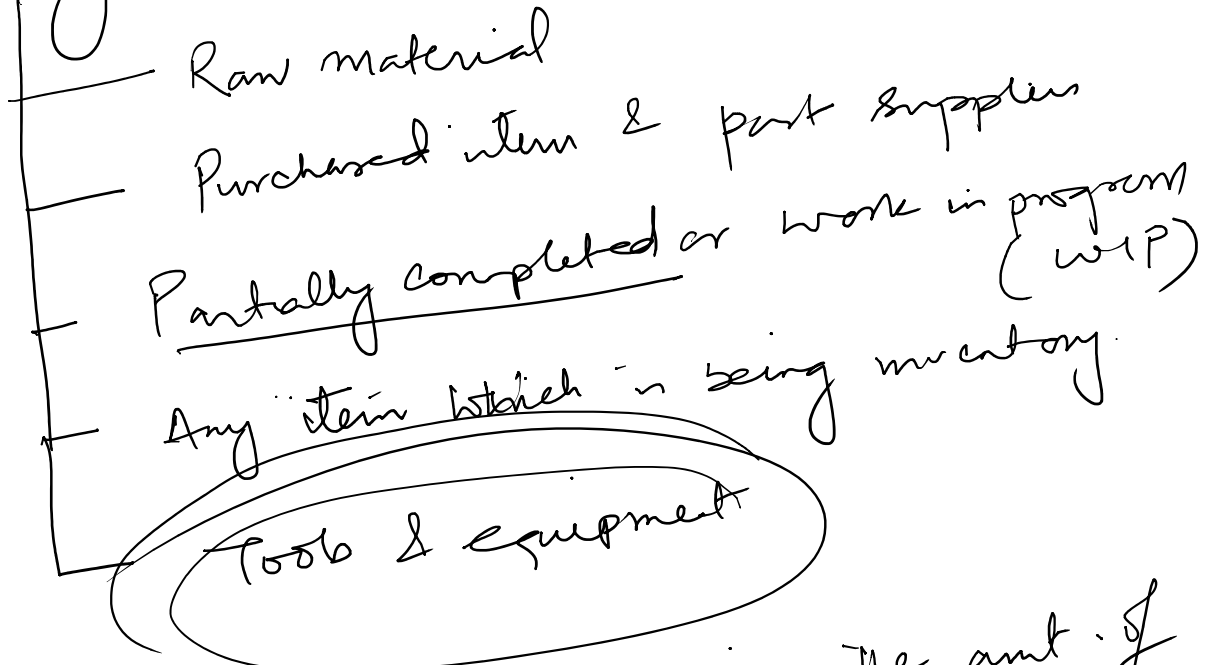


# Elements of Inventory Management

## 1. Inventory



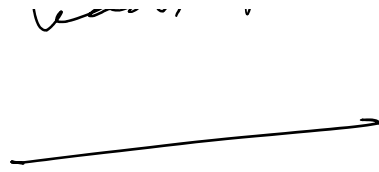
Inventory Mgt. is to determine the amt. of inventory to keep in stock, how much to order & when to replenish or order.

## 2. Demand

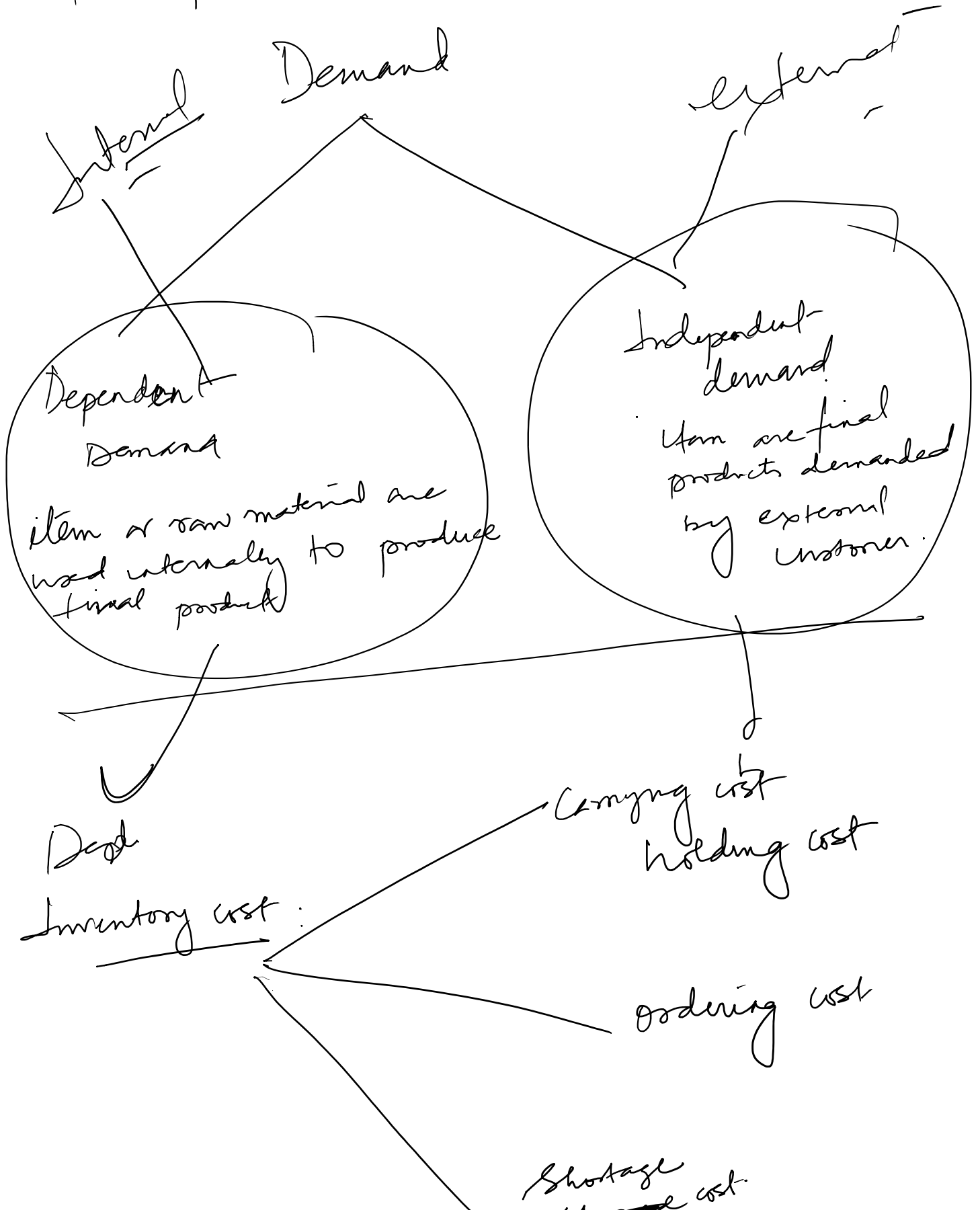
Forecasting  $\times$  Inventory Mgt

Better forecasting leads to better Inv. Mgt. Stock out!

Better forecasting  
Poor forecasting

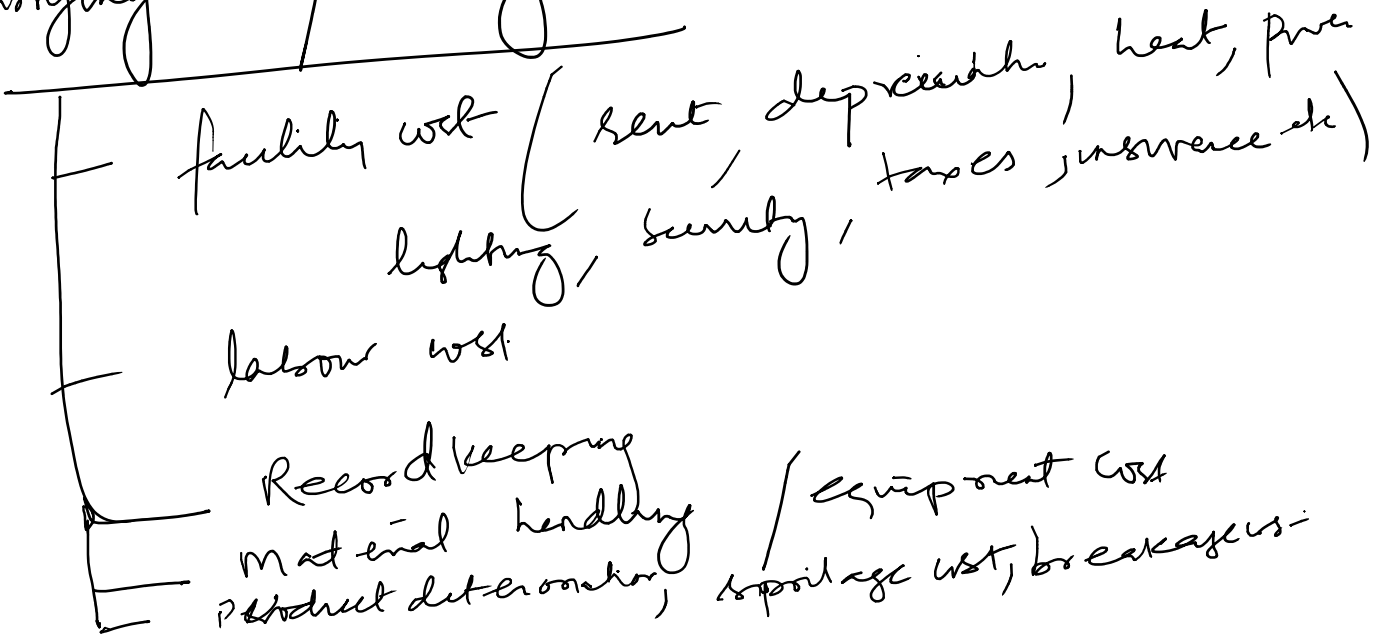


Stock out /  
under stock



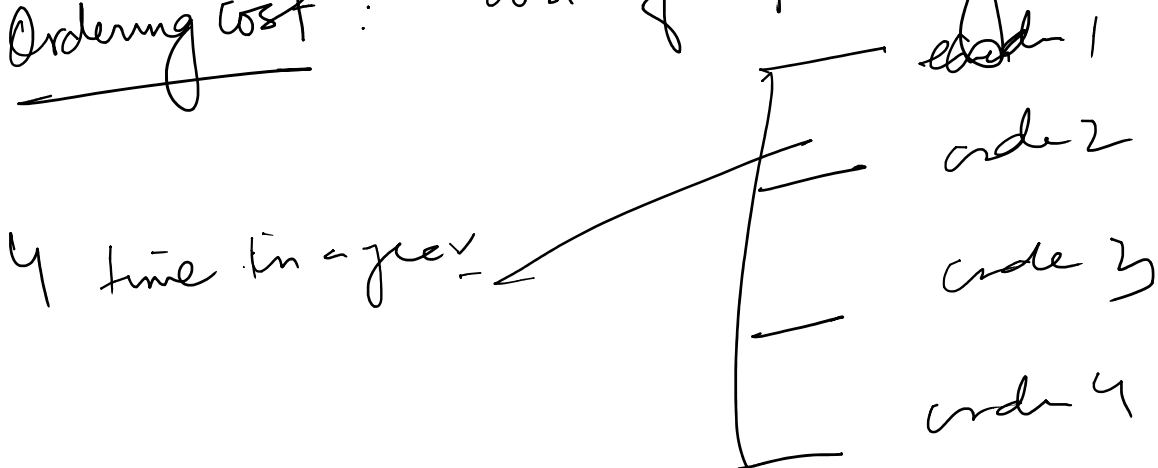
Shortage  
~~Usage~~ cost.

Carrying cost / holding cost.



Carrying cost can range from 10% to 40% of the value of a manufactured item.

2. Ordering cost : cost of replenishing inventory.



3. Shortage cost : temporary or permanent loss of ... not be met.

3. 10000 0  
Temporary or permanent ...  
sales when demand cannot be met.

Stockout cost  
Stockage  $\propto$   $\frac{1}{\text{Carrying cost / holding cost}}$

Stockage

EOQ

Inventory Control System



Continuous Inventory system (fixed order quantity)  
... at when

↓  
A constant amount is ordered when inventory declines to a pre-determined level

Periodic Inventory level: (fixed time period system inventory or periodic review system)  
An order is placed for a variable amount after a fixed passage/period of time

## Economic Order Quantity Model

EOQ

- 
- Moonehem
1. It was established in 1996 in Yangzhou China
  2. They renowned as leading mfg of:  
... industrial chemical ... cosmetic chemical

- b) Speciality Chemical (i.e. ~~cosmetics~~)
- c) ~~Food additives~~
- d) pharmaceutical chemical.

3. They have 8 mfg. plants & 40 distribution centres worldwide.

4. In the speciality chemical market, Moondra has differentiated the US Midwest region for laying out a new concept of consignment inventory.

Consignment Inventory is a supply chain model in which product/unit is sold by a retailer, but ownership is retained by the producer/supplier until the product has been sold.

5. If consignment inventory model found to be profitable, Moondra plan to launch it at a national level.

## Problem Overview of the case

1. Business review

1. Moonchem's year end business review meeting reveals the new inventory strategy of <sup>cc</sup> consignment inventory has delivered low inventory turnover ratio (ITR).

$$ITR = \frac{\text{annual sale value of good sold}}{\text{avg. inventory value}}$$

• require of a stable product demand from the customer

• Over 50% of moonchem inventory has been classified as <sup>cc</sup> consignment inventory.

• Only 20% of their total no. of customer use consignment inventory.

• Mr. John Krueger, VP of supply chain Dept of Moonchem Company decided to look how consignment inventory is being managed & to come up with an appropriate increase in the ITR value.

manager -

plan to increase The ITR value.

## Question

1. What is the current Annual cost of Moonchem's strategy of sending full truck load to each customer in the pernia region to replenish consignment inventory?
2. Consider different delivery option & evaluate the cost of each option. What delivery option do you recommend for moonchem?
3. How does your recommendation impact consignment for moonchem?

## Solution Strategy

1. 
$$ITR = \frac{\text{Annual sale value of good sold}}{\text{Average Inventory value}}$$
2. Moonchem can't influence the demand from its customer.  
- increase inventory value

3. But it ~~can~~ decrease the ~~amount~~ U  
 by decreasing:
1. Cycle Inventory
  2. Subsequently the total annual cost incurred.

— they conduct pilot study in the  
 Peoria Region of US mid west  
Illinois state for the consequential  
Inventory distribution Strategy Analysis

Customer type	no. of customer	Total consumption lb/month
Small	12	1000 pounds/mo
medium	06	5000 pounds/mo
Large	02	12000 pounds/mo

Operational  $\triangleright$  de

Logistic contractor —

Golden Foneking

Tonnel capacity — 40,000 pounds

	full truck, single customer Drop off	full truck, multiple customer drops off
Transportation cost	\$400 / truck	\$350 + \$50 / drop off

Holding cost (h) = 0.25 (ie 25%)

Unit cost (C<sub>s</sub>) = (C<sub>m</sub>) = (C<sub>L</sub>) = \$1 / pound

existing strategy

if Moon Chen send full truck to each customer.  
irrespective of customer type

$$Q_s = Q_m = Q_L = 40000 \text{ pounds}$$

$$\text{order frequency} = 'n' = \frac{D}{Q}$$

$$ATC = \frac{Q}{2} \times h \times C$$

$$AAC = D \times S$$

$$AVC = \frac{VC}{Q}$$

$$ATC = AVC + AFC$$

Existing strategy of moonchem

for small retailers

$$\text{Demand / year (D)} = \underline{12000 \text{ pounds}} \quad (1000/mo)$$

$$\text{fixed cost / shipment (S)} = \underline{\$400}$$

$$\text{fixed order size} = \underline{40000 \text{ pounds}}$$

$$\text{cycle inventory } \frac{Q}{2} = \frac{40000}{2} = \underline{20000 \text{ pounds}}$$

$$\text{order frequency} = \underline{0.3}$$

$$\frac{Q}{2} \times h \times c = \frac{20000}{2} \times 0.3 \times 1$$

$$\begin{aligned} \text{Annual holding cost (AHC)} &= \frac{Q}{2} \times h \times c \\ &= 20000 \times 0.25 \times 1 \\ &= \underline{\$5000} \end{aligned}$$

$$\text{Annual Ordering Cost} = \frac{D}{Q} \times S$$

$$= \frac{12000 \times 400}{115000}$$

$$= \$120$$

$$\text{Annual Total Cost} = 5000 \times 120 = 5120$$

for medium

$$\text{Demand} = 5000 \times 12 = 60000$$

$$\text{fixed cost / shipment (S)} = \$400$$

$$\text{fixed size order} = 40000$$

$$\text{cycle time} = 20000 = \left(\frac{Q}{2}\right)$$

$$\text{order frequency (n)} = \frac{60000}{40000} = 1.5$$

$$\text{ATC} = \frac{Q}{2} \times h \times C = 20000 \times 0.25 \times 1$$

$$\text{ADC} = \frac{D}{Q} \times S = \frac{60000}{40000} \times 400 = \$600$$

$$\text{ATC} = \$5600$$

for large order.

$$\text{Demand (D)} = 12 \times 12000 = 144000$$

$$\text{forecast/order}(s) = \$4000$$

$$\text{fixed order size } (Q) = 40000$$

$$\text{cycle inventory} = Q/2 = 20000$$

$$\text{order frequency} = 'a' \quad \frac{144000}{40000} = 3.6$$

$$\text{ATC} = \frac{Q}{2} \times h \times C = 5000$$

$$\text{AOC} = \frac{144000}{40000} \times 400 = \$1440$$

$$\text{ATC} = \$6440$$

Total cost for this system

$$= 5120 + 5600 + 6440$$

$$= \underline{\underline{\$17160}}$$

My strategy - that I'll go with  
no aggregation model

The products are delivered independently to each type of customer in a "Just-in-Time" basis where optimal order quantity for each type of customer is predicted by using basic EOQ (economic order quantity) models.

$$Q^* = \sqrt{\frac{2 \times D \times S}{h \times C}}$$

$$n = \frac{D}{Q}$$

for small retail

$$D = 12000$$

fixed cost per order = \$400

$$Q^* \text{ (optimal order size)} = \sqrt{\frac{2 \times 12000 \times 400}{0.25 \times 1}}$$

$$\text{cycle inv} = \frac{Q}{2} = \frac{6196}{2} = 3098$$

$$\text{order freq} = n = \frac{D}{Q} = \frac{12000}{6196}$$

$$\text{AHC} = \frac{Q}{2} \times h \times C = \frac{3098}{2} \times 0.25 \times 1 = 775$$

$$\text{AOC} = \frac{D}{Q} \times S = \frac{12000}{6196} \times 400 = 775$$

$$\text{ATC} = 775 + 775 = \$1550$$

for medicine

$$D = 60000$$

$$s = \$400$$

$$Q^* = \sqrt{\frac{2 \times 60000 \times 400}{0.25 \times 1}}$$
$$= 13856.41$$

$$n = \frac{D}{Q} = \frac{60000}{13856} = 4.33$$

$$AFC = \frac{Q}{2} \times h \times c$$

$$= \frac{13856}{2} \times 0.25 \times 1$$

$$= \$1732$$

$$AOC = \frac{D}{Q} \times s = \frac{60000}{13856} \times 400$$

$$= \$1732$$

$$ATC = 1732 + 1732 = \$3464$$

for large stocks

$$D = 144000$$

$$S = \$400$$

$$Q^* = \sqrt{\frac{2 \times 144000 \times 400}{0.25 \times 1}}$$

$$= 21466$$

$$\text{Cycle time} = \frac{Q}{2} = \frac{21466}{2} = 10733$$

$$'n' = \frac{D}{Q} = \frac{144000}{21466} = 6.7$$

$$\text{ATC} = \frac{Q}{2} \times h \times C = \frac{21466}{2} \times 0.25 \times 1 = 2683$$

$$\text{AOC} = \frac{D}{Q} \times S = \frac{144000}{21466} \times 400 = 2683$$

$$\text{ATC} = 2683 + 2683 = 5366$$

TC of delivery strategy with  
no aggregation.

$$5366 + 3467 + 1550$$

$$= \underline{\$10380}$$