

Exam 05/11/21

19100915

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Q1a)

$$\sqrt{\frac{2 C_0 D}{C_H \left[1 - \frac{d}{p}\right]}} = \sqrt{\frac{2 \times 350 \times 55,000}{12 \times \left[1 - \underbrace{\left(\frac{3500}{4200}\right)}_{0.83}\right]}}$$

$$\sqrt{\frac{38500000}{2}} = \sqrt{19250000}$$

$$= 4387.5 = 4,388 \text{ units}$$

$$TC = \frac{D}{Q} \times C_0 + \frac{I_{max}}{2} \times C_H \times Q \left(1 - \left(\frac{d}{p}\right)\right)$$

$$TC = \frac{55,000}{4,388} \times 350 + \frac{I_{max}}{2} \times 12$$

$$I_{max} = 4,388 \left(1 - \left(\frac{3500}{4200}\right)\right) = 4,388 (1 - 0.83)$$

$$= 4,388 \times 0.16 = 702.08$$

$$TC = 12.53 \times 350 + 351 \times 12$$

$$TC = 122864 + 4212 = \underline{\underline{\pounds 127,076}}$$

Q1b)

The factors that should be considered when analysing the three areas of inventory are firstly when deciding on how much inventory to hold you need to consider the cost of the storage. Building, rental is not cheap especially if stored off site with additional storage and transportation costs. Consideration for when to order include the lead time or replenishment this is particularly prudent in the current BREXIT / COVID world where supply chains have been impacted globally. So if the supplier lead time is longer than our customer lead time then a consideration for holding more stock on site should be explored in order to not pass this pain / delay on to the customer. When considering what to hold in stock the seasonal aspect of forecasting needs to be reviewed there are 3 categories of stock MTO - Made to order, ATO Assemble to order and MTS Make to Stock. Review forecasting models / Seasonal trends against Safety Stocks / Risk factors is critical to ensure the most effective inventory is held at the correct time with the least risk.

Q1c)

The Costs typically associated with holding inventory can be broken down into 2 categories direct costs and indirect costs.

Direct Costs such as

Capital investment -

Storage Costs - off site vs on site

Service Costs - insurance Costs material dependent

Risk Costs

Obsolescence

Damages.

INDIRECT COSTS. - These relate to loss of Sales and loss of customers. If a Stock out situation occurs this could have a impact on our direct customer & future business as well as a knock on effect to wider customers / business reputation. Fail to deliver on a big project as promised big consequences late penalty fines etc.

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Q2 a)  $OEE = Availability \times Quality \times Performance$

$$Availability = \frac{\text{Operating time}}{\text{Planned production time}}$$

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

$$Quality = \frac{\text{Good parts made}}{\text{Bad parts made}}$$

$$Availability = \frac{(10 \times 60 - 30 - 30)}{600 - 30 - 30 - 30} = \frac{540}{510}$$

$$Performance = \frac{\frac{540}{600} = 0.95 \times 100 = 95\%}{\frac{37,600 / 510}{110} = 0.67 \quad 67\%}$$

$$Quality = \frac{\frac{220}{37,600} = 98.94\%}{380} = 97.94\% \quad 98\%$$

$$OEE = 0.85 \times 0.98 \times 0.67 = 55\%$$

The Availability % is below world class

The Quality % is below world class

The Performance % is far below world class

Q2b) 4 of the 'six big losses' are as follows

- 1) BREAKDOWN
- 2) PRODUCTION REJECTS.
- 3) SMALL STOPS
- 4) Reduced Speed.

BREAKDOWNS, fits into the 'Downtime loss' OEE loss category. examples of this are unplanned maintenance a machine is scheduled to be down next month but breakdown next week causing unplanned down time.

Production Rejects - fit into the 'Quality loss' OEE loss category these stem from any Scrap/rework, due to incorrect assembly or in process damage.

Small Stops - OEE loss cat = Speed loss. These can be caused by blocked sensors, part misfeeds/jams, these are often difficult to track as less than 10 mins stoppages not classed as a breakdown. if you have multiple small stops in a shift they add up.

Reduced Speed - Also 'Speed loss' - this can be contributed by operator inefficiency, lack of appropriate training, wear on machines/equipment causing the process to run rough.

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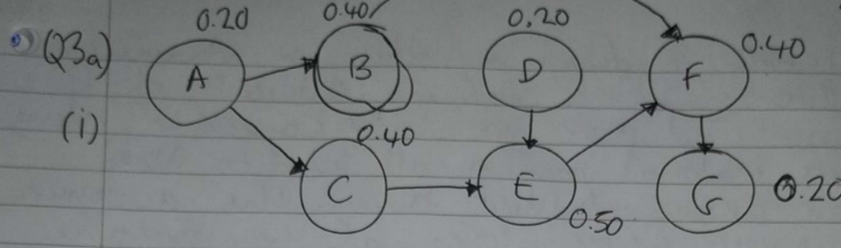
Q2c) 5 potential benefits of carrying out planned maintenance, are as follows.

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Q1a

1. A reduction in the maintenance costs. The uses the concept that smaller issues that are more simple to repair can be caught sooner rather than waiting for a costly major breakdown.
2. ~~Reduction~~ Reduction of downtime - Business cannot afford for a process to stop this could be hours, days if not kept atop of it.
3. Safety improvement - minimize the safety risk of operation of machinery equipment. Reduce chance of injury / downtime / fines etc.
4. Extended asset life - Regular planned maintenance activities such as servicing increase the life cycle of equipment. Looking after the plant will negate the need to regularly replace using up valuable capital investment and machinery maintained hold a better residual sales value if required.
5. Improved workplace morale - If the machine an operator is on is constantly breaking down the overall mood and engagement will be down, the planned downtime activities can take place outside work hours reducing the impact on production disruption.

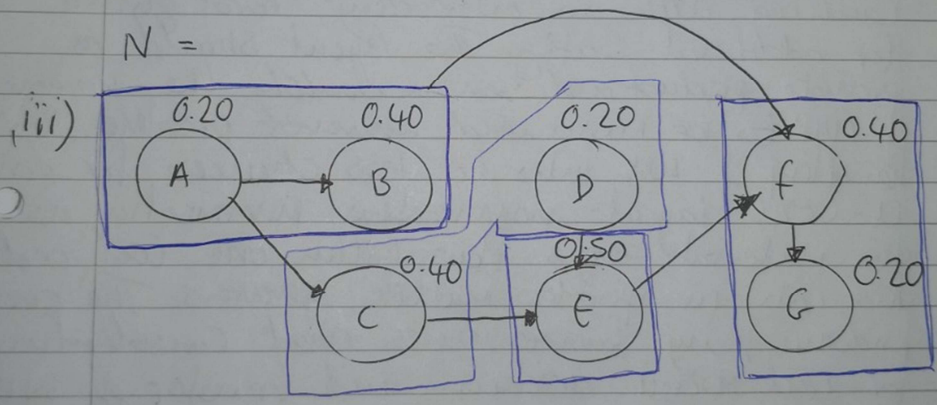
TC =



(ii)  $CT = 40 \times 60 = \frac{2400}{4000} = 0.60 \text{ mins}$

N° of work stations =  $\frac{\text{Production time}}{CT}$

$$\frac{2.3}{0.60} = 3.83 \text{ or } \underline{4} \text{ work stations}$$



(iv) Efficiency =  $\frac{2.3}{4 \times 0.6} = 0.9583 = 96\%$

With 0.60 being the desired time Station E falls slightly below this. The balance delay is 1 - Efficiency = 4.16%. Any lean investigation for improvement would be focused around Station E. As the other groupings attain 0.60

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b) In order to design a factory for maximum efficiency factors such as utilization of space, and people need to be considered along with material handling all linked to the main wastes identified through the acronym DOWNTIME which looks at transportation wastes so ensure the raw material is located close to the first part of the process where it is required, stored in a safe and accessible manner. The layout should actively be designed to eliminate bottlenecks, as a process is only as strong as the weakest link.

To be further effective layouts should have the Safety and Security measures integrated. Such as a light guard curtain on a high voltage test station combined with an interlocking hard guard for additional safety. The layout should also promote product and service quality the movement of WIP to be minimised whenever possible, less handling of WIP links to less chances for damage. U-CELL layouts provide this minimisation as the material stages flow within one cell and this can incorporate multiple operators. The current pandemic / any future issues need consideration for cell social distancing and transfer of WIP material. A Cellular layout can also reduce the Setup times they are easier to automate and control as in some instances the first and last step all take place in the same area. The issues arise with poorly balanced cells. The balance of each process with machine / attended time by operators sometime a float is required to ensure a further step is not left idle.

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Q3b Cont. There is also an potential of increase of Capital investment required. Additional Equipment duplicated in multiple Cells. The physical restrictions on machine to Cell footprint. Some automated processes need additional guarding / controls to operate safely.