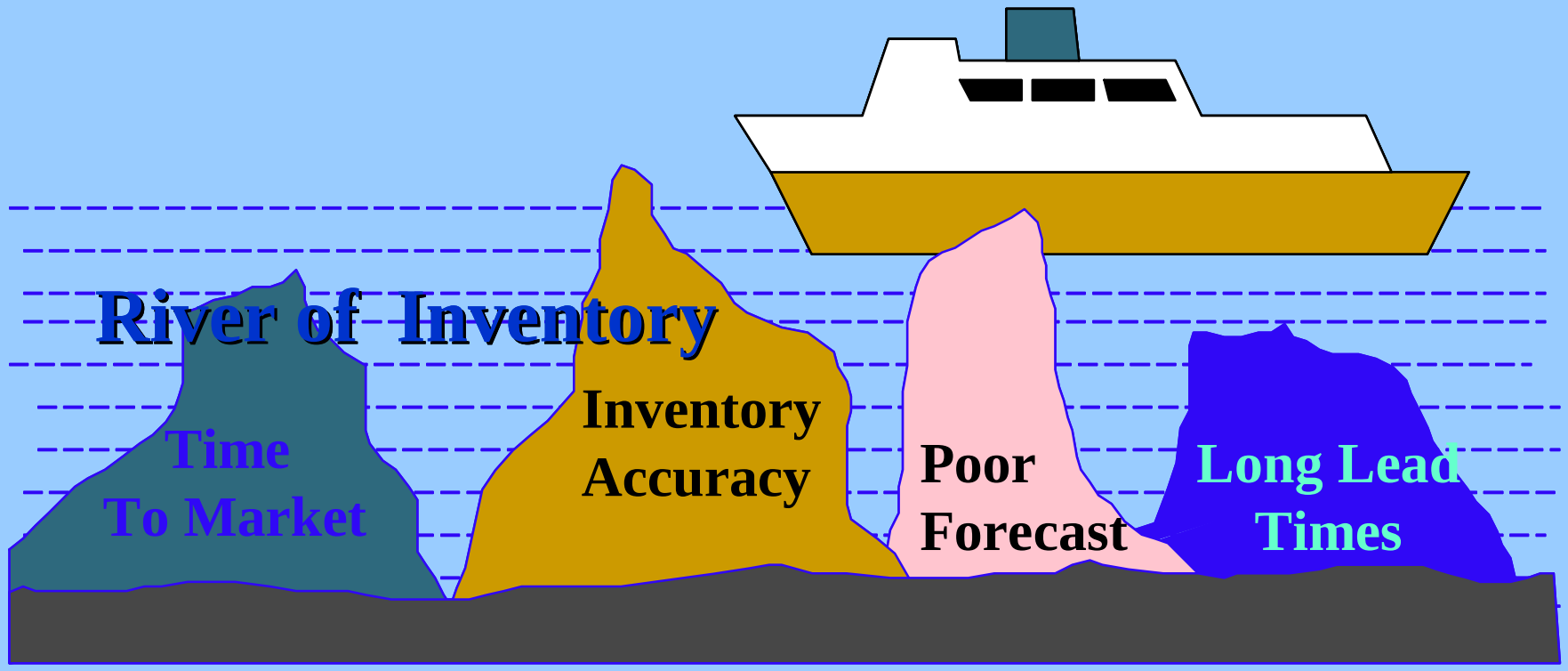
It's Depth Will Depend Upon Your Views.

How A Business Utilizes Inventory



One approach: use inventory to hide the problems……

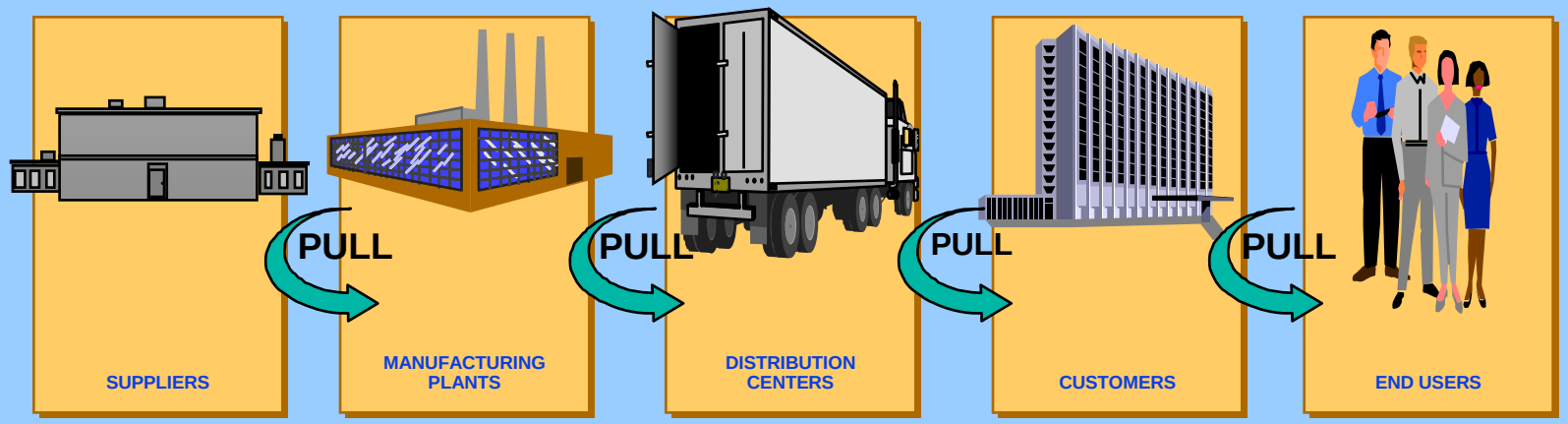
How A Business Utilizes Inventory



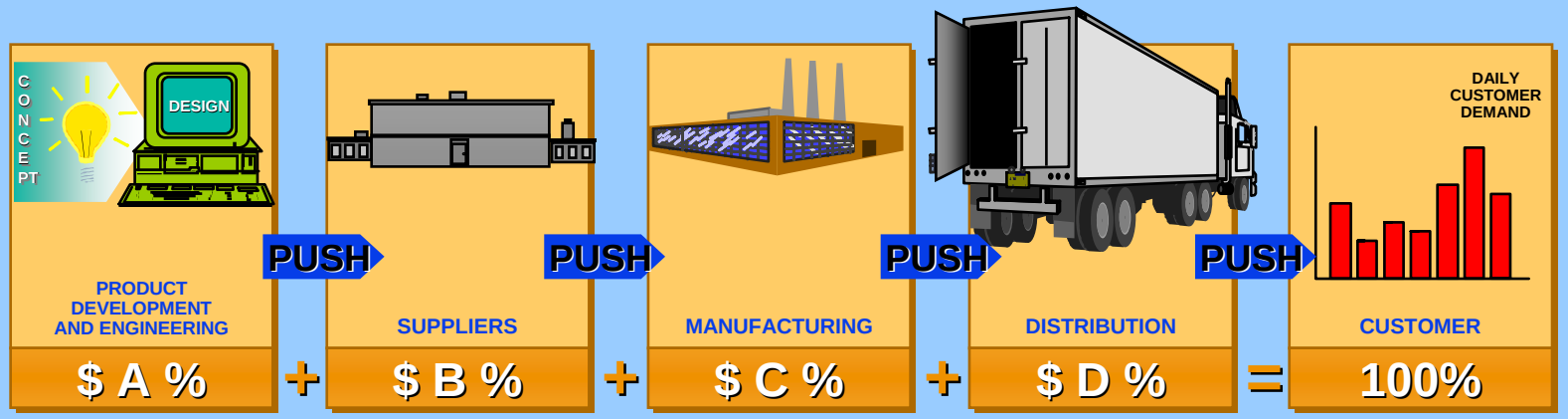
Keep inventory low so that the problems can be identified and solved.

Pull Inventory

Pull inventory systems "Draw" products through the supply chain elements.



Push Inventory



Push inventory systems "FORCE" products through the supply chain.

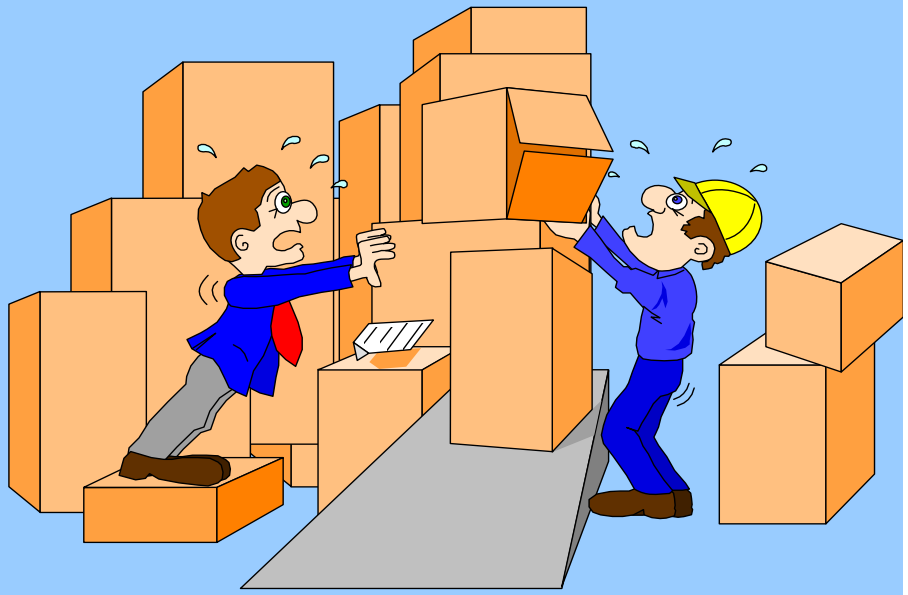
Postponement

- Dell Computer
- Bright Stocks
- Custom Blending
- Mass Customization

Stock Comes In Many Types

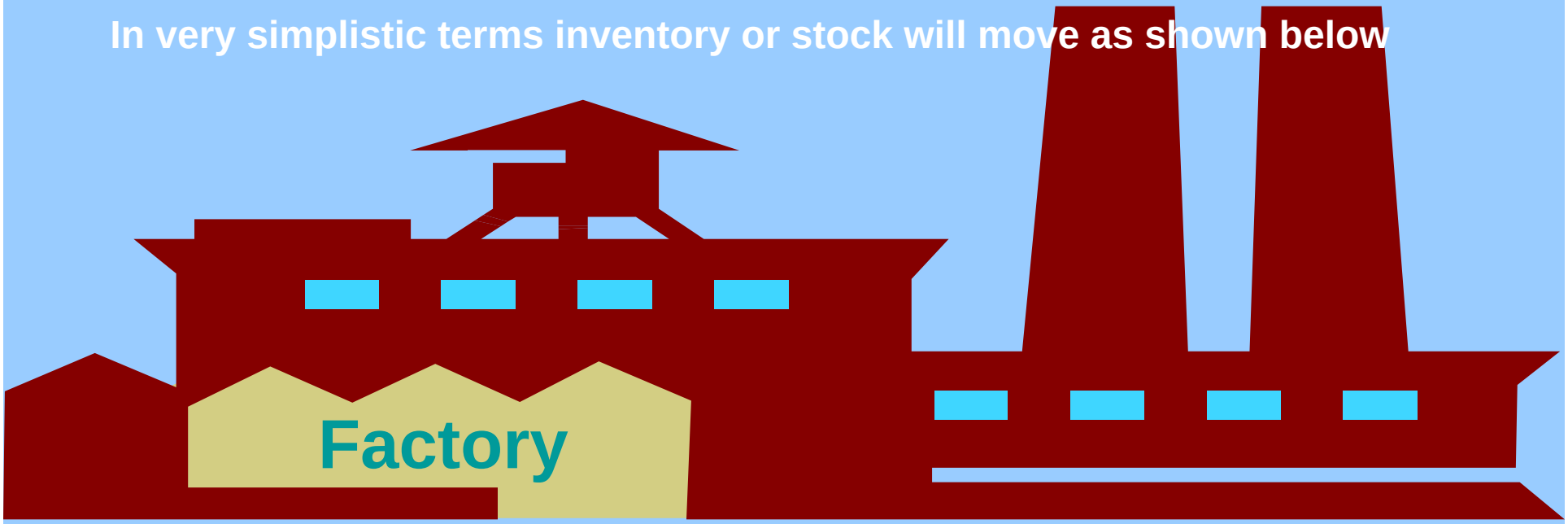
In its simplest form inventory can be considered as

Finished Goods



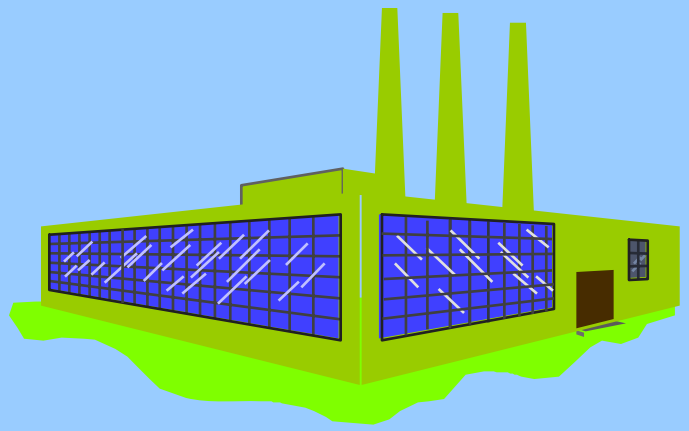
Stock Movements

In very simplistic terms inventory or stock will move as shown below



Supplier → **Raw Material** → **Work in Progress** → **Finished Goods** → **Customer**

Make To Order Or Stock

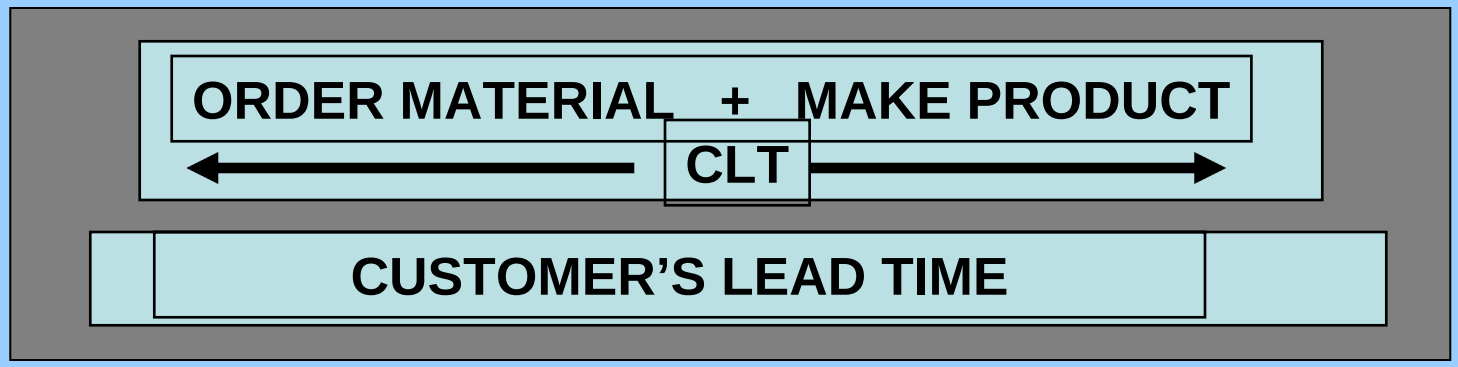


Companies that 'make-to-order'

Companies that 'make-for-stock'

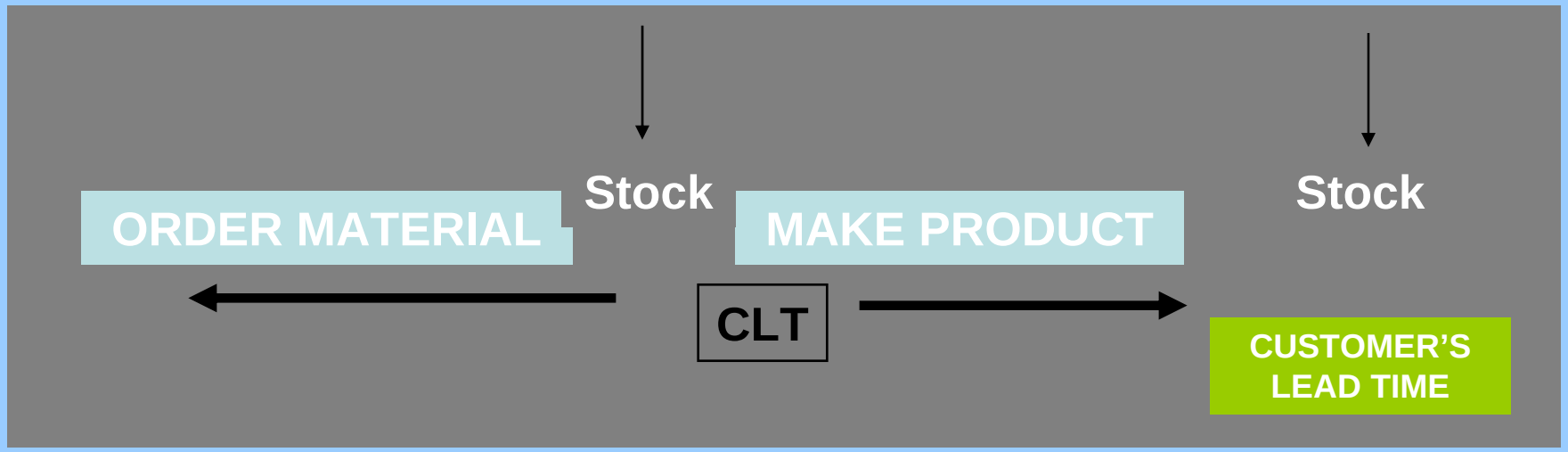
Make-To-Order

In make-to-order it is important that the time it takes to order the material and make the product (CLT = Cumulative Lead Time) must be less than the customer's lead time.

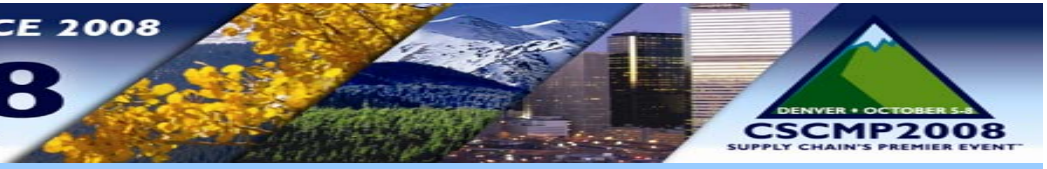


A make-to-order product is not made until customer orders it

Make-to-Stock



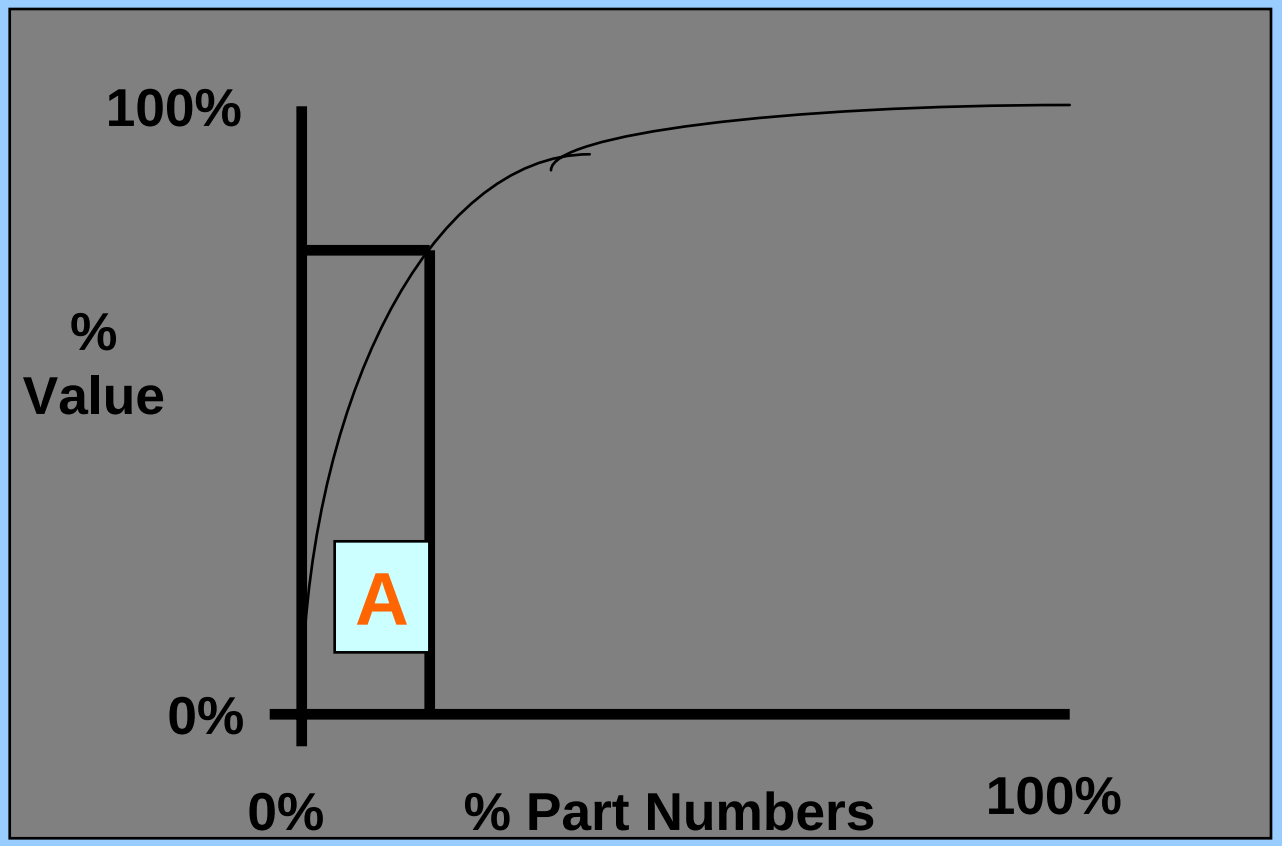
In make-to-stock, stock is produced in anticipation of orders.



ABC Classification

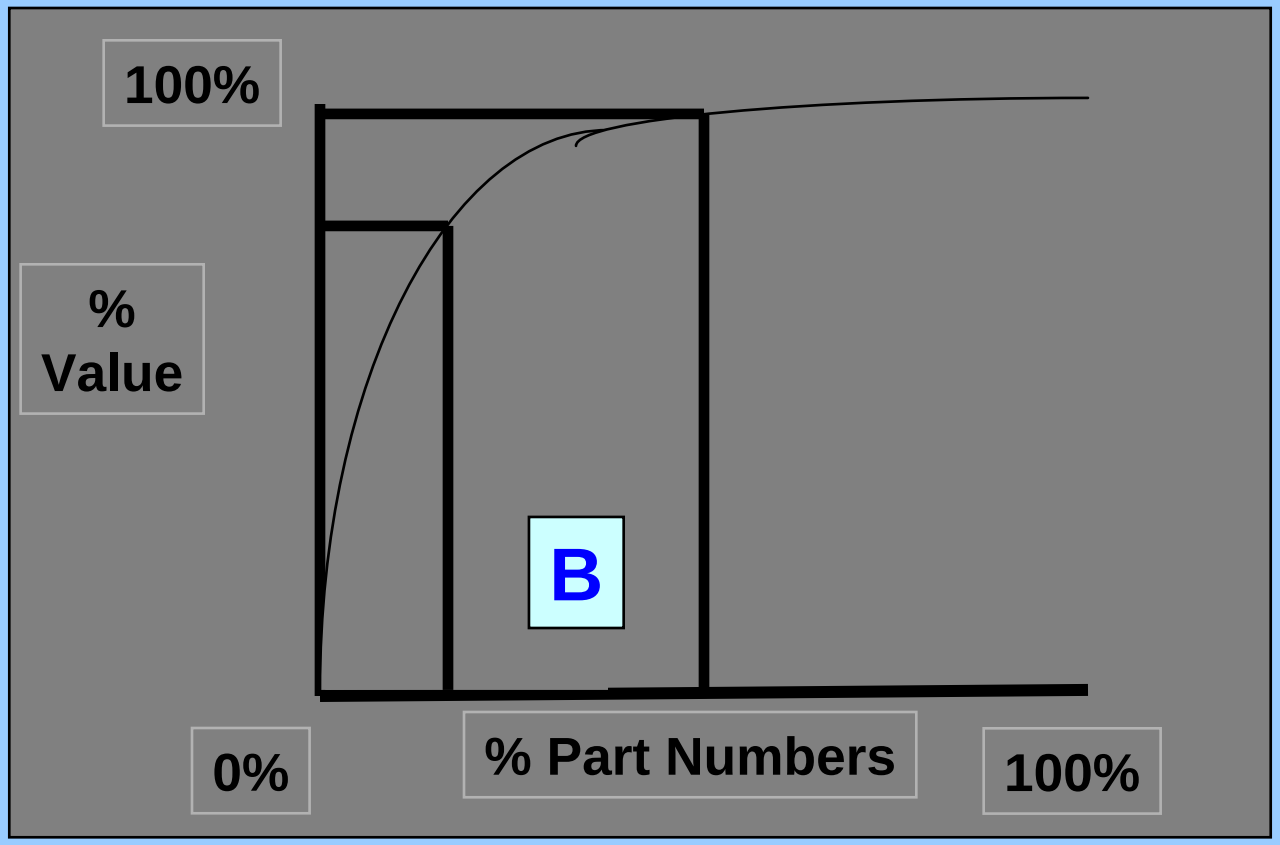
- In any business some parts will have a higher value than others and some parts will have a higher usage than others
- By multiplying the expected annual usage by the value you can determine the total financial impact of each item
- If all parts are then ranked in the order of this value an interesting fact emerges
- A few parts will represent the majority of the total annual revenue, cost, investment, etc.

ABC Classification



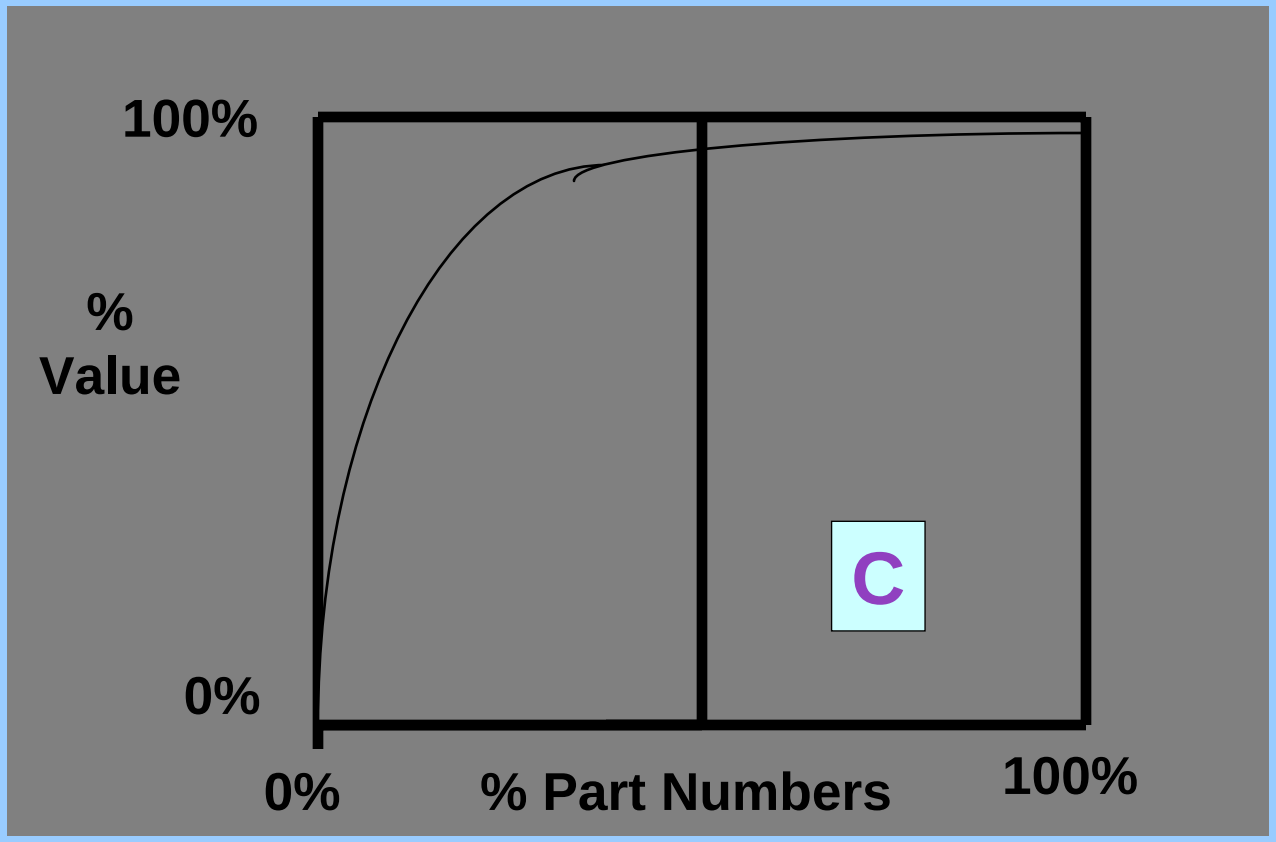
About 12.5%of parts are Class A items contributing about 70% of the total value

ABC Classification

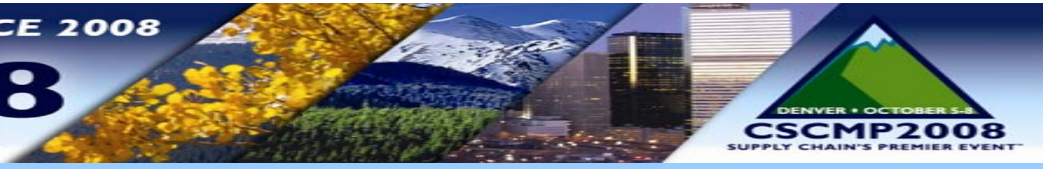


About 37.5% of parts are Class B items contributing about 25% of the total value

ABC Classification

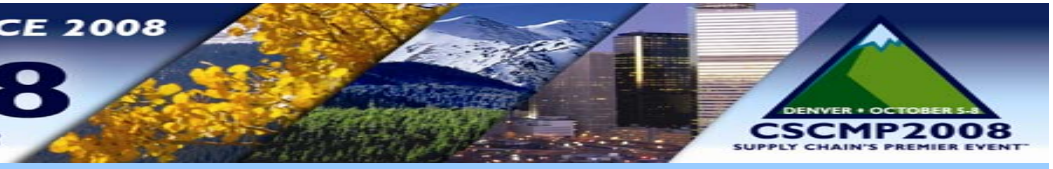


About 50% of parts are Class C items contributing about 5% of the total value



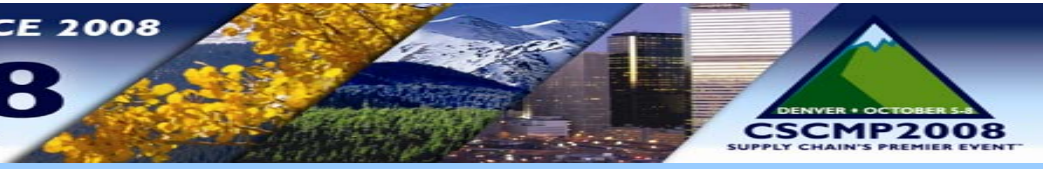
Different Classifications Different Controls

- Class A items MUST be controlled with the utmost care
- Class B items can be controlled carefully but with broader rules
- Class C items warrant the least amount of attention



Importance of Accuracy

Inadequate inventory accuracy is the most frequent cause of implementation failures for formal planning and *operating systems*.



Operating Perspective

"Inventory Accuracy is the Lifeblood of any Formal Planning System"

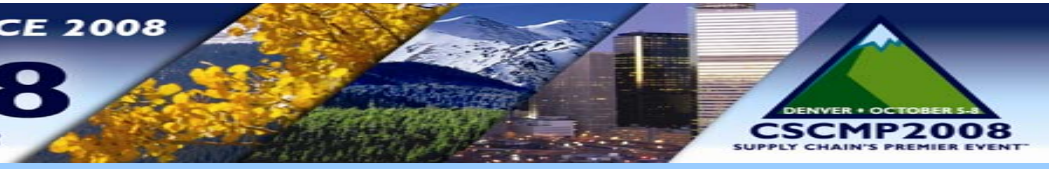
Formal

- Proactive
- Integrated
- Structured Plans & Schedules
- Data Intensive
- Disciplined
- Rational

Informal

- Reactive
- Compartmentalized
- Hot Lists & Shortage Lists
- Expedite Intensive
- Assumes Inaccuracies
- Emotional

Bean Counters



What is Inventory Accuracy?

Recorded Inventory Quantity = **Physical Inventory Quantity**

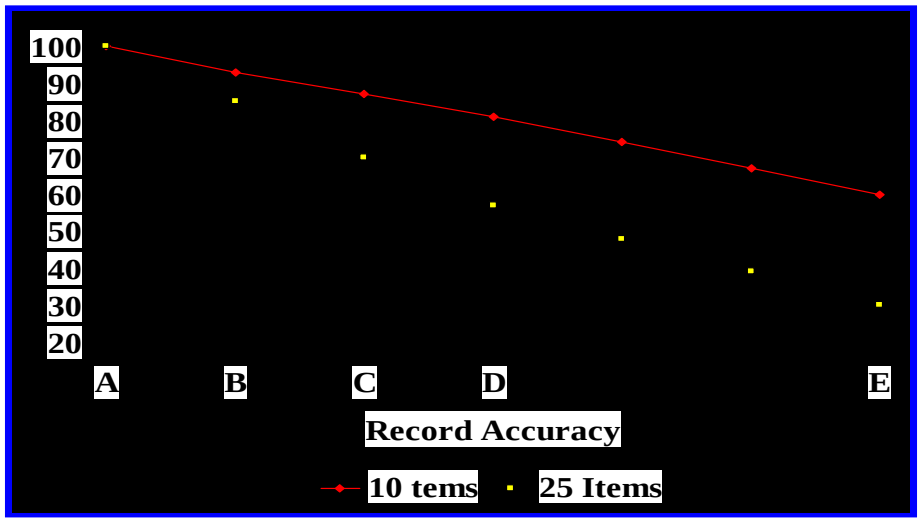
Financially acceptable results ***do not*** necessarily equal acceptable levels of inventory accuracy.

Inventory Accuracy focuses on item quantities while financial accuracy focuses on "average" monetary value.

Loss	$3,000,000
Gain	$3,000,000
Net	$ 0

Why is 99+% Accuracy Required?

Cumulative Probability of Full Availability



A=100%, B=99%, C=97.5%, D=95%, E=90%

Cumulative Probability Of Filling an Order

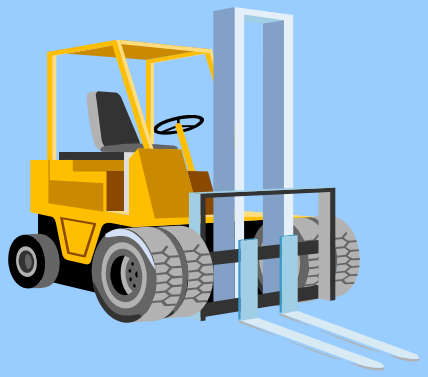
	Inventory Accuracy			
Items	90%	95%	98%	99%
5	77%	88%	94%	98%
10	60%	78%	88%	95%
15	46%	68%	83%	93%
20	36%	60%	78%	90%

Keys to Accuracy

Automatic Data Capture

Real-Time Inventory

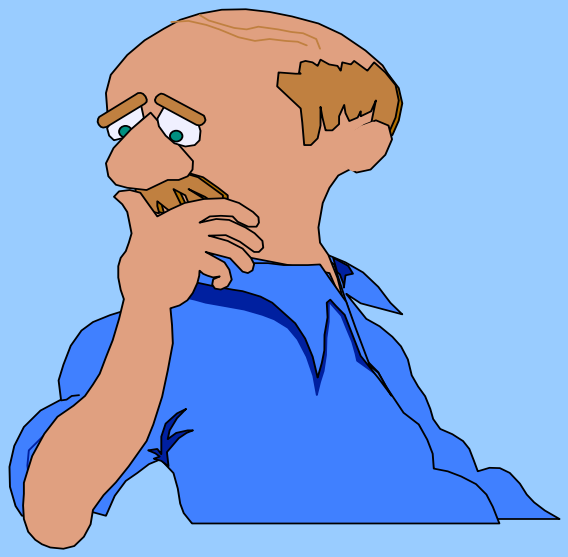
Item Master



Receiving

Operational inventory discipline

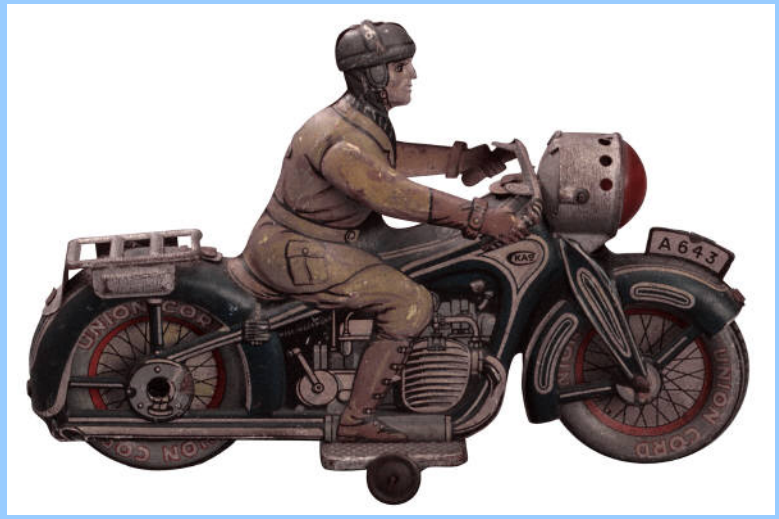
If There Are Major Difficulties Associated With The Annual Audit



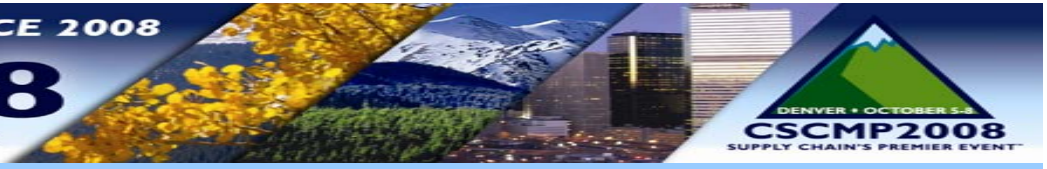
What's the alternative?

A Perpetual Audit

This can be achieved using a technique known as cycle counting

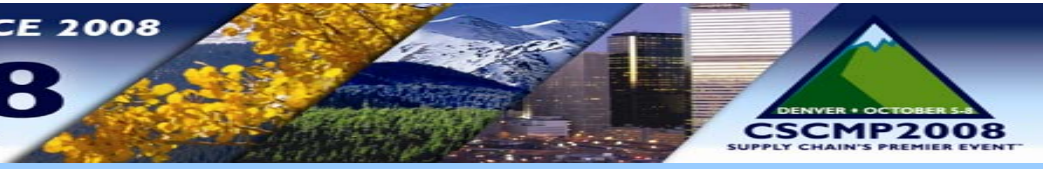


"A physical inventory technique where inventory is counted on a periodic schedule rather than once a year." – *APICS dictionary*



Benefits of Cycle Counting

- *There is no disruption to production during the stock check as it can be carried out quickly and during the quiet times of the day*
- *It's considerably more accurate*
- *Results are obtained much quicker*
- *Important items are checked more regularly - once a year is not enough!*



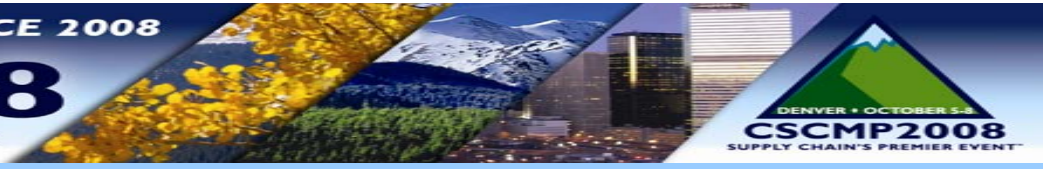
Frequency

"A" items = six times per year
"B" items = twice per year
"C" items = once per year

The mathematical formula for determining the frequency of cycle counting is:

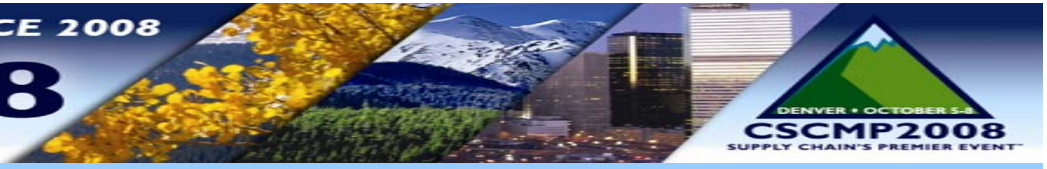
$$RCL = (1-ALD) / (ALD*Pv)$$

Where: RCL = required cycle time in weeks
ALD = accuracy level desired (e.g., 99%)
Pv = probability of a variance occurring in a given week.



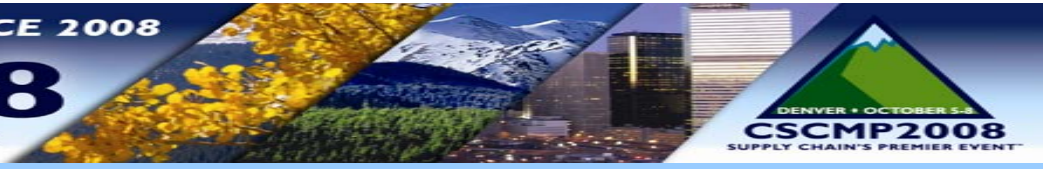
The Purpose Of Cycle Counting

- *Primarily to audit the stock and amend records to reflect the true position*
- *But also to identify why errors have occurred*
- *And to ensure that future stock keeping practices are improved*



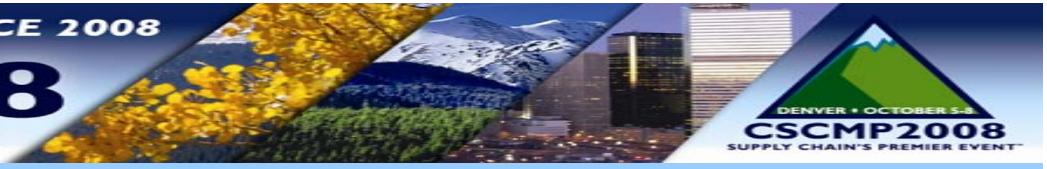
What It Is & What It Isn't

- *Cycle counting is a measurement tool.*
- *Cycle counting is **not** a comprehensive inventory accuracy program.*
- *Cycle counting will **not** eliminate the factors which cause inventory record errors.*
- *Cycle counting with corrective action can drastically improve inventory accuracy*



How -To And When

- *Cycle count during non-operational shifts if possible*
- *Cycle count at the end of activities - transactions after the start of a count can not be posted until after the count period*
- *Suspend activity of those items being counted until after the count is complete*
- *Cycle counts should be made as blind counts*
- *Cycle count teams should not be the same personnel responsible for the accuracy of the inventories being counted*
- *Recounts and inventory investigations should be conducted by independent personnel*

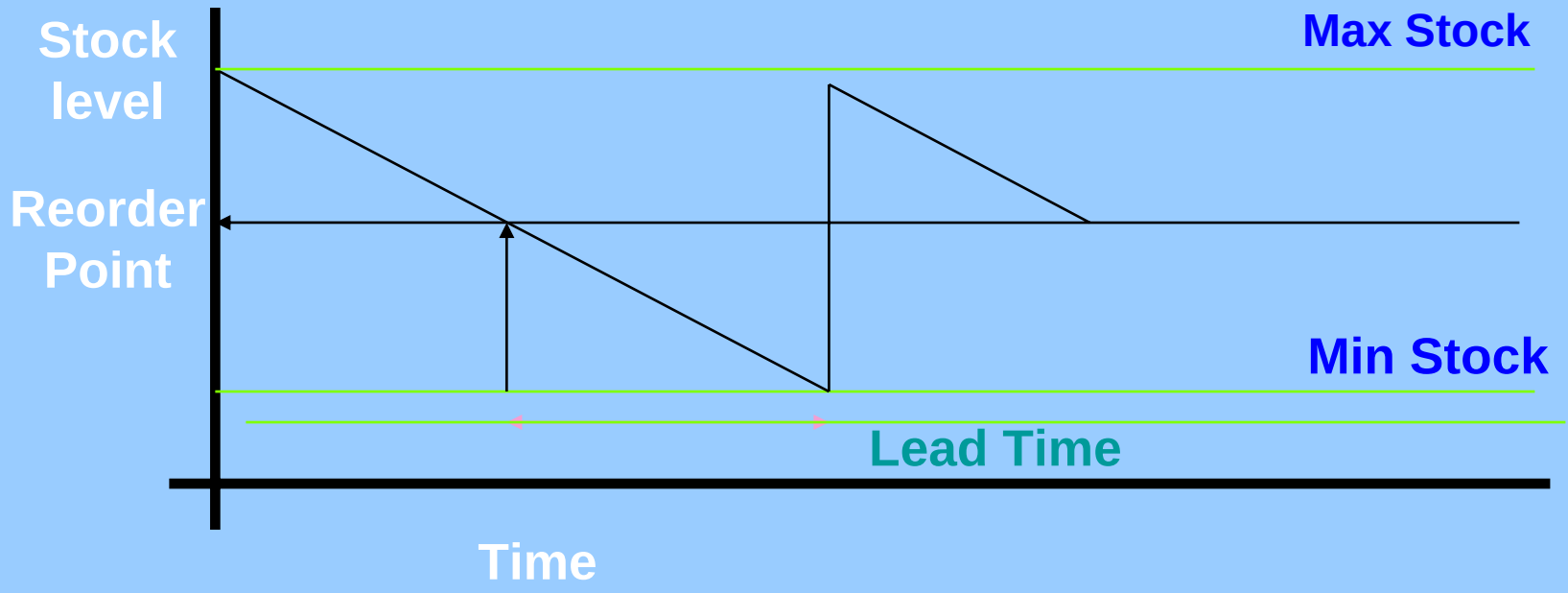


Reordering

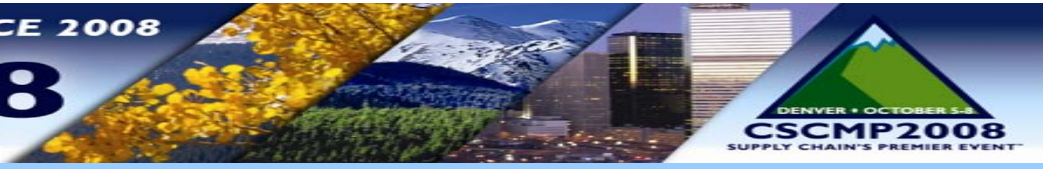
Factors to consider

- The minimum stock level to set
- The part's average usage
- The lead time for that part
- The last two factors will give the lead time usage

Factors To Consider



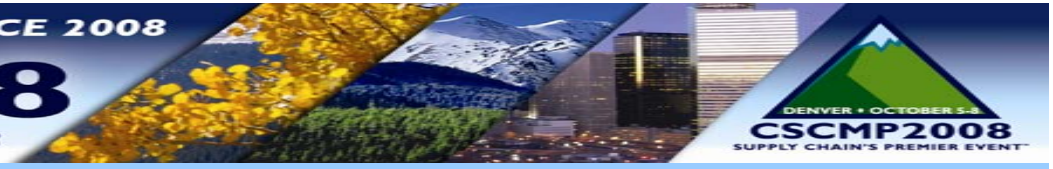
When the stock reaches the reorder point again



Reorder Quantity

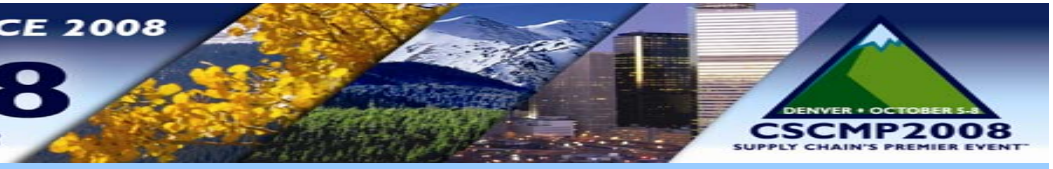
Factors to take into account

- The cost of holding stock
- The cost of placing an order
- The usage
- Unit cost
- The shelf life
- Price and quantity discounts



Reorder Methods

- Order Point
- Just In Time
- Periodic Review
- Two Bin System
- Min Max System
- Kanban

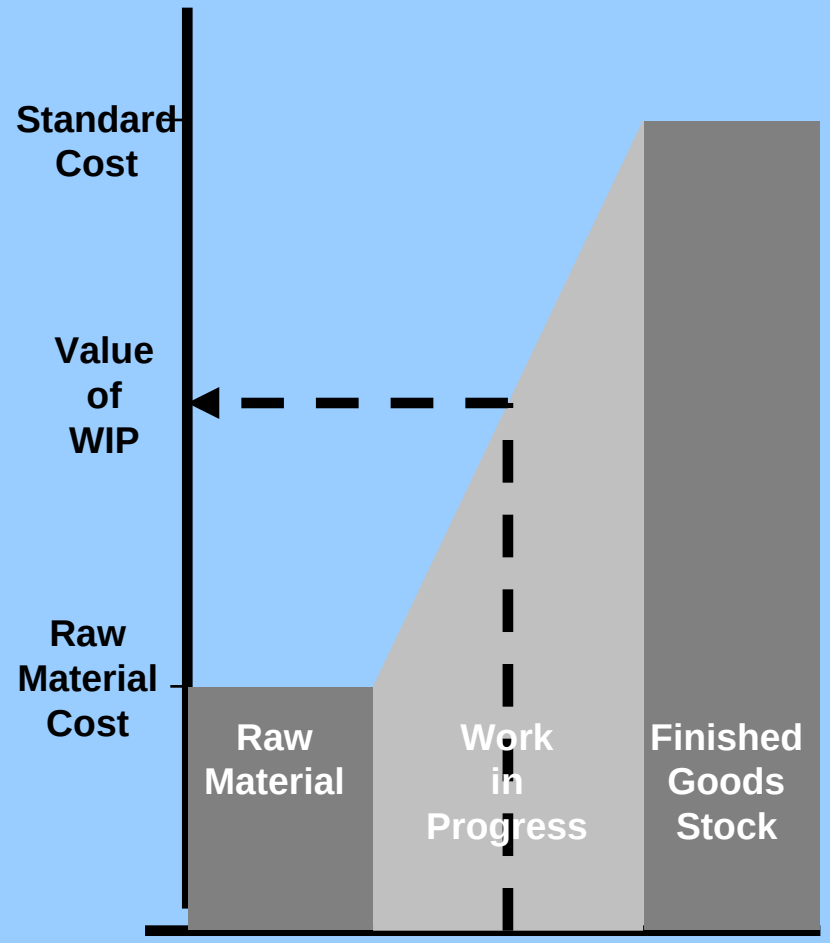


It Is ALWAYS Worth Asking…

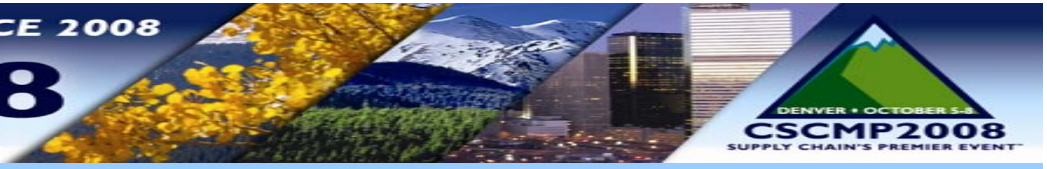
- ***Which parts are under reorder point control?***
- ***How many parts are there?***
- ***Who sets the MIN stock values?***
- ***Who sets the reorder quantity?***
- ***How are these values set?***
- ***How often are they reviewed?***

Unfortunately, most companies set these up once and never review them again!

Inventory Valuation



- LIFO
- FIFO
- Weighted average
- Standard costing



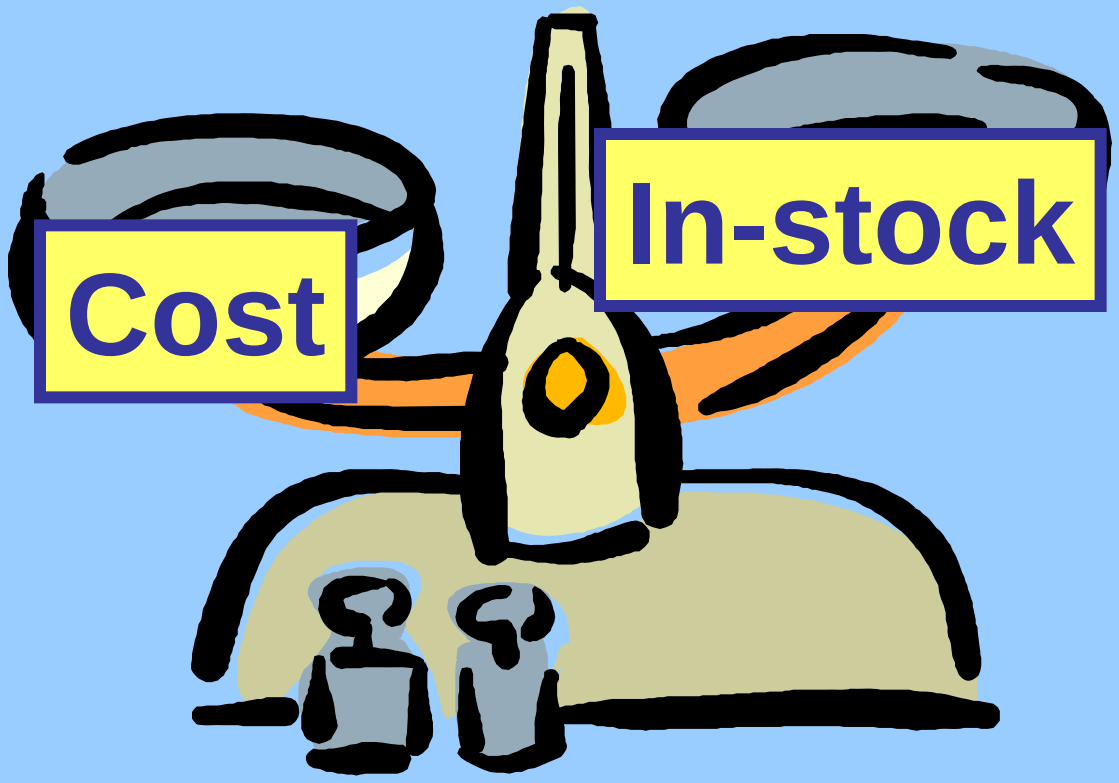
Inventory Valuation

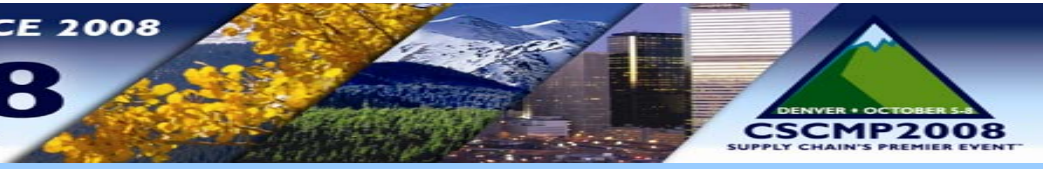
We have purchased part ABC123 three times this year

100	on January 1st	costing $10 per unit
100	on March 1st	costing $15 per unit
100	on May 1st	costing $12 per unit

- LIFO (Last in First Out) says that we should value our stock of 300 at $12 per unit (i.e. At the last price paid)
- FIFO (First in First Out) says that we should value our stock of 300 at $10 per unit (i.e. At the first price paid)
- Weighted Average says that we should value our stock of 300 at $12.33 per unit
  (i.e. At the average unit price)
- Standard Costing says that we ignore what we paid for the part. We set a value for the part at the beginning of each financial year

Finding the correct balance



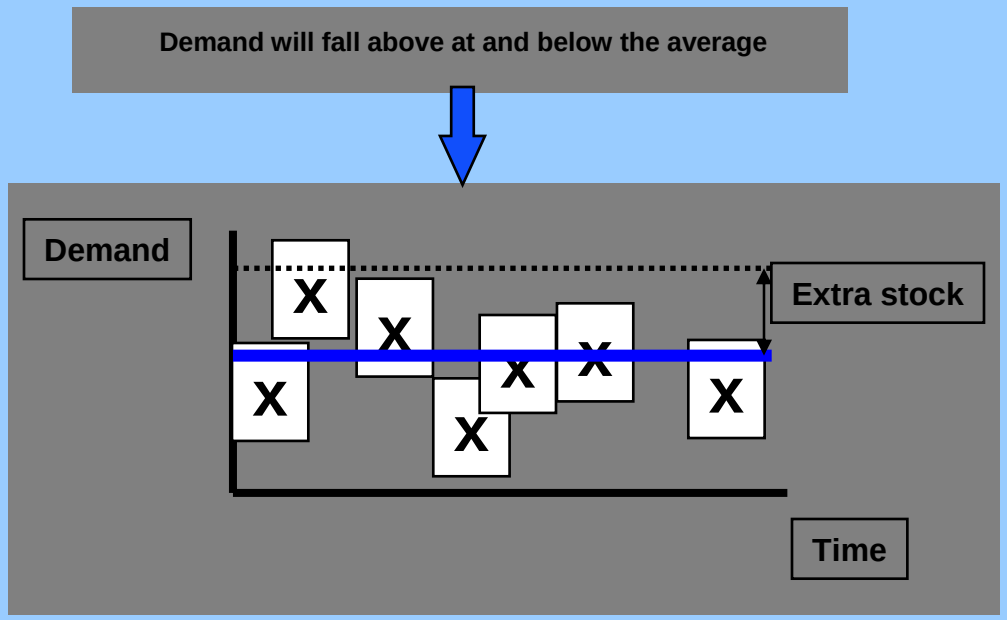


Why We Hold Safety Stock

- Variation in demand
- The lead time
- Variation in lead time
- The service level required

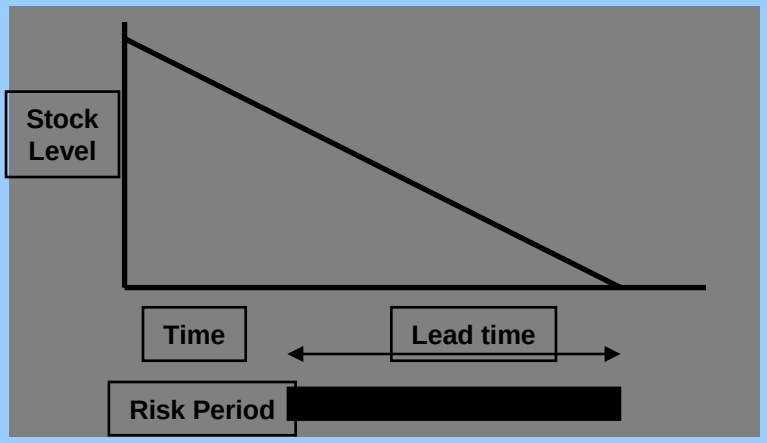
Variation in demand

- In a make-for-stock environment, the factory demand is driven by a forecast
- The forecast attempts to predict the eventual customer demand
- The forecast and the customer demand will unfortunately NEVER be the same



Lead Time & Risk

The time when we could run out of stock is known as the: 'risk period'



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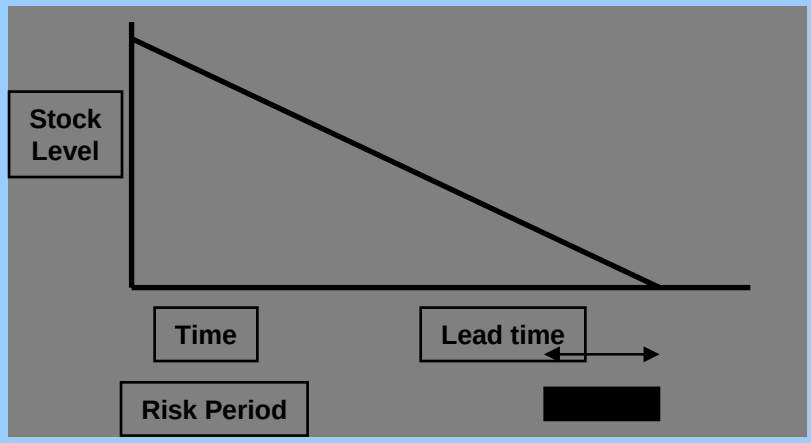
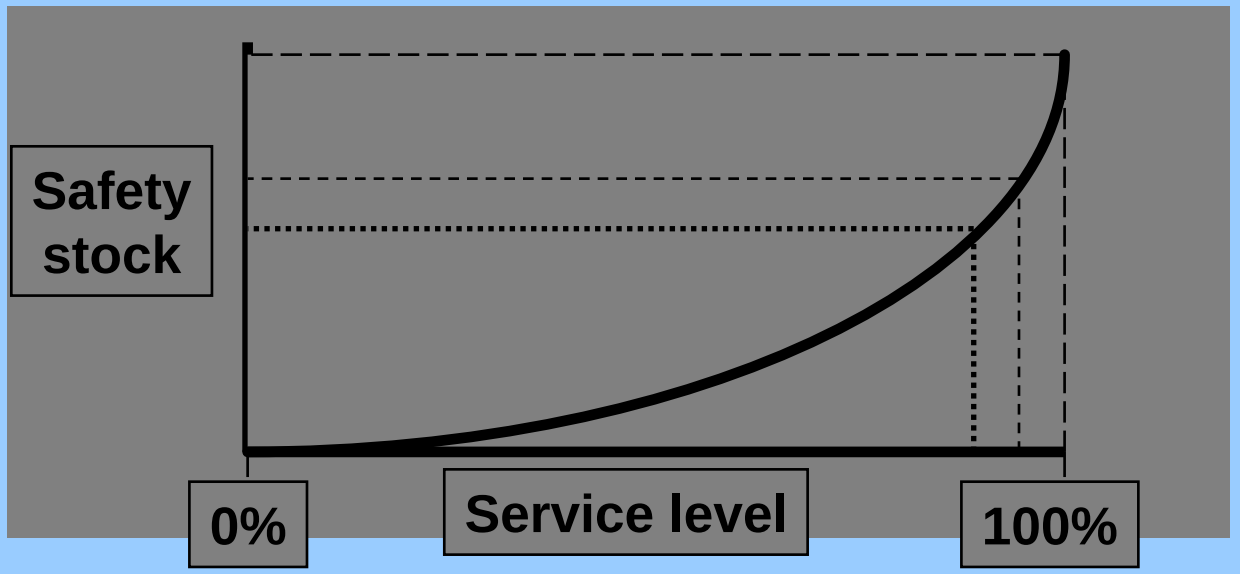


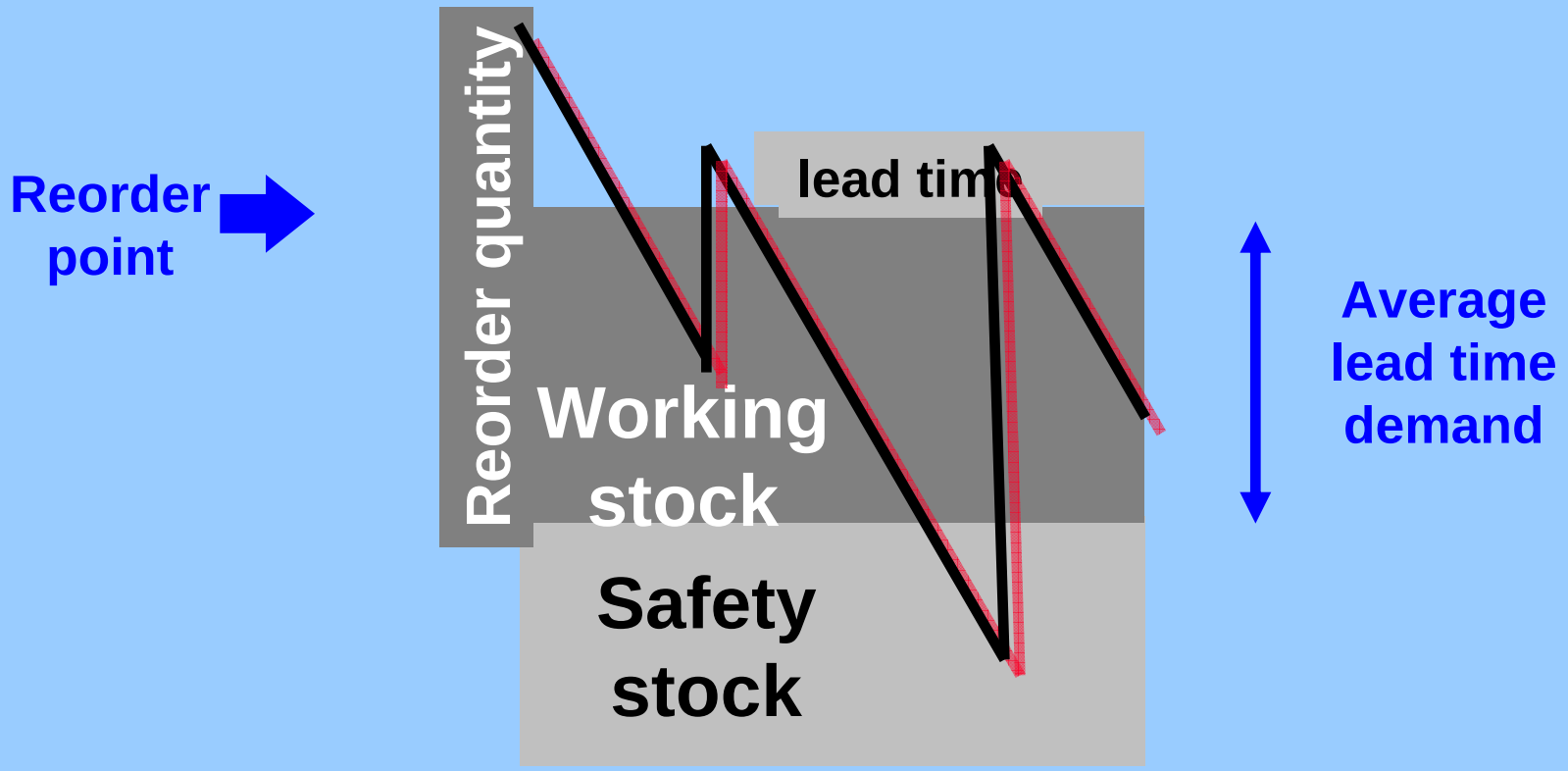
If we reduce the lead time we can reduce the risk period and the safety stock requirements

Safety Stock And Service Level



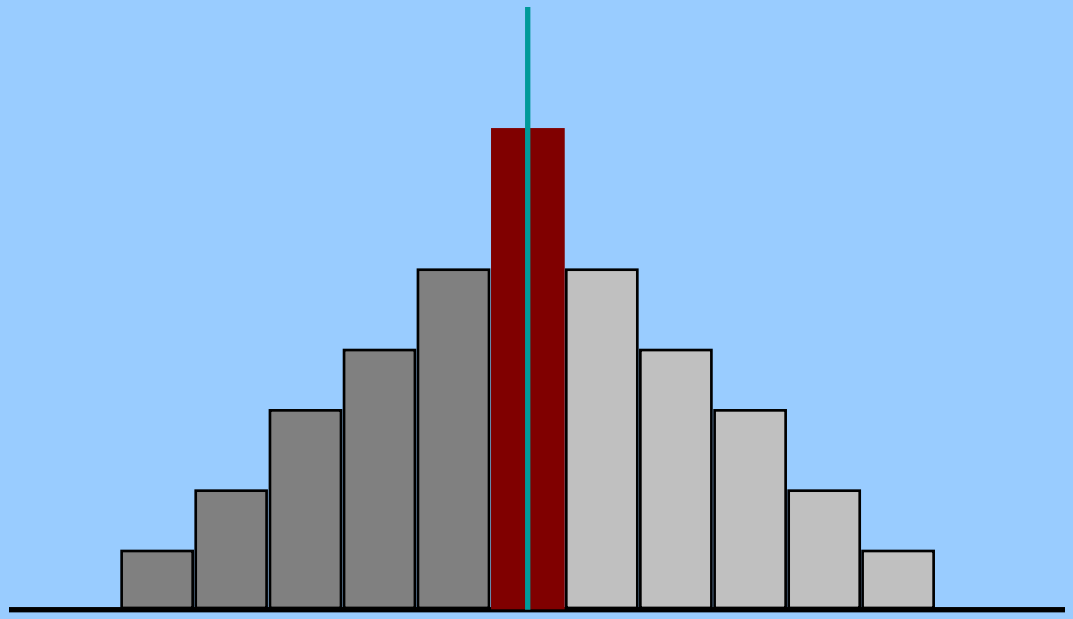
- The relationship between service level and safety stock is exponential
- 90% service level can be achieved with a relatively low level of safety stock
- 95% service level can be achieved with a higher level of safety stock
- A guaranteed 100% service level is a virtually impossibility

Demand Variability



We must consider working stocks, reorder points, lead times and the variability or uncertainty of each

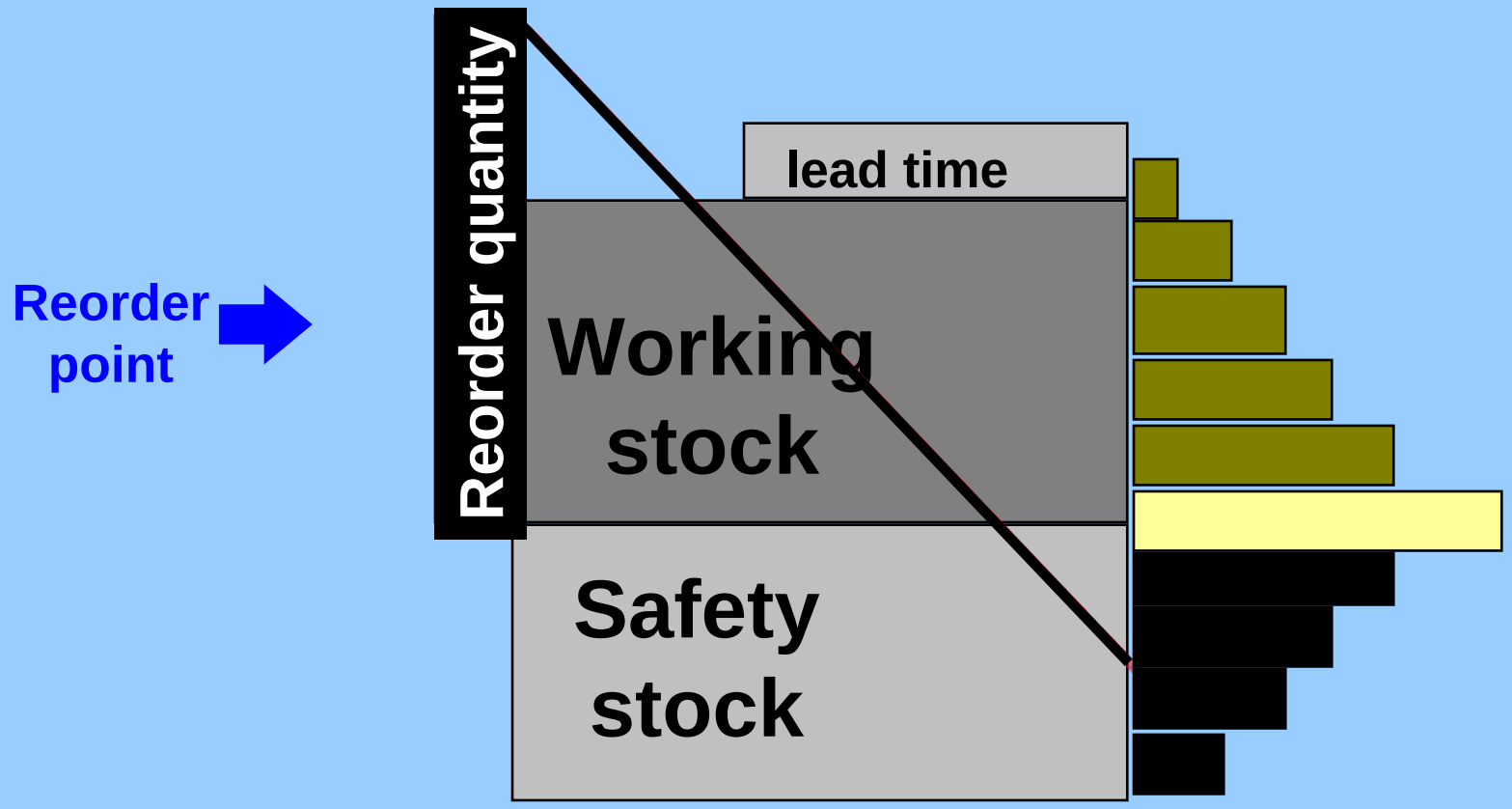
Over Time



Lower Average Higher

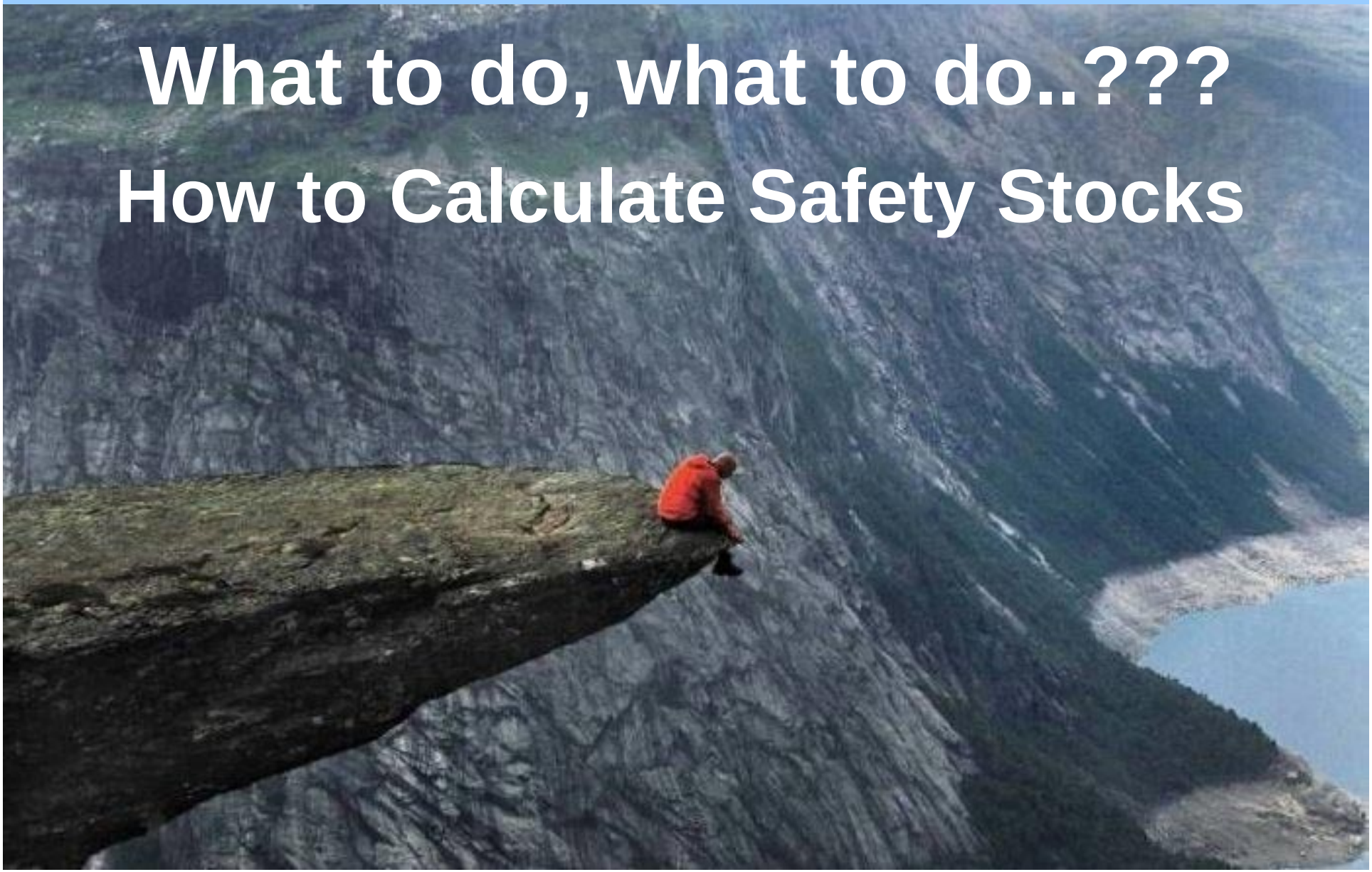
We would see a spread of demands both higher and lower than the average

To Calculate The Probability Of Stock Outages We Need To Combine All Of This

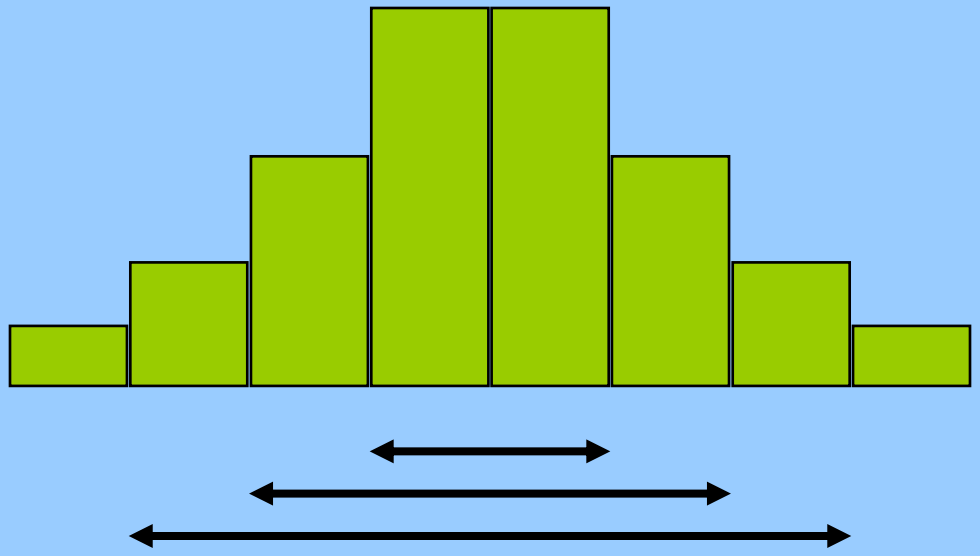


What to do, what to do..???

How to Calculate Safety Stocks



Normal Distribution



68.27% of demand will fall within one standard deviation of the mean

95.45% of demand will fall within two standard deviations of the mean

99.73% of demand will fall within three standard deviations of the mean

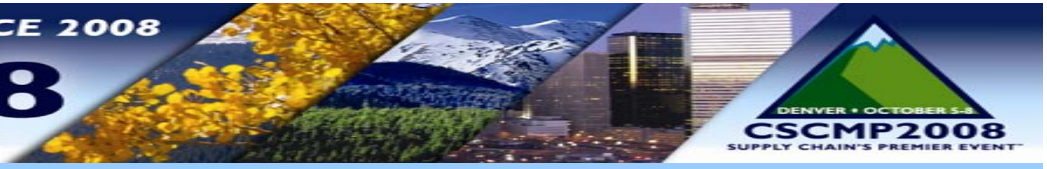
Normal distribution has two key statistics:
The mean (or average) and the standard deviation.

How To Calculate The MAD

The Mean Absolute Deviation is calculated as

$$MAD = \sum \frac{\text{Actual demand - Forecast demand}}{n}$$

where n = the number of observations



Standard Deviation

We can make an estimate of the standard deviation by:

Standard Deviation = 1.25 x MAD

The safety stock can be estimated by using a formula

Safety Stock = Safety Factor x 1.25 MAD

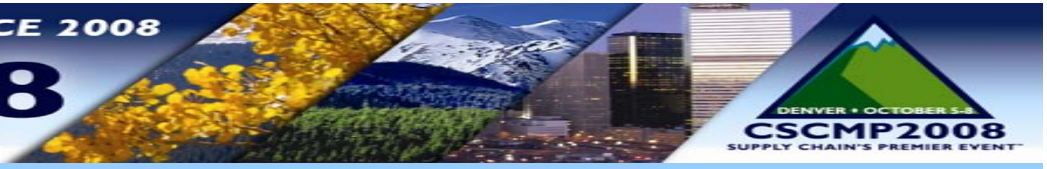
This is best explained by an example

MAD
Mean Absolute Deviation

Period	1	2	3	4	5	6
Actual Demand	100	109	116	120	111	117
Forecast Demand	115	115	115	115	115	115
Error	15	6	1	5	4	2

MAD = 33/6 = 5.50

In calculating the MAD the error is treated as an absolute number not net



Safety Stocks

The Standard formula for the calculation of safety stock (to provide a 99.0% service level) is:

- **Safety factor for 99.0% from statistical tables = 2.32**
- **If the MAD is 5.5 (from the last table)**
- **Safety stock = safety factor x 1.25 x MAD**
- **Safety stock = 2.32 x 1.25 x 5.5**
- **=15.66 = 16 or 16/115 = 13.91% of forecasted demand**

Inventory Opportunities

- Better forecasting
- Increase inventory accuracy
- Reducing batch/lot sizes
- More frequent ordering
- Shorter lead times
- Moves towards Just in Time

Keep Your Eyes on What's Ahead Not Just Where You've Been

Questions?

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