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05/11/21

Q1

$$a) EOQ = \sqrt{\frac{2 \times D \times C_o}{C_h \left(1 - \frac{d}{P}\right)}}$$

$$I_{\max} = Q \left(1 - \frac{d}{P}\right)$$

$$TC = \left(\frac{D}{Q} \times C_o\right) + \frac{I_{\max}}{2} \times C_h$$

$$D = 55,000$$

$$C_o = 350$$

$$C_h = 12$$

$$d = 3500$$

$$P = 4200$$

$$\therefore EOQ = \sqrt{\frac{2 \times 55000 \times 350}{12 \left(1 - \frac{3500}{4200}\right)}}$$

$$= \sqrt{\frac{38500000}{12.04}}$$

$$Q = 4344.25$$

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$$a) \text{cont } I_{\max} = Q \left(1 - \frac{d}{p}\right)$$

$$= 4344.25 \left(1 - \frac{3500}{4200}\right)$$

$$= 4344.25 \times 0.17$$

$$I_{\max} = \underline{724.04}$$

$$TC = \left(\frac{D}{Q} \times C_o\right) + \left(\frac{I_{\max}}{2} \times C_H\right)$$

$$= \left(\frac{55000}{4344.25} \times 350\right) + \left(\frac{724.04}{2} \times 12\right)$$

$$= 4431.14 + 4344.24$$

$$\therefore TC = \underline{\pounds 8775.38}$$

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- 5) Decisions on managing inventory is critical. The last thing a company needs is unused stock in the warehouse. 1 because money has already been paid to buy the product and 2 this stock stops any 'needed' inventory to be stored.

The company needs to decide what type of inventory to hold. This inventory could be make to order (MTO), Make to stock (MTS) or Assemble to order (ATO). Depending on the business the make to order decision ~~is~~ could mainly be for bespoke or rare products, this is because the company will not know what to order until an order has been raised.

Businesses also make lots of product ~~but~~ that would have the same design but allows for extra parts to be added. Therefore the company would hold just made products and stores as inventory and then when an order is raised can finish the item off to the customers specification. Make to stock inventory is primarily for businesses that make (off the shelf) sales or know quantity of products well in advance.

Depending on the type of business will depend on the product they manufacture.

How much stock and when to order is another essential decision/exercise that needs to be agreed. The factors that will make the decision is:

- Buffer inventory
- Service levels
- Re-order point
- Demand forecast

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An equation can be used to estimate the service level that needs to be maintained. This will allow to hold some inventory at acceptable levels.

$$\text{Service level} = \frac{\text{Customers served without delay}}{\text{Total orders received}}$$

There is also a 'stock out' protection level that can be calculated.

$$100 \times (1 - \text{probability of a stock out})$$

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c) Costs associated with holding inventory are:

- Cost of placing the order
- Stock out cost
- Price discount costs
- Storage Costs
- Working capital costs
- Obsolescence costs
- Production inefficiency.

There are 2 types of Costs, Direct & indirect.
Direct Costs are Risk

- Service
- Capital
- Storage
- Damage

Indirect costs :

- Business risks
- Opportunity cost
- Incremental Cost

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Q2

a) $OEE = Availability \times Quality \times Performance$.

$\therefore Availability = \frac{\text{Operating time}}{\text{planned production time}}$.

10 hrs shift

30 min break

15 min break

15 min break

30 min Downtime

$10 \text{ hrs} = 10 \times 60 = 600 \text{ mins}$

$\therefore 600 - 30 - 15 - 15 - 30 = 510 \text{ min}$

$\therefore Availability = \frac{510}{600} = \frac{0.85}{0.94} = 0.85 \text{ or } 85\%$

$Quality = \frac{\text{Good pieces made}}{\text{total pieces made}}$.

Good = 37220

Total = 37,600

$\therefore Quality = \frac{37,220}{37,600} = 0.99 = 99\%$

$Performance = \frac{\text{total pieces/operating time}}{\text{run rate}}$.

Cycle time = 110 p/min

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$$\text{Performance} = \frac{37,220}{540} = \frac{68.92}{110} = \text{OEE of } 62\%$$

$$\begin{aligned}\text{OEE} &= 0.94 \times 0.99 \times 0.62 \\ &= 0.58 \text{ or } 58\%\end{aligned}$$

b) The 6 big losses are:

1) Breakdowns - These will include tooling failures, equipment failures, unplanned breakdowns. Any breakdown results in the machine/equipment not producing any items and therefore losing money.

2) Set ups - This includes tool changes, operators training, adjustments and warm up time among many others

3) Start up rejects - This includes rework, scrap, incorrect assembly requiring rework

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4) Production rejects - Such as Scrap, rework, damage, bad assembly.

Any reject is a loss of money and material.
Any machine downtime is money ^{loss} due to ~~lack~~ of produced items.

5) 5 potential benefits of carrying out planned maintenance are:

1) To avoid downtime. Any unplanned downtime reduces the factory output. By planning maintenance, you can plan when it can be carried out without disruption to the product.

2) Minimise repair costs. It is more beneficial to maintain the machines preventing breakdowns and losing money/profit due to repair costs, new parts costs and also not making any money due to the machine not functioning.

3) To prevent employee downtime. If the machine suddenly breaks down, potentially the factory will at some point, stop! If the factory is not producing anything then the employees will be getting paid to stand around until the machine is repaired.

4) To increase the machines running life. Like any machine, maintenance will enhance the performance for a longer working life. The longer the machine works, the sooner it is ~~paid~~ paid off and produce more profit for the company.

5) Higher quality. By maintaining the machines enables the machines to run smoothly to produce high quality parts.

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4 a) Dapper Thomas 1905425
Value Stream Mapping is essential in manufacturing. It allows you to:

- Visualise the whole process from start to finish.

- Helps identify any waste in the whole process

- Provides a common language when discussing process, a good visual for everyone to understand the production rate.

- It helps to make decisions about the flow of the product

- It involves lean principles that can make the company more 'lean'

- Can help in planning new products and help to understand how it can be made cheaper etc...

- Helps design/implement the product from cradle to grave

- It is also used for information flow as well as material flow

- It holds/shows more information than older tools

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It is a qualitative tool where you describe in detail how a product should be made and how the factory should run.

The process map can show priority ratings and help decide if extra stations are required due to bottlenecks, or the opposite! Some stations could be amalgamated.

By utilising a process map with factory layout, process flow, information flow, material flow, you are able to see pictorial evidence of all waste. It helps employees across the whole company to understand where changes are needed and be able to make financial decisions based on the map.

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b) Current state map.

To construct a current state map you will need to walk the factory floor door to door. During this walk you start by:

- Plotting the stations
- Plotting the machines
- Plot the flow of materials

You place these in blocks at the start.

When this 'basic' map has been drawn the next step is to go deeper into each process, and keep doing this until you can't go any further.

While doing the 'walkround' collect current state papers only together with material flow and information flow. It is good practice to start at the finished end or shipping end and walk backwards to the beginning of the process.

It is also good practice to time each operation. This will give a good example of how much work is carried out at each stage. Do this process on yourself as everyone has different styles and this will muddy the over all process map.

Typical icons for this map are

assembly

- include manufacturing processes.

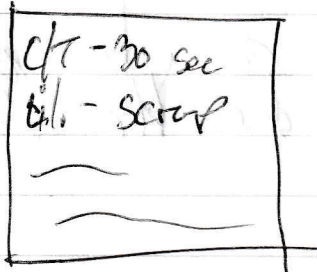
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— outside sources



— This is good, easy and simple to understand for each station/process



— Manual flow



— electronic flow

The Current State map will start with customer requirements with the outside sources con. together with data box to show customer requirements etc. Then input the factories production process box's. These process boxes shows material and information flow. If the process has a break in it (for example it is required to have to a different site for work to be continued) then the process box stops

Ideal process data required to get an accurate picture of the whole process are: -

- Cycle times
- Change over times
- No. of people
- No. of their ~~various~~ variants
- up time

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- Production batch size
- Pack size
- Scrap rates

From all this information it is easy to determine the current state and to enable the future state map to begin.