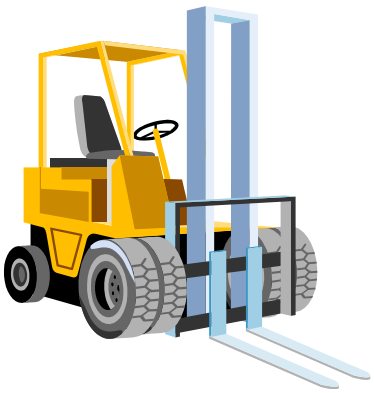
INVENTORY



Carrying a large amount of inventory is costly and a risk. Inventory represents a lot of money tied up and not out earning interest. It could be lost in an disaster or become obsolete. Other considerations include warehousing and the costs of workers associated with the warehouse. Also must take into account time value of money issues. Many ills associated with inventory.

On the other hand we never want to be caught with too little inventory, would not want to miss an opportunity. Must have what the customer wants when they want it (at a price they are willing to pay). Must strike a balance between having enough and not having enough. This is a great challenge.

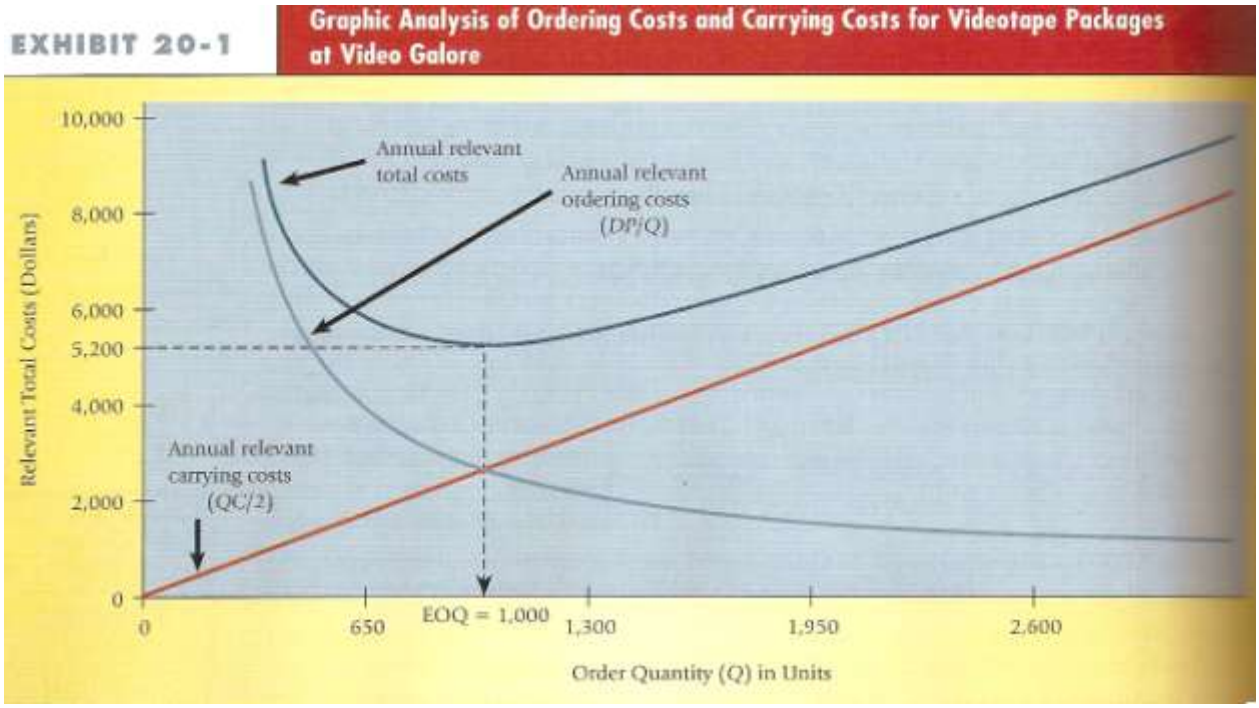
Just-In-Time inventory says purchase inventory just in time to provide the product to the customers. In this way we do not have it in inventory a long time. This increases our turnover ratio. But the manufacturer is dependent on the supplier as well as his ability to understand customer buying trends. Must also consider that you must have EXACTLY what the customer wants. If your product requires any kind of customization the challenge is even greater. Just-In-Time requires absolute coordination and quality in order to work. Must have a very reliable process and the parts you buy must me reliable. There are many things which can go wrong, cause glitches. The biggest improvements companies see from Just-In-Time are the improved teamwork and quality. Marketing must be able to reasonably forecast.

Economic Order Quantity Model

The Economic Order Quantity Model helps manufactures save enormous amounts in all 4 of the profitability categories (volume, unit sales price, unit variable costs, fixed costs). This is really a mathematical minimization model. The EOQ model said that if you took two times demand multiplied by the cost of a purchase order, divide by carrying cost and take square root. This gives a quantity that is economic to order. The model gives the quantity which is economic to order.

$$EOQ = \sqrt{\frac{2DP}{C}}$$

C = Carrying Costs **D = Demand** **P = Purchase Costs**



Actual purchasing costs decline as quantity purchased increases. Large order sizes require issuing less purchase orders. But if you buy a lot of stuff your carrying costs are going to increase. These are the two basic costs, cost or ordering inventory and the cost of carrying inventory. Carrying costs increase linearly with quantity where as you order higher quantities your ordering costs decline but in linearly. The intersection between these two kinds of costs at which the total of the two is at it's minimum. The heavy blue line (annual relevant total costs) is the sum of annual relevant carrying costs and annual relevant ordering costs and is minimized at the intersection of the two. In this example each is $2,600 which total to $5,200.

Annual Rel. Total Costs = Annual Rel. Carrying Costs + Annual Rel. Ordering Costs
Total Costs = Carrying Costs + Ordering Costs
At the intersection carrying costs = ordering costs
Carrying Costs + Ordering Costs
QC/2 = DP/Q ➔ **QC = DP**

Example:

Demand = 10,000 (for some period)
Purchase Costs = $245 per purchase order
Unit Carrying Costs = $10 (per peiod same as D)
①

$$EOQ = \sqrt{\frac{2DP}{C}}$$

$$EOQ = \sqrt{\frac{2 * 10{,}000 \text{ units} * \$245 \text{ per unit}}{\$10}} = \$700$$

EOQ says that when we order we should order in 700 unit quantities, that is the most economical quantity. Now we want to know how many purchase orders we are going to place per year. This is simply Demand divided by our EOQ order quantity:
②

$$\frac{D}{Q} = \frac{10000}{700} = 14.286 \text{ purchase orders per year}$$

(in our calculations we **MUST** use the full floating point fraction even though we know we are not going to order a fraction of a component)

Now we ask ourselves, what is the Total Relevant Costs (TRC) at that level? TRC has only two components, the cost of ordering plus the cost of carrying.
③

$$TRC = \left[\frac{D}{Q} * P\right] + \left[\frac{Q}{2} * C\right]$$

$\frac{D}{Q}$ = Number of Purchases
P = Cost per Purchase

$\frac{Q}{2}$ = Average Inventory
C = Cost of Carrying

In our example:

$$TRC = \left[\frac{D}{Q} * P\right] + \left[\frac{Q}{2} * C\right] = \left[\frac{10{,}000}{700} * 245\right] + \left[\frac{700}{2} * 10\right] = \$7{,}000$$

Reorder Point: At what point, as our stock goes down, do we reorder? Reorder point has a lot to do with how fast we are using inventory relative to the lead time. Say the lead time is 1 Week. Want to find out what the demand is per unit of time multiplied by the lead time which gives us the inventory point at which we should reorder.

If our lead time period is in Weeks, then we might as well convert our demand to the same units of time. Assume demand is 50 weeks.
④

$$RP = \text{Demand per Unit of Time} * \text{Lead Time}$$

$$RP = \frac{10{,}000}{50 \text{ Weeks}} * 1 \text{ week} = 200$$

This says that our demand is 200 units per week multiplied by 1 week says that our reorder point should be 200 units.

So now we start with 700 units in inventory and by the end of the first week we've used up 200 leaving 500. Second week we use another 200 taking the in stock inventory down to 300. Midway into the 3rd week we have used another 100 and are now down to 200 units in stock. We order the new quantity of 700 that day and continue to use our existing inventory while waiting for the new shipment to arrive. At the end of the 3rd week we will be down to 100 units in stock. Midpoint of the next week we are down another 100 and as we are pulling out the last unit of inventory the ordered quantity arrives,. That's Just-In-Time inventory.

Now, what happens if we disregard the Just-In-Time / EOQ principles. May be tempted to say that I know the carrying of $10 are much less then the purchasing cost of $245. May reason that it is cheaper to carry than order. May try to place orders of 2000 units. Now we are lowering the number of purchase orders placed to 5 per year which gives
5 * 245 = 1225 cost of ordering. Lets check what happens to our carrying costs:
(2000 / 2) * 10 = $10,000 which gives us our Total Relevant Costs:

TRC = $1225 + $10,000 = $11,225 whereas it had been $700. That's a 16x INCREASE in TRC just because we did not follow the EOQ model.

What if we try the opposite, say instead of ordering 700 units we only order 200.
Now D/Q = 10,000/200=50 orders placed per year. Our ordering costs are now
500 * 245 = $12,250. This leads to TRC = $12,250 + $1,000 = $13250 which is a 19x INCREASE in TRC!

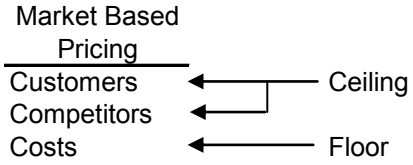
So the EOQ model can save enormous amounts. But there are several assumptions:
1) You can estimate the costs accurately.
2) Demand is straight line.

It can be difficult to get a handle on the costs that are incurred for ordering and carrying activities. But if you can then consider that manufactures order and inventory 1000's of parts and large savings can be realized on each one.

PRICING

Pricing, a very interesting area and an area a lot of people do not really understand. Pricing has a great deal to do with your profitability.
There are two parts or aspects to pricing. One is more artistic (**Market Based Pricing**) and the other is more scientific (**Cost Based Pricing**).

Consider that the market place is changing constantly. Competitors come up with new products, technology changes, pricing changes, needs change. It's not easy to pin down but you know that in a market based environment there are 3 things you must always remember, price will depend on three factors:



These are the three factors which impact pricing decisions. Your price is somewhere between the ceiling and the floor. Although there is an elasticity which occurs between your volume and your pricing. The higher you go up in price the lower your potential volume will be and bias-versa. This elasticity has an impact on profitability. What we are after is that point at which volume and price connect to maximize profitability. And the place you come to must fit your business model in the current competitive environment. Your target customers and what they will pay.

The costs we are considering here include the entire value chain of costs and earn a profit on top of that. Cannot sell for less than the cost of the entire value chain or you won't be able to pay the bills.

COST BASED PRICING

Company Budget (in thousands)			Job 123 (in Dollars)		
D/M	77,000		D/M	11,000	
D/L	10,600		D/L	1,515	
Other Direct	11,400		Other Direct	1,628	
Total Direct	99,000	126.3% of Direct Costs	Total Direct	14,143	
MFG O/H	125,000		MFG O/H burden of	17,857	@ 126.3% of Direct Costs
Total MFG Costs	224,000		Total MFG Costs	**32,000**	
Operating (rd, mkg)	136,000	60.7% of MFG Costs	Operational Costs of	19,429	@ 60.7% of Operational Costs
Total (**Full**) Costs	**360,000**		Total (**Full**) Costs	**51,429**	

The company projects their Total Costs to be $360,000 for the year, this is the amount they must be able to recover in their pricing. Along comes job 123, they must come up with a price for this job. They know what the D/M, D/L, and Other Direct will be.

At this point we must come up with the full costs for this project and a price!
To come up with this price we use two ratios:

$$\text{Overhead Burden} = \frac{\text{MFG O/H}}{\text{Total Direct}} = \frac{125{,}000}{99{,}000} = 126.3\%$$

$$\text{Operational Costs} = \frac{\text{Operating Exp}}{\text{Total MFG Costs}} = \frac{136{,}000}{224{,}000} = 60.7\%$$

Now in the job we apply the Overhead Burden to the Total Direct Costs and the Operational Costs to the Total Manufacturing Costs.

These ratios allow us to easily estimate our MFG O/H and Operational Costs for any job.
We use these ratios to fully costs this job.

Now that we have calculated Full Costs for our jobs it is time to add in Profit.
There are two ways to compute the profit margin: **Cost Plus Basis** and on the basis of a commercial price which is a **Desired Profit Percent of Sales**.

20 % Profit Margin

Full Costs = $51,429

	Cost Plus	Desired Profit as a % of Sales	
Cost	51,429	Cost	
Profit %	x 1.20	1 - Profit %	
Job Price	61,715		
		51,429 / 1 - .2	= $ 64,286
Price	61,715	64,286	
-- Full Costs	-- 51,429	-- 51429	
Profit	$10,286	**$12,857**	
Price Diff =	**$2,571**		

Keep in mind in the Cost Plus column the $10,286 is 20% of Costs, not 20% of sales. This is the government "cost plus" pricing method.

If you want to make a percent of sales on your bottom line use the Desired Profit as % of Sales method.

Note that these two methods give different profit margin, in the above example Desired Percent gives $2,571 more.

Key is understanding your full costs and being able to compute it on a particular job. Then knowing how to mark up your costing to come up with a reasonable price.

Homework from notes (written on board) and pb 20-18.