

Q1

- a) Given: $D = 55,000$ units Annually
 D (Monthly) = $35,000$ units
 $C_0 = £350$
 $C_h = £12$ / unit

We need to calculate

- a) Economic Production Quantity
b) Annual cost

Solution

a) $EPQ = \sqrt{\frac{2 C_0 D}{C_h \left[1 - \frac{d}{P}\right]}}$

$$= \sqrt{\frac{2 (350) (55,000)}{12 \left(1 - \frac{146}{140}\right)}}$$

* $d = 140$
 $P = 116$

$$EPQ = 1368$$

b) Total annual cost = $\frac{D}{Q} \times C_0 + \frac{I_{\max}}{2} \times (C_h - (A))$

$$I_{\max} = Q \left(1 - \frac{d}{P}\right) = 1368 \left(1 - \frac{116}{140}\right)$$

$$I_{\max} = 234$$

Now (A) becomes

$$\text{Total annual cost} = \frac{55000}{1368} \times 350 + \frac{234}{2} \times 12$$

$$= £15,475$$

Q1 1- How much inventory to hold.

b) For a variety of reasons, businesses frequently elect to finish orders ahead of schedule. To guarantee that due dates are met, known orders or scheduled call offs against customer contracts are frequently made or delivered in advance. Seasonality patterns inventory to meet future demand peaks inventory to level out capacity requirements.

A major factor influencing the decision of what inventory to hold is whether a company selects a

- make to order
- Assemble to order
- Make to stock

i make to order are often special products, but some companies meet demand for standard items only on an MTO order basis.

ii Assemble to order businesses are those that part finish an item beforehand and then complete it on receipt of an order

iii Make to stock businesses are those that complete or purchase items ahead of demand then meet orders from finished goods inventory.

2 - When to order.

An organisation's desired level of service may be determined, and the amount of buffer inventory required to provide acceptable service levels can be estimated as follows. $\text{Service level} = \frac{\text{orders without delay}}{\text{Total orders delivered}}$

Companies can assess the risk of a stock out they are willing to bear by approaching this criteria from the opposite direction. This is referred to as the 'protection level' and it is equal to

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

Q1 3- What items to hold in stock:

b) cont

Grouping stock goods into groups based on the amount of yearly spending they ~~cost~~^{incur}, which is calculated by multiplying the projected annual number of items utilised by the unit cost. The 80/20 rule, often known as the Pareto Principle states that 10-20% of things account for 60-80% of annual expenditure. These are known as A items and they must be regularly monitored in order to minimise overall spending.

The following 20-30% of goods are classified as B items. Inventory level equations are required less frequently than for A goods. It is possible that a fixed order interval system with a minimum order level or a fixed order quantity system would be more suited. C products make up the remaining 50-70% of items, however they only account for around a quarter of overall spending.

Q1 c) The total cost of maintaining unsold goods is known as inventory holding costs. Within a single supply chain, inventory holding costs are considered as part of the overall inventory costs. Warehousing, insurance, labour, transportation, depreciation, inventory shrinkage, damaged or spoilt goods, obsolescence, and opportunity expenses are all expenditures that must be considered.

Warehouses are huge storage rooms that businesses can rent, own, or create to store their products.

Depending on the type of product you keep, you may require a warehouse with additional amenities such as temperature control, which will likely raise the storage prices.

Q1)

(cont) Facility:

Temporary holding Containers can be hired or purchased to retain goods when you can no longer function your things in your home. Individual Storage Containers or units in a specific storage system are excellent solutions for organisations that are rapidly developing or in the middle of a transformation, despite the fact they are often considerably smaller than warehouses.

Q2 Given:

a) Shift = 10hr

Break = 30 min + 2 (15 min)

Break = 60 min, Planned Production time = 540 min

Downtime = 30 min

Cycle time = 110 Pieces/min

Total pieces = 37,600

Good Pieces = 37,600 - 380 = 37220

Operating time = 540 - 30 = 510 min

OEE = Availability x Quality x Performance.

Availability = $\frac{510}{540} \times 100 = 94\%$ Quality = $\frac{37220}{37600} \times 100 = 98.9 = 99\%$ Performance = $\left[\frac{37600/510}{110} \right] \times 100 = 67\%$ OEE = $94 \times 99 \times 67 = 62.35\%$

85% OEE is considered world class for discrete manufacturers. So the OEE comes out at 62.35% for this example shows that it needs to improve its processes and equipment through TPM and lean.

Q2 OEE Cuses:

b) 1- Breakdowns

Breakdowns are a form of unexpected stop that occurs when equipment fails and time is lost. ~~Unplanned~~^{Planned} Stops like a breakdown have an impact on OEE availability. Tooling failures, unplanned maintenance, general breakdowns, equipment failures are all examples of this loss.

2- Reduced speed

Reduced speed accounts for time where equipment runs slower than the ideal cycle time. Examples of common reasons for reduced speed include dirty or worn out equipment, poor lubrication, substandard materials, poor environmental conditions, operator inexperience, start up, shutdown.

3- Set up and adjustments

Any major periods of time when equipment is planned for production but is not operating due to a change over or other equipment modification are accounted for in Setup and adjustments.

4- Small stops

Idling and minor stops are defined as periods of time when the equipment stops for a brief amount of time, usually a minute or two, and the operator resolves the halt. Small stops cost you time and money. Material jams, impeded product flow, wrong settings, misaligned or blocked sensors, equipment design faults, and frequent fast cleaning are all major causes of idling and minor stops.

Q2

(C)

1- Due to fewer unexpected machine breakdowns, Planned Maintenance reduced Production time. Equipment Shutdowns that are Planned or anticipated can be Strategically worked into Production Planning to reduce the impact on Production Schedules.

2- Replacement components may be budgeted for and Planned for ahead of time. Costs have been greatly reduced due to applying Planned maintenance activities.

3- In the end, the cost of an unanticipated failure is made up of expediting expenses, labor costs, lost production time and perhaps missed delivery dates, in addition to the cost of the parts themselves.

Planned Maintenance helps to minimise these costs.

4- Capacity losses are further reduced as Maintenance tasks can be Planned to minimise time lost during normal working hours.

5- Finally, the durability of your Packaging and Shipping Equipment is improved by Planned Maintenance.

Q4

a)

Value Stream Mapping is a tool which is used to find the areas for improvement in Service or Manufacturing Processes by separating value added and non value added activities through a graphical representation.

Companies, especially manufacturing companies working on high demands often face delays in deliveries to customers. As a result, Companies face customer dissatisfaction and obviously financial losses. Lean Manufacturing and DMAIC practices provide Companies to focus on the bottlenecks in their processes and then to remove these bottlenecks and waste activities with the help of several available lean tools. VSM is the tool that provides a clear picture of the current state of any manufacturing facility and tells us where the actual waste activities

Q4

a (cont)

that lead to increase production lead time.

VSM is a tried and tested lean technique that can be applied to any sector or business where products must pass through numerous departments and/or phases before reaching the client. A VSM is used to visualise the whole process flow from beginning to end and to devise a strategy for optimising efforts to get the organisation to its targeted outcomes. A VSM shows you where the current gaps are by depicting the current status. You can find possibilities in a future state map and design an implementation plan to attain your goals once you've identified inefficient or unwanted operations. VSM has 4 main steps for implementation which are data collection, mapping current state, applying VSM tools and mapping future state with Kaizen. The data collection is a very complicated step in which information about demand of customer and physical flow is gathered. Current state is mapping by understanding the demand of the customer, process flow, information flow and material flow.

Q4

b)

VSM Projects consists of 3 steps, creating ~~stat~~ Current State Mapping, creating future state mapping and preparing future state with an implementation plan.

To construct current state mapping, the following steps should be followed:

Step 1 - Identify the Problem

In this step the problem of the company needs to be identified. This problem can be related to customer demand or quality of the product/process.

Step 2 - Brainstorm activities involved.

In this step, find out what steps involved in manufacturing process and notice the cycle-time, change over time, up time and number of operators.

Step 3 - Determine and sequence the steps.

Sequencing of ^{the} process will help to draw a correct and productive current state mapping. This sequence can be visualised during gemba walk on the shop floor.

Step 4 - Finalise the process flowchart

In this step, the final current state mapping will be drawn using excel, visio or any other software.

The current state mapping will be showing the clear picture of cycle from customer order to delivery of product. The inventories between different processes

is a very important parameter to find out non-value added time in the current state mapping. At the end sum of all cycle times of all the processes the total processing time will be given and the sum of all non-value added time will be the total lead time.