Section 1

Let's Get Started

Why take this course?

John Mandic in the flesh

Who is John Mandic?

- Background
- Education
- Experience

What will you learn

- Customer Demand and spotting different patterns of demand.
- Demand Forecasting techniques.
- Forecast error.
- Manufacturing strategies.
- Product Life Cycle.
- Manufacturing processes and layouts.
- Production Planning.
- Resource Requirements Planning.

Here is more you will learn

- Master Production Schedule.
- Rough Cut Capacity Planning.
- Available-to-Promise.
- Material Requirements Planning.
- Capacity Requirements Planning.
- Bill-of-Material
- Manufacturing Lead-Time.
- MRP Offsetting and Exploding.
- Planned Orders, Released Orders, MRP Action and Exception Messages.

Here is more you will learn

- Available Capacity, Available Time, Utilization and Efficiency and Rated Capacity.
- Production Activity Control.
- Inventory, Customer Service, Safety Stock and Stock-Out.
- Carrying Costs and Ordering Costs.
- Economic Order Quantity.
- Manage Inventory.
- ABC Analysis and Pareto's Law (the 80/20 rule).
- Customer Expectations, Supply Chain Sustainability.

How will you learn

My challenge ...

What is a Supply Chain?

The job of a Supply Chain is to get the “right product, to the right customer, at the right time, at the right place, in the right quantity, in the right condition and at the right cost.”

Supply Chain Management by Coyle, Langley, Novack, Gibson

Traditional Supply Chain

Complex Supply Chain

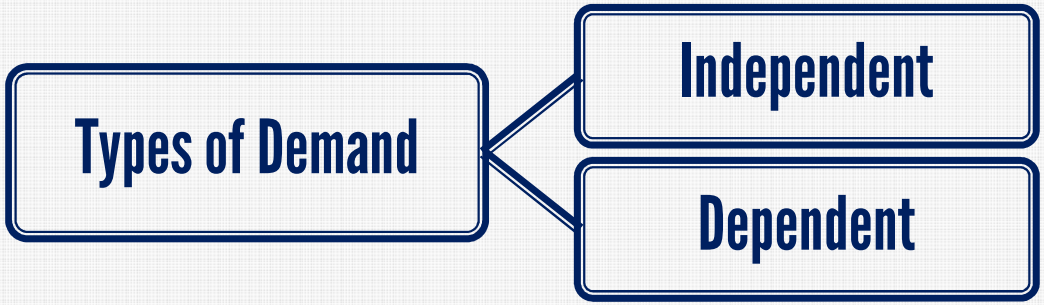
Navigating the Exercises

A few options ...

Section 2

What is Demand?

Refers to the need for a particular item, product, component or service.



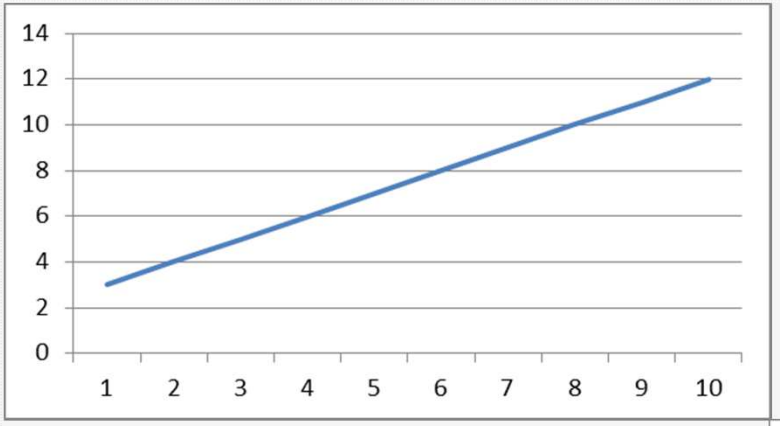
Understanding Demand

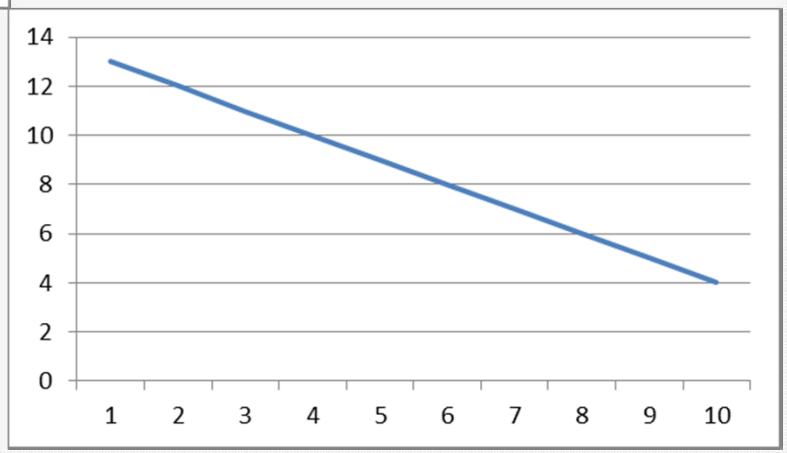
Understanding the behavior of demand becomes a step in being able to predict it.

Forecasting Demand

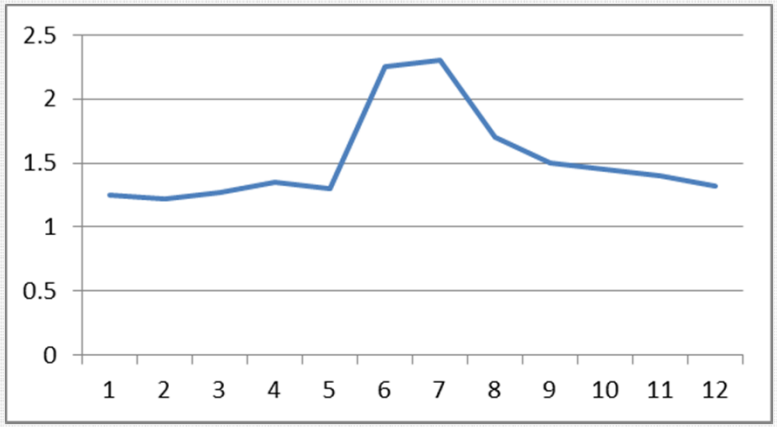
- Trend
- Random Fluctuations
- Seasonal Fluctuations
- Cyclical

Trend

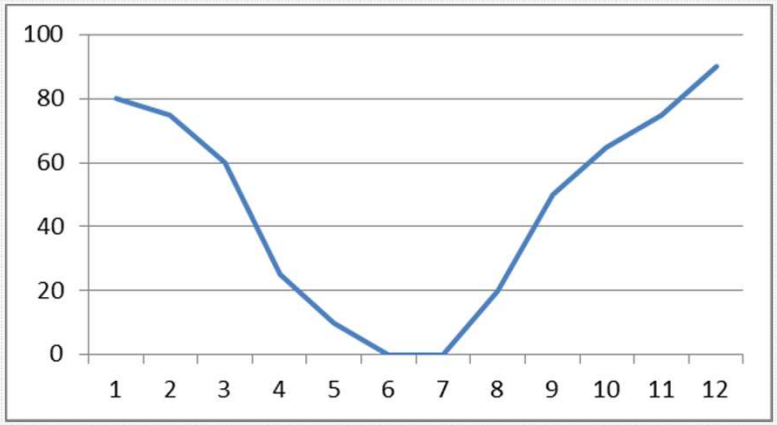




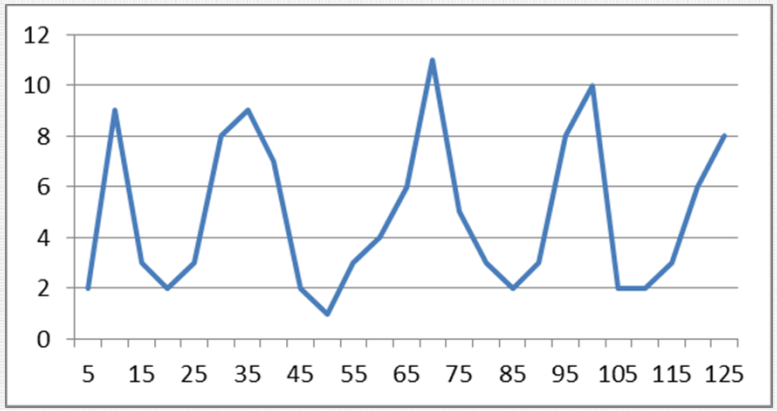
Random Fluctuation



Seasonal Fluctuation



Cyclical



Simple Moving Average Forecast

Month	Demand	3 Month Average		Forecast
1	88			
2	88			
3	95	271	90.33	
4	92	275	91.67	90
5	94	281	93.67	92
6	103	289	96.33	94
7	106	303	101.00	96
8	110	319	106.33	101
9	112	328	109.33	106
10				109

Weighted Moving Average Forecast

Month	Demand	3 Month Average		Forecast
1	88			
2	88			
3	95	(95x0.75 + 88x0.2 +88x0.05) =	93.25	
4	92	(92x0.75 + 95x0.2 +88x0.05) =	92.4	93
5	94		93.65	92
6	103		100.65	94
7	106		104.8	101
8	110		108.85	105
9	112		111.3	109
10				111

Factor	Weight	Description
D1 =	75%	Most recent demand
D2 =	20%	2nd most recent demand
D3 =	5%	3rd most recent demand

Exponential Smoothing

Month	Demand	Forecast
1	88	
2	88	
3	95	
4	92	93
5	94	93
6	103	93
7	106	96
8	110	99
9	112	102
10		

(92x0.3 + 93x0.7)

(94x0.3 + 93x0.7)

Factor	Weight
α =	0.3
(1 - α) =	0.7

Understanding Forecast Error

Managing the accuracy of a forecast requires minimizing the errors between the actual demand and the forecasted demand.

Measuring Forecast Error

- Cumulative Sum of Error
- Mean Square Root
- Mean Absolute Deviation
- Mean Absolute Percent Error

Cumulative Sum of Error

Month	Forecast	Demand	Cumulative Sum of Error
January	1120	1400	280
February	999	960	-39
March	1005	1440	435
April	850	1175	325
May	950	815	-135
June	1236	775	-461
July	995	880	-115
August	1125	930	-195
September	1050	1550	500
October	995	665	-330
November	1030	1305	275
December	875	550	-325
Total	**12230**	**12445**	**215**

Cumulative Sum of Error	**215**

Mean Square Root

Month	Forecast	Demand	Cumulative Sum of Error	Mean Square Root
January	1120	1400	280	78400
February	999	960	-39	1521
March	1005	1440	435	189225
April	850	1175	325	105625
May	950	815	-135	18225
June	1236	775	-461	212521
July	995	880	-115	13225
August	1125	930	-195	38025
September	1050	1550	500	250000
October	995	665	-330	108900
November	1030	1305	275	75625
December	875	550	-325	105625
Total	**12230**	**12445**	**215**	**1196917**

$1196917/12 = 99743$

$\sqrt{99743} = 315.82$

Mean Square Root	**316**

Mean Absolute Deviation

Month	Forecast	Demand	Cumulative Sum of Error	Mean Square Root	Mean Absolute Deviation
January	1120	1400	280	78400	280
February	999	960	-39	1521	39
March	1005	1440	435	189225	435
April	850	1175	325	105625	325
May	950	815	-135	18225	135
June	1236	775	-461	212521	461
July	995	880	-115	13225	115
August	1125	930	-195	38025	195
September	1050	1550	500	250000	500
October	995	665	-330	108900	330
November	1030	1305	275	75625	275
December	875	550	-325	105625	325
Total	**12230**	**12445**	**215**	**1196917**	**3415**

3415/12 = 284.58

Mean Absolute Deviation	**285**

Mean Absolute Percent Error

Month	Forecast	Demand	Mean Absolute Deviation	Mean Absolute Percent Error
January	1120	1400	280	20%
February	999	960	39	4%
March	1005	1440	435	30%
April	850	1175	325	28%
May	950	815	135	17%
June	1236	775	461	59%
July	995	880	115	13%
August	1125	930	195	21%
September	1050	1550	500	32%
October	995	665	330	50%
November	1030	1305	275	21%
December	875	550	325	59%
Total	**12230**	**12445**	**3415**	**354%**

Mean Absolute Deviation / Demand X 100%

354%/12 = 30%

Mean Absolute Percent Error	**30%**

Understanding Forecast Error – Part 2

As a Supply Chain Expert, always choose the forecasting technique that best fits the data to minimize the forecast error. Minimizing the error will give you the most accurate forecast.

Summary – Forecast Error Measuring Techniques

Month	Forecast	Demand	Cumulative Sum of Error	Mean Square Root	Mean Absolute Deviation	Mean Absolute Percent Error
January	1120	1400	280	78400	280	20%
February	999	960	-39	1521	39	4%
March	1005	1440	435	189225	435	30%
April	850	1175	325	105625	325	28%
May	950	815	-135	18225	135	17%
June	1236	775	-461	212521	461	59%
July	995	880	-115	13225	115	13%
August	1125	930	-195	38025	195	21%
September	1050	1550	500	250000	500	32%
October	995	665	-330	108900	330	50%
November	1030	1305	275	75625	275	21%
December	875	550	-325	105625	325	59%
Total	**12230**	**12445**	**215**	**1196917**	**3415**	**354%**

Cumulative Sum of Error	**215**
Mean Square Root	**316**
Mean Absolute Deviation	**285**
Mean Absolute Percent Error	**30%**

Exercise – Moving Average

Month	Demand	Forecast 3 Month Avg
1	90	
2	89	
3	87	
4	92	89
5	94	89
6	101	91
7	99	96
8	100	98
9	105	100
10	108	101
11	110	104
12	105	108

Exercise – Moving Average

Month	Demand	Forecast 4 Month Avg
1	90	
2	89	
3	87	
4	92	
5	94	90
6	101	91
7	99	94
8	100	97
9	105	99
10	108	101
11	110	103
12	105	106

Exercise – Measuring Forecast Error

Month	Forecast	Demand	Cumulative Sum of Error	Mean Absolute Deviation
January	1350	1275	-75	75
February	1200	999	-201	201
March	1250	1375	125	125
April	1150	1015	-135	135
May	1275	1325	50	50
June	1300	1375	75	75
Total	**7525**	**7364**	-161	661

Cumulative Sum of Error	-161	
Mean Absolute Deviation		110

Quiz

1		Which forecasting method uses the average demand for a past number of periods?	
	a	Trend Analysis	
	b	Linear Smoothening	
	c	Moving Average	Answer
	d	None of the above	
2		What assumption is made about forecasting methods?	
	a	Demand variation must be linear	
	b	The past is an acceptable indicator of the future	Answer
	c	Demand variation must be small	
	d	The past is not an acceptable indicator of the future	
3		End item A is made from subcomponents B & C. Subcomponent B is made from	
		part D and raw material E. Which component should be forecast?	
	a	A, B, C, D and E	
	b	B and C	
	c	D and E	
	d	Only A	Answer
4		Which of the following is typical of demand?	
	a	It contains average variation	
	b	It contains seasonal fluctuations	Answer
	c	It does not contain random flucutations	
	d	All of the above	
5		Which of the following does not belong?	
	a	Trend	
	b	Cyclical	
	c	Average	Answer
	d	Random Fluctuations	

Section 3

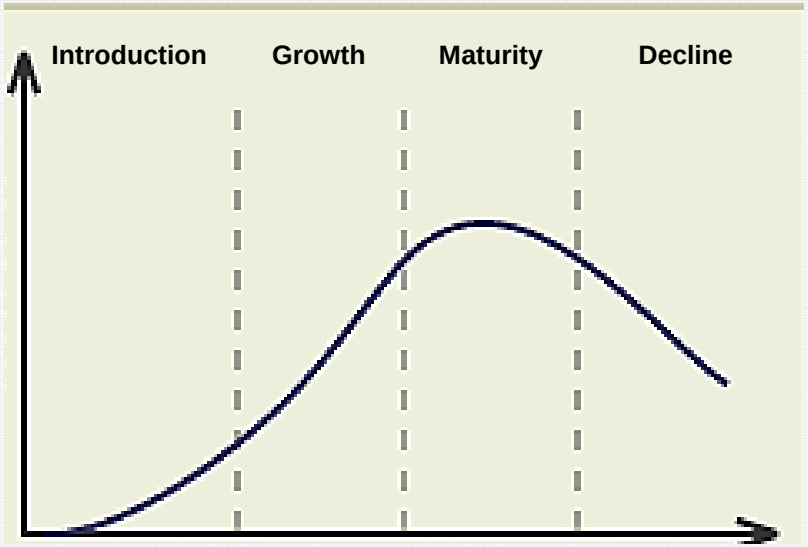
Introduction to Manufacturing

Transforms raw materials into finished goods that meet the needs of customers.

Choosing a Manufacturing Environment

- ETO – Engineer-to-Order
- MTO – Manufacture-to-Order
- ATO – Assemble-to-Order
- MTS – Manufacture-to-Stock
- Mass Customization

Product Life Cycle



- Introduction Stage
- Growth Stage
- Maturity Stage
- Decline Stage
- Phase-Out Stage

Choosing a Manufacturing Layout

- Intermittent
- Cell
- Flow
- Continuous
- Project

Vocabulary Exercise – Match the Word and Phrase

B	A production environment where an item is manufactured after receipt of a customer order.
D	The time span of a product from the time it is introduced into the market to the time people stop buying it.
C	A network used to deliver products or services from raw materials to end customers.
E	Equipment and workers are arranged in a linear flow.
A	A manufacturing environment where a product is assembled after receipt of a customer order.

A	Assemble-to-Order
B	Make-to-Order
C	Supply Chain
D	Product Life Cycle
E	Cell Layout

Quiz

1		Which of the following manufacturing strategies has the longest delivery lead-time?	
	a	ATO	
	b	MTS	
	c	ETO	Answer
	d	MTO	
2		Why is manufacturing important to the economy?	
	a	It decreases employment and prevents waste.	
	b	It creates wealth and reduces waste.	
	c	It adds value to products and creates wealth.	Answer
	d	None of the above.	
3		Which of the following is not associated with an Intermittent layout?	
	a	Uses lots and batches	
	b	MTS	Answer
	c	Equipment is not dedicated	
	d	Job Shop	
4		Which of the following manufacturing strategies has the shortest delivery lead-time?	
	a	ATO	
	b	MTS	Answer
	c	ETO	
	d	MTO	
5		In the Product Life Cycle, at what stage is the product most expensive?	
	a	Growth	
	b	Decline	
	c	Maturity	
	d	Introduction	Answer

Section 4

What is Production Planning?

Is a process in a manufacturing business that establishes a production rate, typically monthly, for a family of parts over a 12 to 36 month planning horizon.

Developing a Production Plan

- Chase Strategy
- Level Production Strategy
- Hybrid Strategy
- Subcontracting Strategy

Exercise – Calculating Expected Ending Inventory

Period	1	2	3	4	5	6
Forecast	500	450	550	700	750	800
Production Plan	600	600	600	600	600	600
Ending Inventory	300	450	500	400	250	50

Beginning Inventory Period 1 = 200

Ending Inventory = Beginning Inventory + Production Plan - Forecast

Exercise - Developing A Level Production Plan

Period	1	2	3	4	5	6
Forecast	40	45	70	58	75	80
Production Plan	53	53	53	53	53	53
Ending Inventory	113	121	104	99	77	50

Beginning Inventory Period 1 = 100

Ending Inventory Period 6 = 50

Calculate total demand = 368

Calculate total production needed = 368 -100 + 50 = 318

Calculate production rate each period = 318/6 = 53

Resource Requirements Planning (RRP)

- Is a check on resources needed to support the Production Plan.
- Deals with capacity at the product family level and determines the need for long-lead resources.

Rough Calculation Example - RRP

Monthly Production Rate is 1000 bicycles.
1 hour welding per bicycle = 1000 hours welding per month.

1 welding operator & 1 welding machine = 40 hours welding per week = 160 hours welding per month
2nd welding operator on afternoon shift = 160 hours welding per month
3rd welding operator on night shift = 160 hours welding per month

Total: 480 hours welding per month

Buy another welding machine and hire 3 more welding operators:

Total: 480 hours welding per month

Work some overtime:

Total: 40 hours welding per month

Grand Total: 1000 hours welding per month

Exercise - RRP

Assumptions:

- 1 machine and 1 operator – Can produce 40 hrs per week or 160 hrs per month.
- Capacity can be further increased by 15% through overtime.
- External company nearby can perform 250 hrs of the work per month at a very reasonable price comparable to your own internal costs.
- Each bicycle will require 0.15 hrs of tube bending.

Verify if you have a capacity shortage and recommend a solution…

Solution:
Monthly tube bending required: 1000 x 0.15 = 150 hrs

Your capacity available is 160 + 15% = 184 hrs. You are okay with current resources to meet the required demand.

Exercise - RRP

Assumptions:

- 1 machine and 1 operator – Can produce 40 hrs per week or 160 hrs per month.
- Capacity can be further increased by 15% through overtime.
- External company nearby can perform 250 hrs of the work per month at a very reasonable price comparable to your own internal costs.
- **Each bicycle will require 0.35 hrs of tube bending.**

Verify if you have a capacity shortage and recommend a solution…

Solution:
Monthly tube bending required: 1000 x 0.35 = 350 hrs
Your available capacity is 160 + 10% = 176 hrs.
Recommendation is to hire another operator and each can work 10% overtime which will give you slightly over 350 hrs each month
or
instead of hiring another operator you can subcontract half the work to the external company.

Quiz

1		Production Planning is associated with?	
	a	Annual Planning	
	b	Strategic Planning	
	c	Sales and Operations Planning	Answer
	d	Short range planning	
2		The Chase strategy leads to?	
	a	Production levelling.	
	b	Demand matching.	Answer
	c	Inventory buildup.	
	d	Lower costs.	
3		If your opening inventory is 200 units, ending inventory is 75 units, sales are 300 units, what amount needs to be produced?	
	a	150	
	b	125	
	c	200	
	d	175	Answer
4		The Hybrid strategy is?	
	a	A combination of Chase and Level.	Answer
	b	A combination of Level and Subcontract	
	c	A combination of Chase and Subcontract	
	d	None of the above	
5		Resource Requirements Planning?	
	a	Is a Medium range planning tool	
	b	Supports the Daily Plan.	
	c	Supports the Production Plan.	Answer
	d	Is a Short range planning tool.	

Section 5

What is a Master Production Schedule (MPS)?

It is a detail schedule of what a company plans to manufacture expressed by specific product configuration, quantities and dates.

Exercise – MPS plus Projected Available Balance (PAB)

Lot size = 50 pcs.

Period		1	2	3	4	5	6
Forecast		40	30	30	40	20	30
Projected Available Balance	50	10	30	0	10	40	10
Master Production Schedule			50		50	50	

Ending PAB = Beginning PAB + scheduled MPS - Forecast

Rough Cut Capacity Planning (RCCP)

- Is a check on resources needed to support the Master Production Schedule.
- It deals with the need for capacity to support components at the end-item level.
- More detail level of capacity which uses weekly (not monthly) time intervals.

Available-to-Promise (ATP)

It is the portion of a company's inventory and production that is uncommitted and therefore available for customer order promising.

Exercise - Available-to-Promise (ATP)

Period	1	2	3	4	5	6
Forecast	20	10	10	10		30
MPS Receipt	35		35		35	
ATP	5		15		5	

Calculate ATP for each period in which an MPS receipt is scheduled.

Exercise – MPS

Lot size = 200 pcs.

Period		1	2	3	4	5	6
Forecast		60	130	280	100	80	180
Projected Available Balance	100	40	110	30	130	50	70
Master Production Schedule			200	200	200		200

Ending PAB = Beginning PAB + scheduled MPS - Forecast

Quiz

1		Which is not associated with an MPS?	
	a	Specific configurations	
	b	Quantities	
	c	Due-dates	
	d	Resource Requirements Planning	Answer
2		RCCP checks capacity for?	
	a	PAB	
	b	RRP	
	c	MPS	Answer
	d	Promising	
3		The MPS receives data from?	
	a	Production Plan	Answer
	b	Master Production Schedule	
	c	Daily Plan	
	d	Short range plan.	
4		What is the name for the inventory and production that is available for customer order promising?	
	a	PAB	
	b	MPS	
	c	RCCP	
	d	ATP	Answer
5		PAB stands for?	
	a	Paul and Bill technique	
	b	Probable Available Balance	
	c	Projected Available Balance	Answer
	d	Pull Another Build	

Section 6

What is Material Requirements Planning (MRP)?

A priority plan that tells you when orders should be released into work, when materials need to be ordered and received, when subassemblies need to be ready, everything needed to complete the end-item to support the due date provided by the MPS.

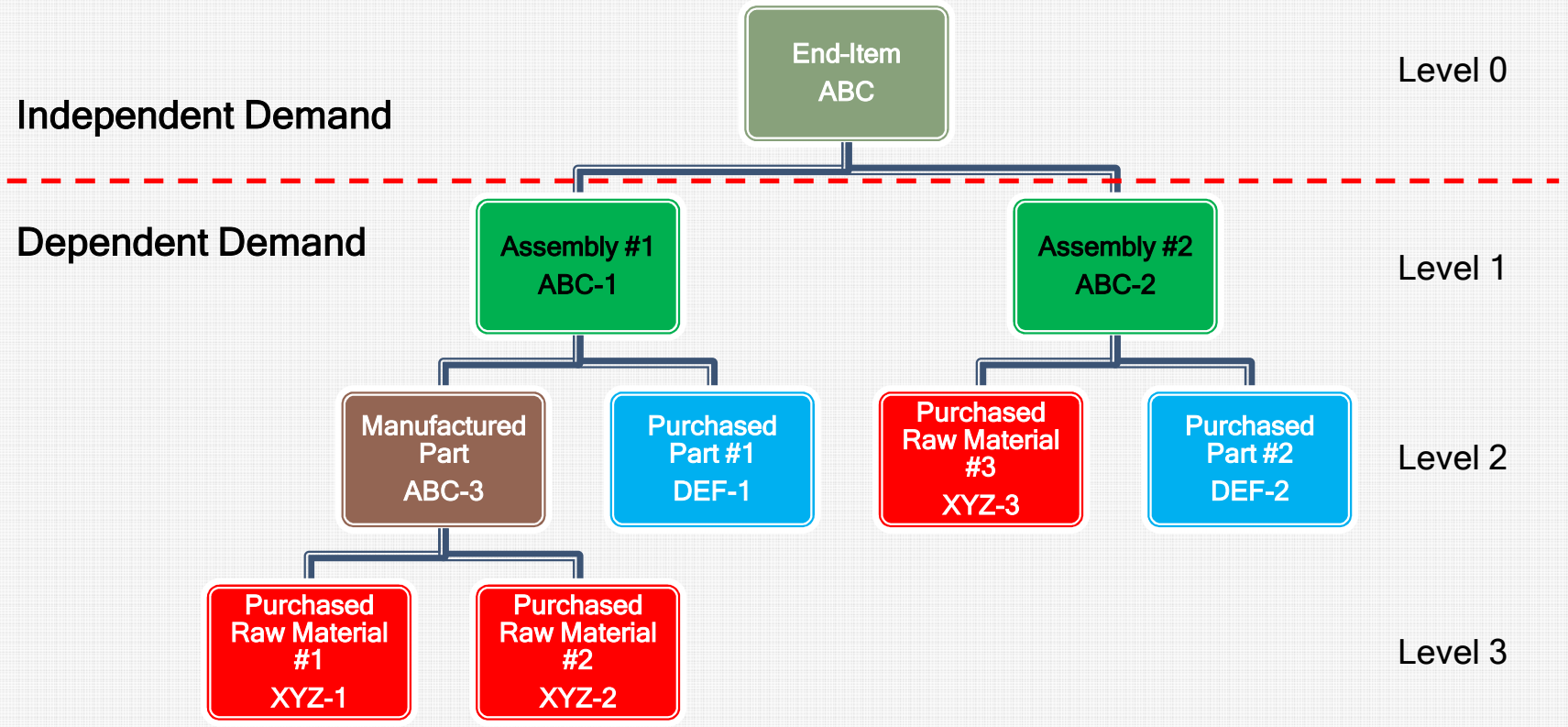
Inputs to MRP

- MPS
- Product Structure File (BOM)
- Inventory Record File
- Item Master File

Summarized Bill of Material (BOM)

Part Number ABC			
Part Number	Description	Qty Req'd	Unit of Measure
ABC-1	Assembly #1	1	Each
ABC-2	Assembly #2	1	Each
ABC-3	Manufactured Part	1	Each
DEF-1	Purchased Part #1	1	Each
DEF-2	Purchased Part #2	1	Each
XYZ-1	Raw Material #1	1	Inch
XYZ-2	Raw Material #2	1.5	Inches
XYZ-3	Raw Material #3	1	Each

Bill of Material (BOM)



What is a Part Number?

Is a unique identifier of an item.

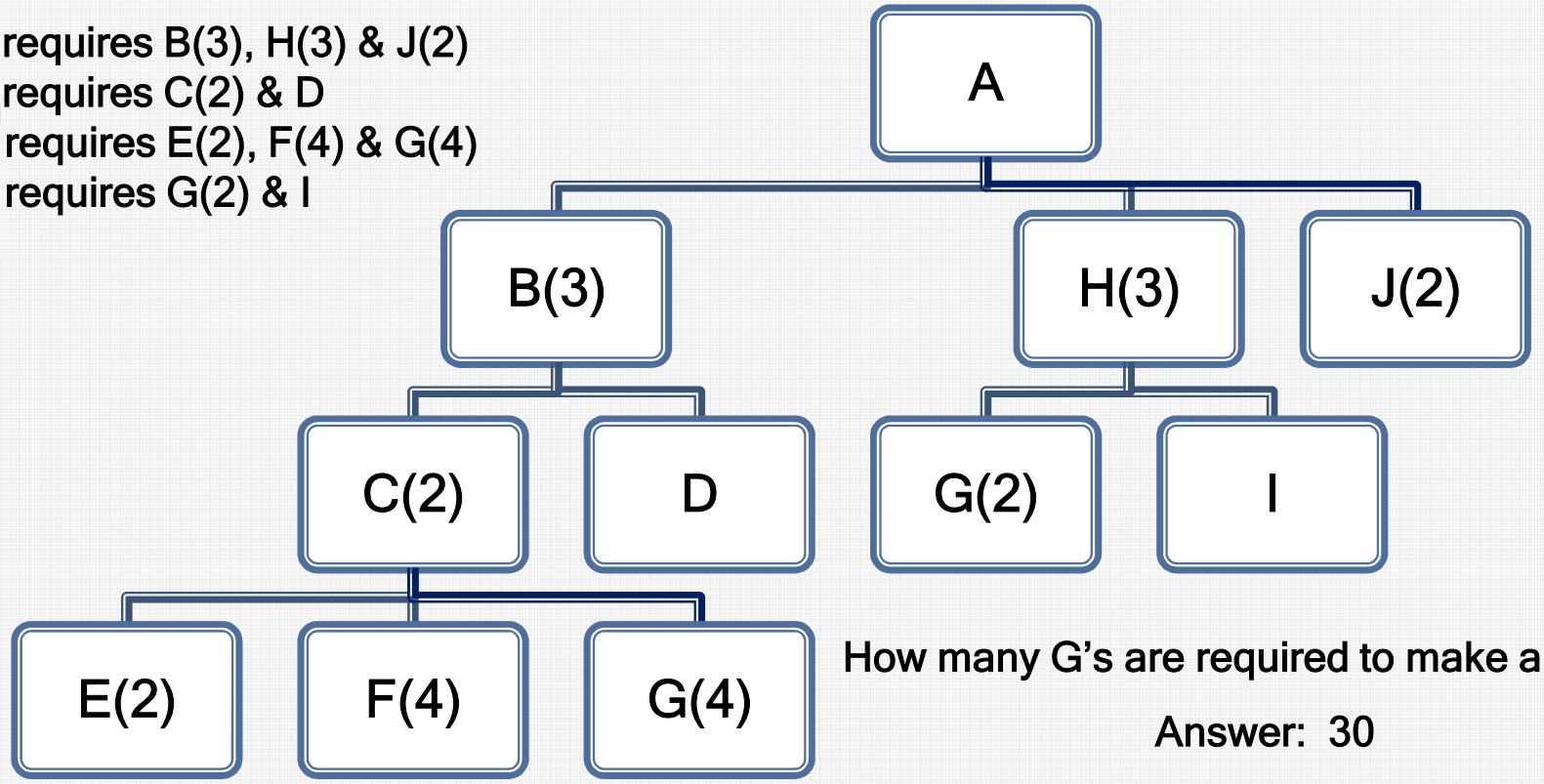
Can also be referred to as Item Number, Product Number, Stock Code and Stock Number.

Part Numbers ...

- Should be assigned to each item
- Should be unique
- Should follow a common format
- Should never be re-used or re-assigned
- Should be created and managing by a dedicated person(s)

Exercise - Bill of Material (BOM)

A requires B(3), H(3) & J(2)
B requires C(2) & D
C requires E(2), F(4) & G(4)
H requires G(2) & I



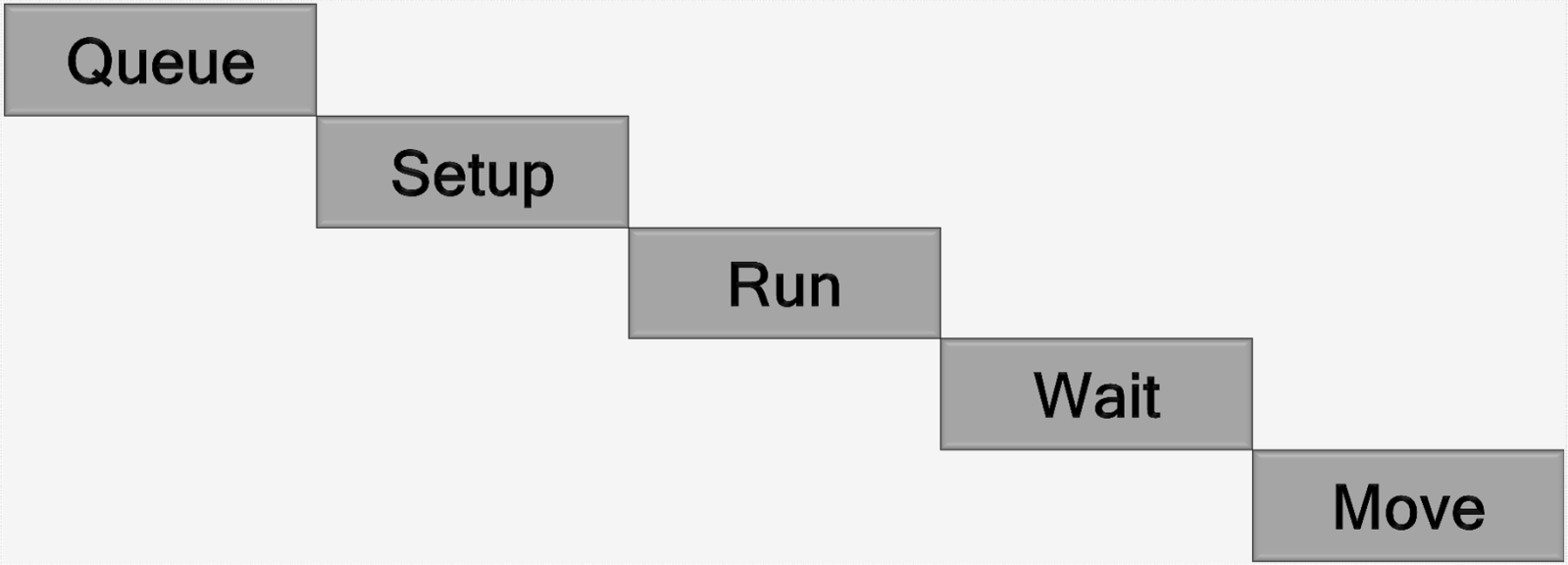
How many G's are required to make an A?

Answer: 30

Lead Time is Defined as ...

A SPAN OF TIME REQUIRED TO PERFORM A PROCESS

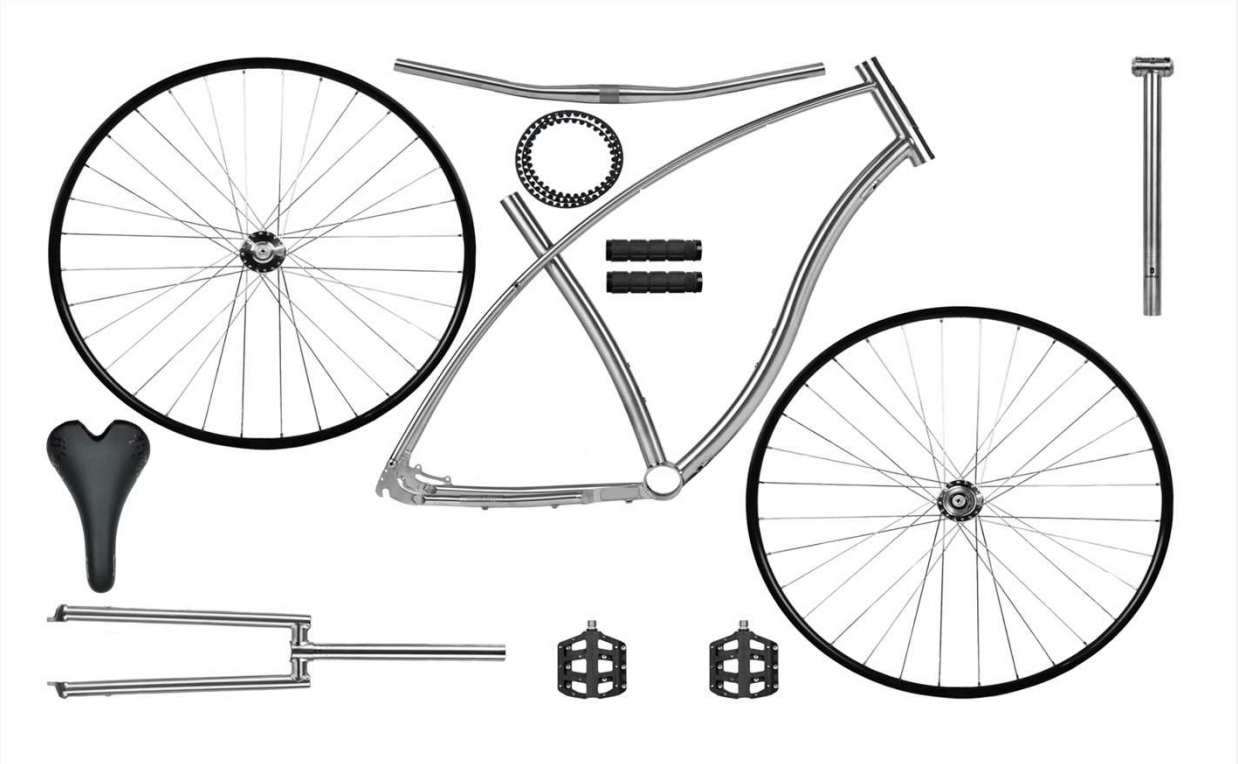
Elements of Manufacturing Lead Time



MRP Logic

- Lead Time Offsetting
- Exploding

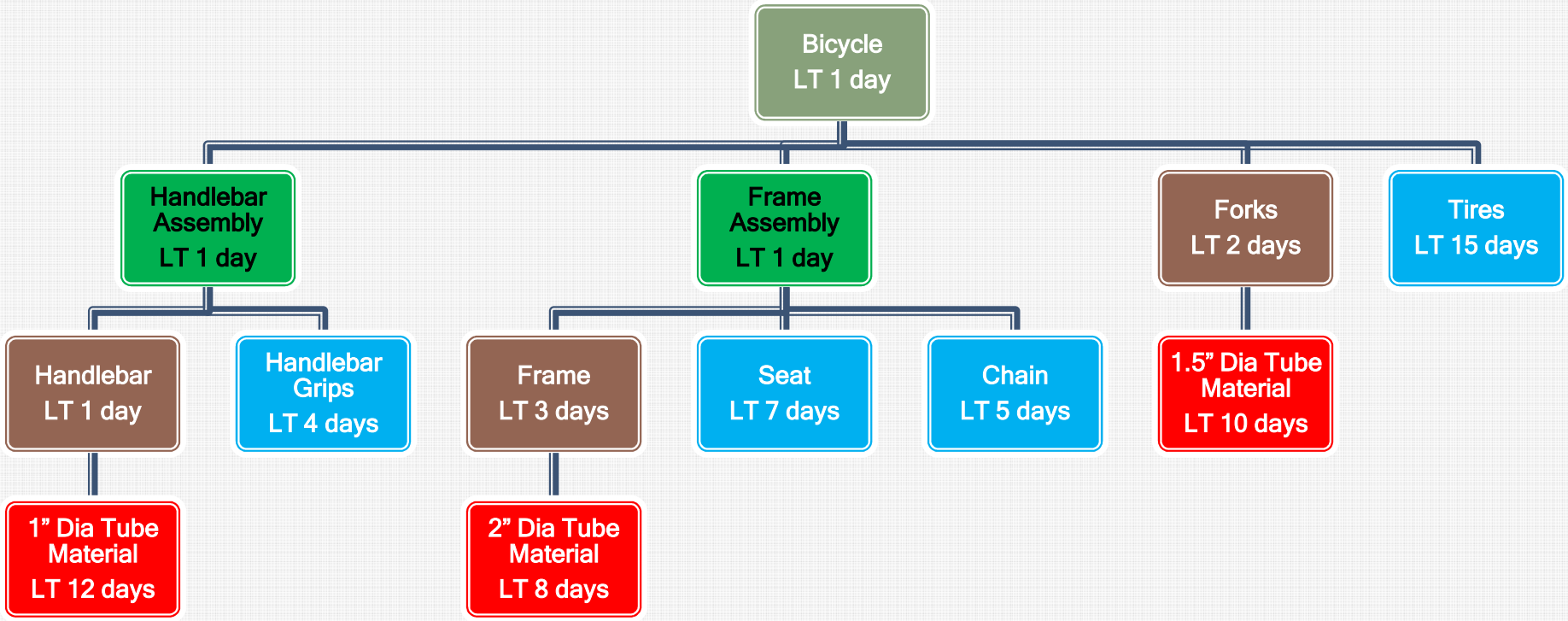
Bicycle Parts



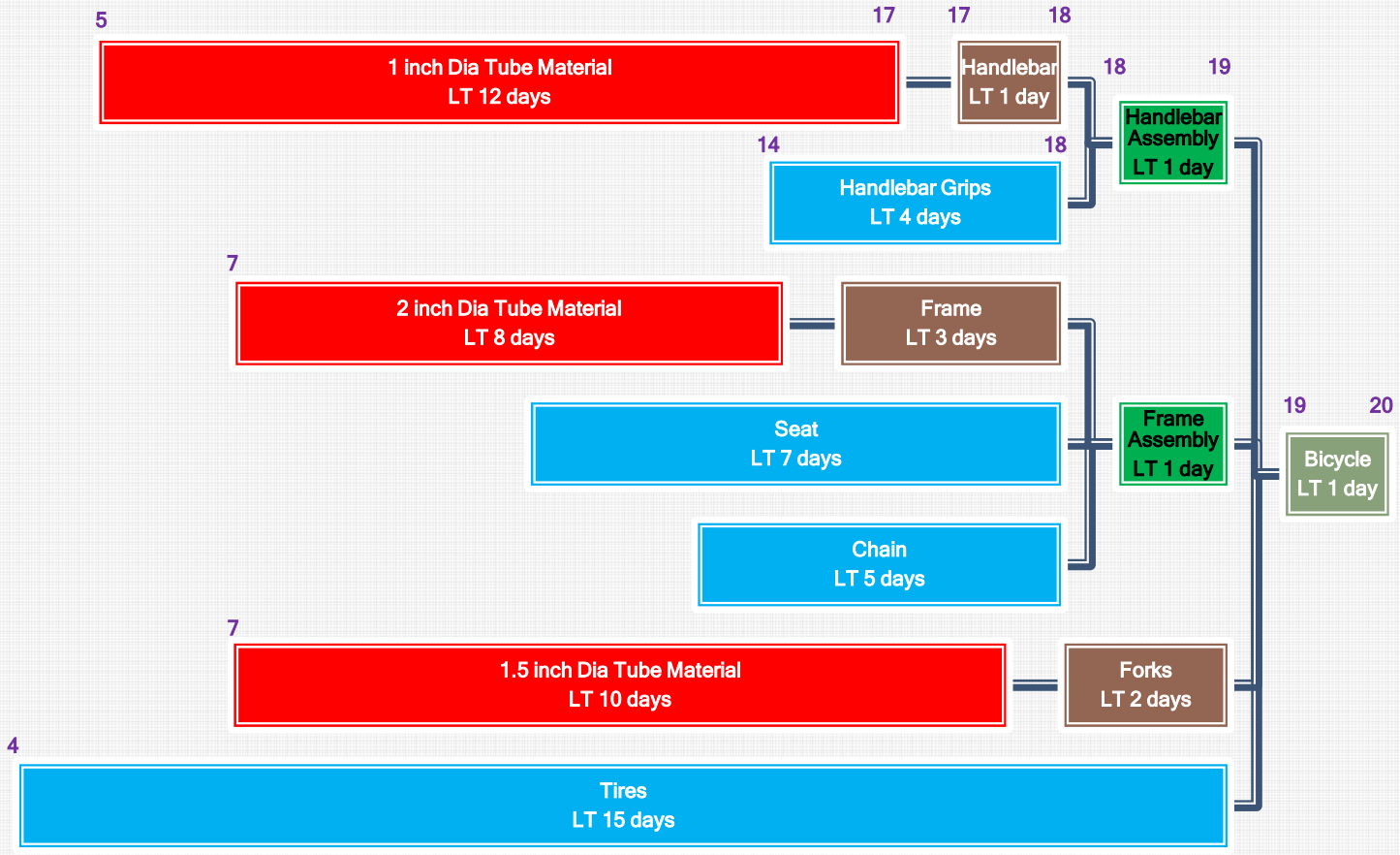
Summarized Bill of Material (BOM)

Bicycle ABC			
Part Number	Description	Qty Req'd	Unit of Measure
ABC-1	Handlebar Assembly	1	Each
ABC-2	Frame Assembly	1	Each
ABC-3	Forks	1	Each
ABC-4	Tires	2	Each
DEF-1	Handlebar	1	Each
DEF-2	Handlebar Grips	2	Each
DEF-3	Frame	1	Each
DEF-4	Seat	1	Each
DEF-5	Chain	1	Each
XYZ-1	1 inch Dia Handlebar Tube Material	2	Feet
XYZ-2	2 inch Dia Frame Tube Material	8	Feet
XYZ-3	1.5 inch Dia Forks Tube Material	3	Feet

Bill of Material (BOM)

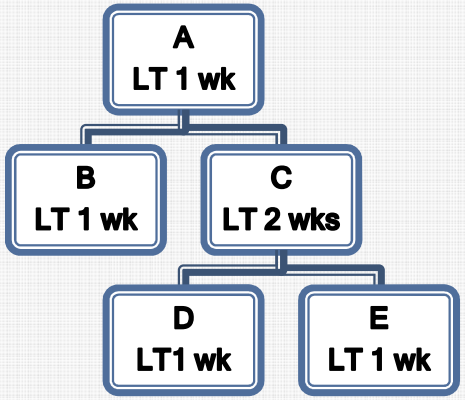


Understanding Time-Phasing



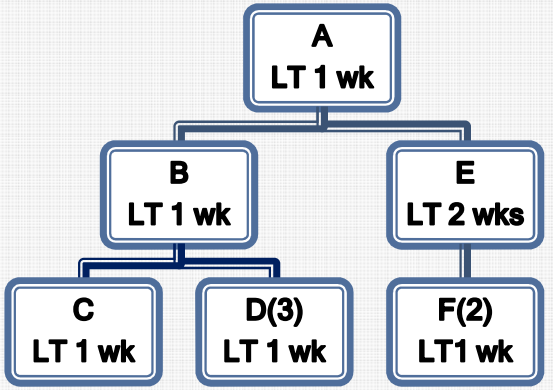
Exercise – Time Phasing

Item Number	Planned Order	Week				
		1	2	3	4	5
A	Receipt					100
	Release				100	
B	Receipt				100	
	Release			100		
C	Receipt				100	
	Release		100			
D	Receipt		100			
	Release	100				
E	Receipt		100			
	Release	100				



Exercise – Time Phasing

Item Number	Planned Order	Week					
		1	2	3	4	5	6
A	Receipt						200
	Release					200	
B	Receipt					200	
	Release				200		
C	Receipt				200		
	Release			200			
D	Receipt				600		
	Release			600			
E	Receipt					200	
	Release			200			
F	Receipt			400			
	Release		400				



MRP – Functions

- Lead time offsetting, explosion calculations, inventory calculations
- Create Action and Exception messages

MRP – Use of Software

- Planned Order
- Released Order
- Firm Planned Order

Capacity Requirements Planning (CRP)

- Is a check on resources needed to support the Material Requirements Plan.
- It determines in detail the amount of labor and equipment resources needed to support the production requirements.

Understanding Time Fences and Zones

- Liquid Zone
- Slushy Zone
- Frozen Zone

Quiz

1		Which of the following does not belong?	
	a	Frozen Zone	
	b	Liquid Zone	
	c	Soft Zone	Answer
	d	Slushy Zone	
2		Which of the following is not an input to MRP?	
	a	Safety Stock	
	b	BOM	
	c	Scrap factor	
	d	All are an input to MRP	Answer
3		Which of the following is true about time fences?	
	a	Changes can be made easily in the liquid zone	Answer
	b	Making schedule changes in the future are costly.	
	c	Changes can be made easily in the frozen zone	
	d	None of the above	
4		Which is not an element of lead time?	
	a	Transfer	Answer
	b	Run	
	c	Setup	
	d	Queue	
5		CRP is a capacity check on?	
	a	MPS	
	b	RCCP	
	c	MRP	Answer
	d	Rate	

Section 7

Capacity Requirements Planning (CRP) in detail

The process of calculating in detail the amount of labor and equipment resources necessary to accomplish a desired level of production output.

Determining Available Capacity

- Available Time
- Utilization
- Efficiency

Available Time

If a manufacturing department in a company has 5 machines that work 8 hours a day and five days a week, what is the available time of that department?

Using the formula: Available Time (hrs) = number of machines x number of hours/day x number of days/week.

Answer: 5 x 8 x 5 = 200 hrs/week

Available Time

The company receives a new contract and the department buys a new machine and adds a 2nd shift, what is the available time?

Answer: 6 x 16 x 5 = 480 hrs/week

Utilization

If a department is available for 200 hrs/week but the hours actually worked only amounts to 150 hrs, what is the utilization of the department?

Using the formula: Utilization = hours actually worked divided by available hours x 100%

Answer: 150/200 x 100% = 75%

Efficiency

If a department has an output of 250 standard hours for the week and actually worked 200 hours, what is the efficiency?

Using the formula: Efficiency = standard hours of work divided by hours actually worked x 100%

Answer: 250/200 x 100% = 125%

Rated Capacity

Using the data from the earlier examples, available time = 200 hrs/week, utilization = 75%, efficiency = 125%, what is the rated capacity?

Using formula: Rated Capacity = available time x utilization x efficiency

Answer: 200 hrs/week x 75% x 125% = 188.5 or 189 hrs/week

Exercise – Capacity

A company that manufactures tire rims has a department of 4 machines that work 8 hours a day, six days a week. Last week due to vacation and illness, actual hours worked by the department was 144 hours. The department on average achieves 115% efficiency.

What is the department's Rated Capacity for the week.

Answer:
Available Time: 4 x 8 x 6 = 192 hrs/week
Utilization: 144 hours / 192 hours x 100% = 75%
Efficiency = 115%
Rated Capacity = 192 hours x 75% x 115% = 165.6 or 166 hours

Quiz

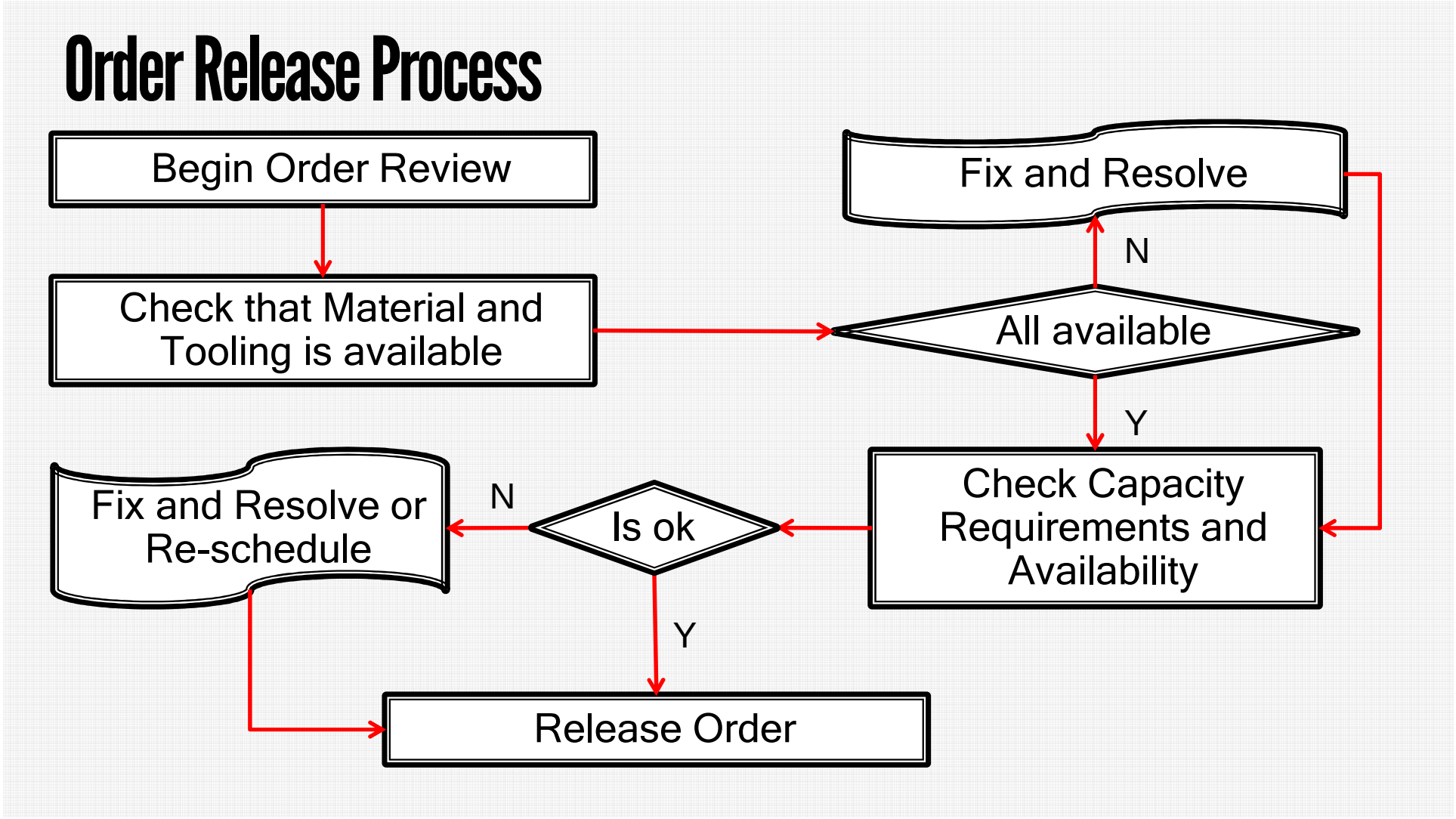
1		What is the liquid zone?	
	a	Has many open orders.	
	b	Schedule changes are difficult to make	
	c	It is a point in time that is beyond the planning time fence.	Answer
	d	It is within the lead time of a part	
2		How many elements of lead time are there?	
	a	4	
	b	7	
	c	5	Answer
	d	6	
3		Utilization is?	
	a	Available hours divided by actual hours worked	
	b	Hours each day divided by 24	
	c	Hours each week divided by 40	
	d	Hours actually worked divided by available hours	Answer
4		A Planned Order?	
	a	This is an order that has been released into work.	
	b	This is an order that is created by the MRP software to satisfy demand.	Answer
	c	This is an order that cannot be changed once created.	
	d	This order is not under the control of MRP.	
5		CRP is?	
	a	The most detailed capacity check.	Answer
	b	The least detailed capacity check.	
	c	Customer Relationship Planning	
	d	Customer Requirements Planning	

Section 8

What is Production Activity Control?

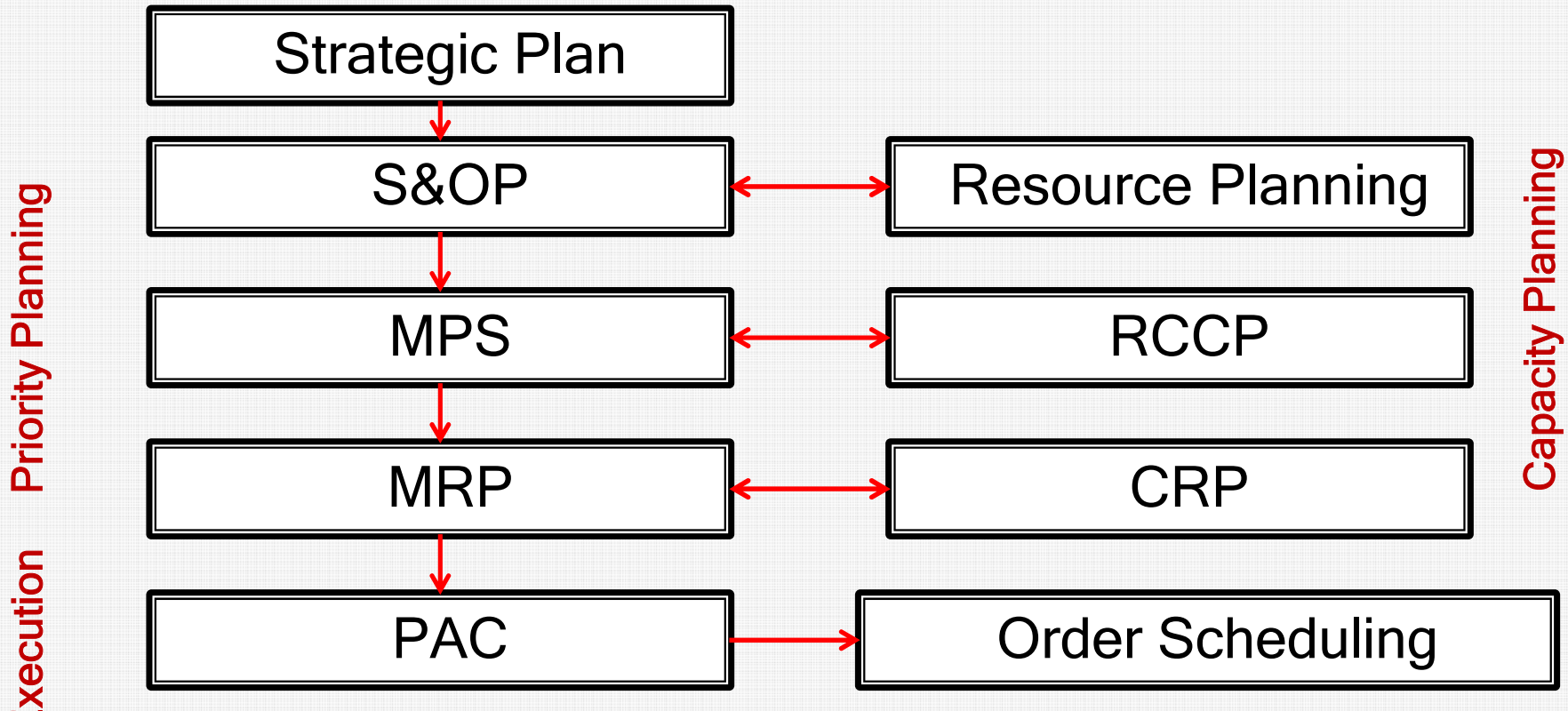
- Executes the Master Production Schedule and the Material Requirements Plan.
- Ensures resources are used optimally.
- Minimizes the work-in-process.
- Ensures customers receive their orders on-time.

Order Release Process



Section 9

Manufacturing Planning & Control Hierarchy



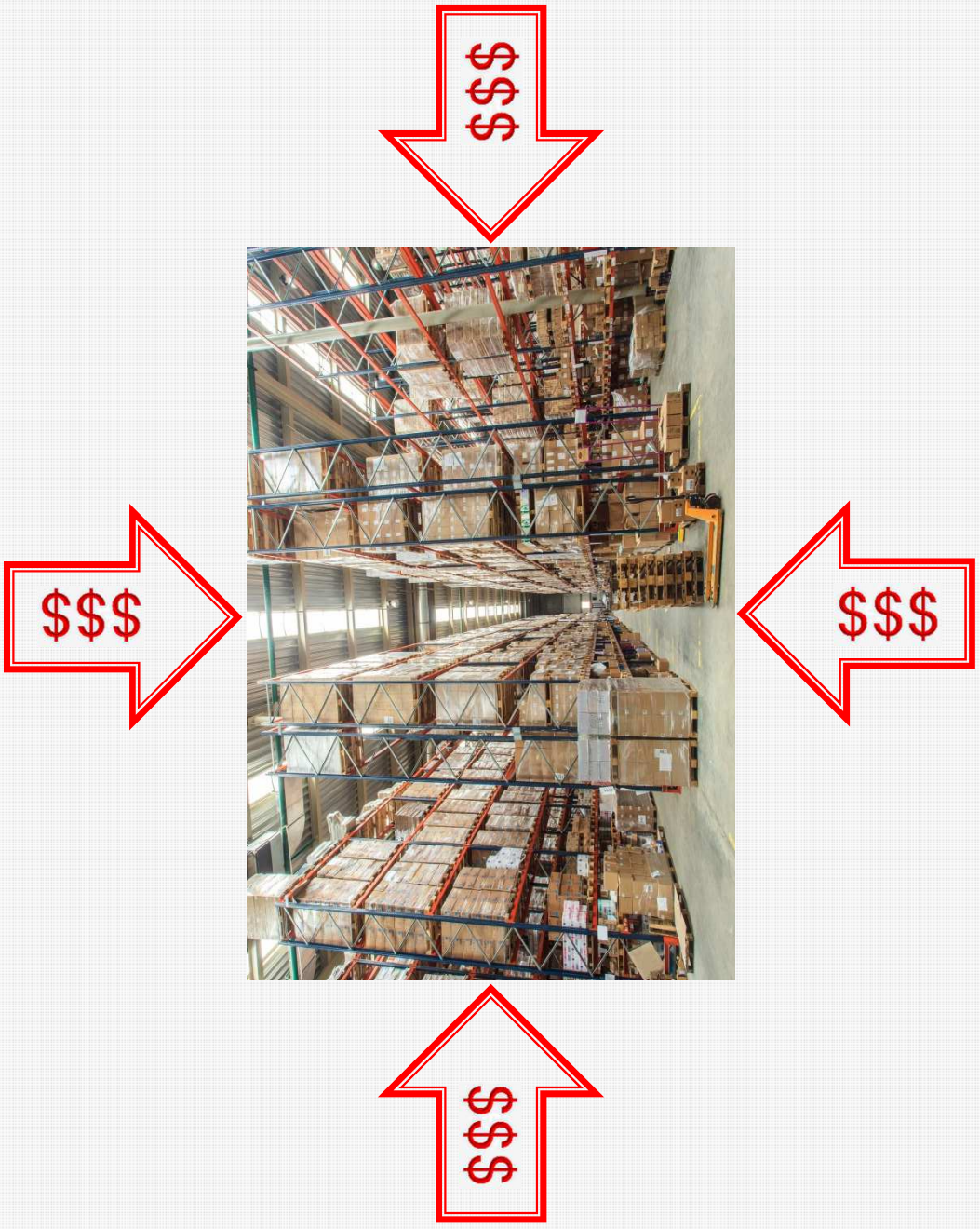
Quiz

1		Which is not part of Capacity Planning?	
	a	Workload Check	Answer
	b	Resource Planning	
	c	CRP	
	d	RCCP	
2		Which is part of the MPC Execution stage?	
	a	Strategic Planning	
	b	S&OP	
	c	PAC	Answer
	d	MRP	
3		Which is not part of Priority Planning?	
	a	S&OP	
	b	MRP	
	c	PAC	Answer
	d	MPS	
4		What is a disadvantage of the Level Production strategy?	
	a	May increase scrap.	
	b	May result in lower production costs.	
	c	May require an external source.	
	d	May result in an inventory buildup.	Answer
5		The Frozen zone is also referred to as?	
	a	Cold Zone	
	b	Ice Zone	
	c	Cool Zone	
	d	None of the above	Answer

Section 10

What is Inventory?

- Raw Material
- Work-in-Process
- Finished Product
- MRO



Customer Service

- A commitment / a mission
- A performance measure
- A task

Customer Service and Safety Stock

Stock-out

A product is not available when and where a customer wants it.

- Customer waits for product to become available
- Back-order is created for the customer
- Customer goes elsewhere and seller loses sale
- Seller loses the customer and all future sales

Carrying Cost vs. Ordering Cost

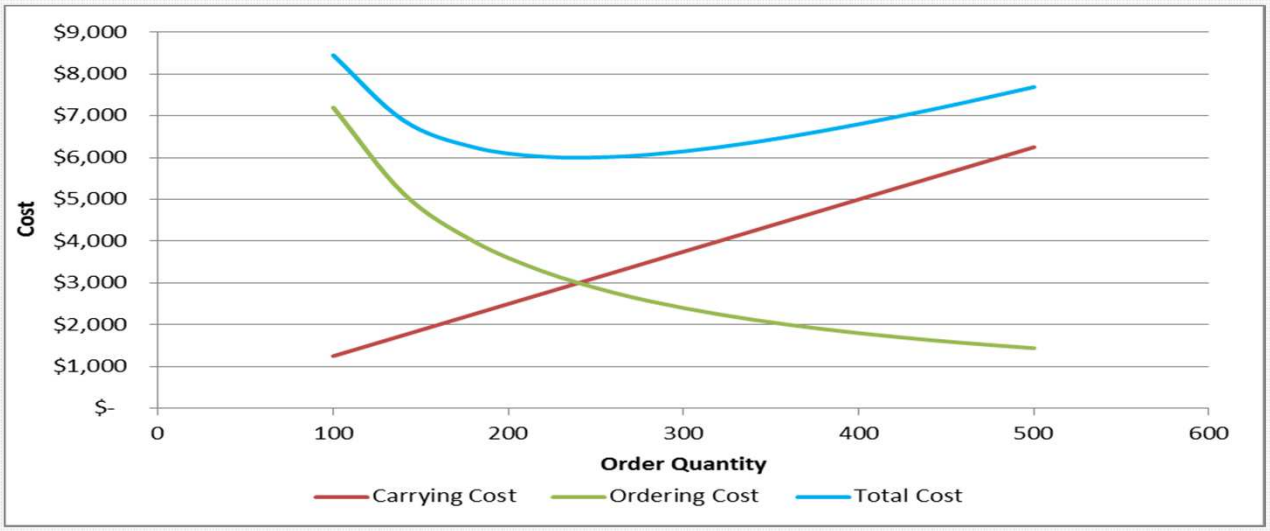
Carrying Cost:

- Capital Cost
- Storage Cost
- Risk Cost

Ordering Costs:

- Factory Orders
- Purchase Orders

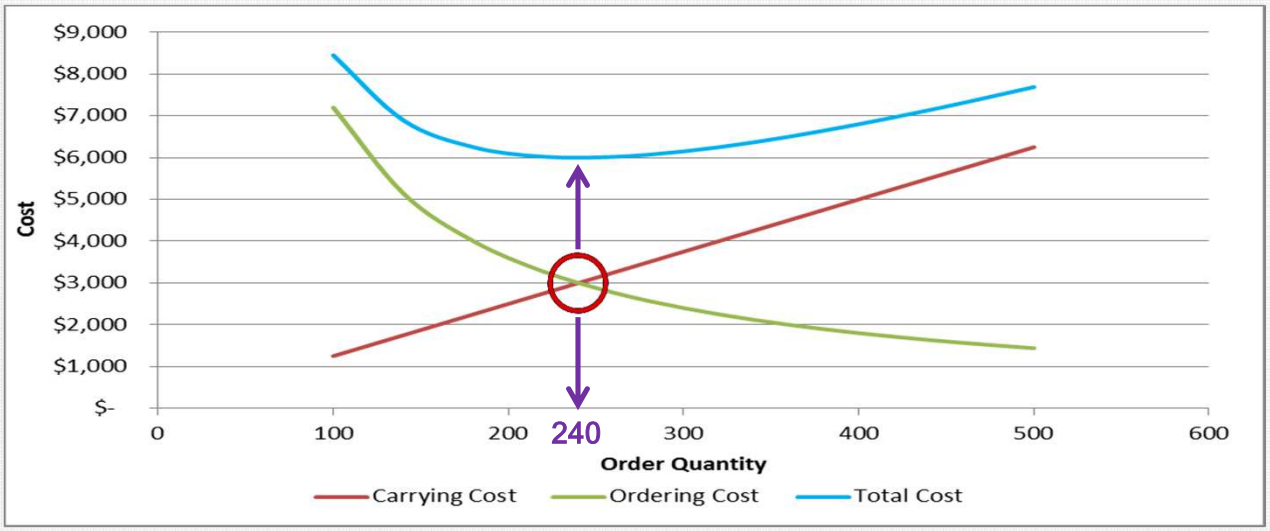
Carrying Cost vs. Ordering Cost



What is EOQ?

Economic Order Quantity is a lot sizing rule used to calculate how much material to order.

Carrying Cost vs. Ordering Cost



Inventory Management

- Vendor Managed Inventory (VMI)
- Consignment Inventory
- ABC Analysis

ABC Analysis

Class	Percent of Items	Percent of Impact
A	20	80
B	30	15
C	50	5

ABC Analysis

A	B	C	D	E	F	G
Item Number	Sales ($)	Item Number	Sales ($)	Cum. Sales	Cumulative %	Classification
1	$ 15,289.00	8	$ 221,873.00	$ 221,873.00	44% 221873/508300	A
2	$ 158,427.00	2	$ 158,427.00	$ 380,300.00	75% 380300/508300	A
3	$ 644.00	5	$ 48,149.00	$ 428,449.00	84% 428449/508300	B
4	$ 8,893.00	7	$ 29,962.00	$ 458,411.00	90% 458411/508300	B
5	$ 48,149.00	10	$ 19,112.00	$ 477,523.00	94%	B
6	$ 4,589.00	1	$ 15,289.00	$ 492,812.00	97%	C
7	$ 29,962.00	4	$ 8,893.00	$ 501,705.00	99%	C
8	$ 221,873.00	6	$ 4,589.00	$ 506,294.00	100%	C
9	$ 1,362.00	9	$ 1,362.00	$ 507,656.00	100%	C
10	$ 19,112.00	3	$ 644.00	$ 508,300.00	100%	C
Total	**$ 508,300.00**	**Total**	**$ 508,300.00**			

Quiz

1		Which is not a form of inventory management?	
	a	VMI	
	b	ABC analysis	
	c	Efficiency	Answer
	d	Consignment	
2		Ordering costs do not include?	
	a	Scheduling	
	b	Cost of receiving the product	
	c	Issuing a purchase order	
	d	Utilities	Answer
3		Which is not an inventory carrying cost?	
	a	Obsolescence	
	b	Capital Cost	
	c	Pilferage	
	d	Ordering	Answer
4		Which of the following is not considered inventory?	
	a	WIP	
	b	P.O.	Answer
	c	Raw material	
	d	Consumables	
5		Which does not belong with regards to Safety Stock?	
	a	Reduces customer satisfaction	Answer
	b	Buffer stock	
	c	Prevents stock-outs	
	d	Extra product	

Section 11

Meeting Customer Expectations

- Cost
- Quality
- Speed
- Dependability
- Flexibility

Section 12

What is Sustainability?

Meeting the needs of today without compromising the needs of tomorrow.

Supply Chain Sustainability

- Re-use
- Re-manufacturing
- Re-conditioning
- Recycling

Section 13

CONGRATULATIONS

Course Creator Acknowledgements:

- Teachings from APICS - The Association for Supply Chain and Operations Management.
- Teachings from Supply Chain Management by Coyle, Langley, Novack, Gibson.

Section 14

What's next?

- Demand Management.
  - Customer Relationship Management
  - Forecasting
  - Order Management
- Distribution Planning
- Vendor Management
- Collaboration
- Detailed Capacity Planning
- Lean
- Logistics
- A lot more exercises
- Many more skill testing questions