

EGT2
ENGINEERING TRIPOS PART IIA

Thursday 5 May 2022 2 to 3.40

Module 3E10

OPERATIONS MANAGEMENT FOR ENGINEERS

*Answer not more than **two** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

Single-sided script paper

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed

Engineering Data Book

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

You may not remove any stationery from the Examination Room.

1 (a) The primary role of the "Operations" function in a firm is to manage the processes that convert inputs into outputs that are supplied to the customer. [40%]

(i) Outline the key managerial activities in this conversion process.

(ii) Discuss the key performance criteria of a process. Of these, which ones are most important? Justify your answer.

(b) Trumpington Foods offers premade salads. The following process is used to make them (see Fig. 1). There is one worker per station. Assume that units are admitted to the process at the rate of the bottleneck resource and the demand is always higher than the process capacity.

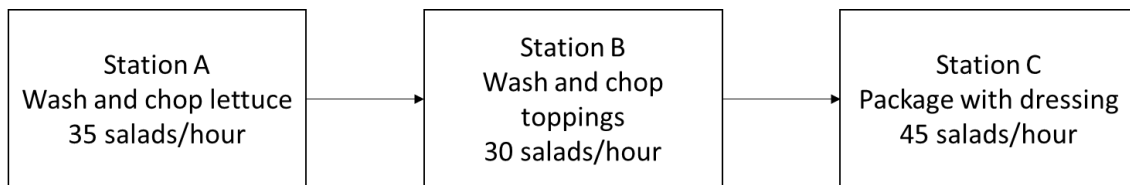


Fig. 1

[20%]

(i) Calculate the throughput time (i.e., flow time) for the 2nd unit of premade salad. Would that throughput time be sustainable?

(ii) Calculate the resource efficiency of the process.

(iii) Calculate the average inventory of salads in the system.

(iv) If the assumption is changed so that units can be admitted at a rate higher than bottleneck, and due to space limitations, you can install only one buffer (e.g., a portable table) where you can temporarily store work-in-progress (WIP) of salads. Where should you place the buffer and why?

(c) Consider the two transformation processes shown in Fig. 2. Please briefly explain which one you think will have on average the higher total production outcome (i.e., total number of products produced in a given time period)? [10%]

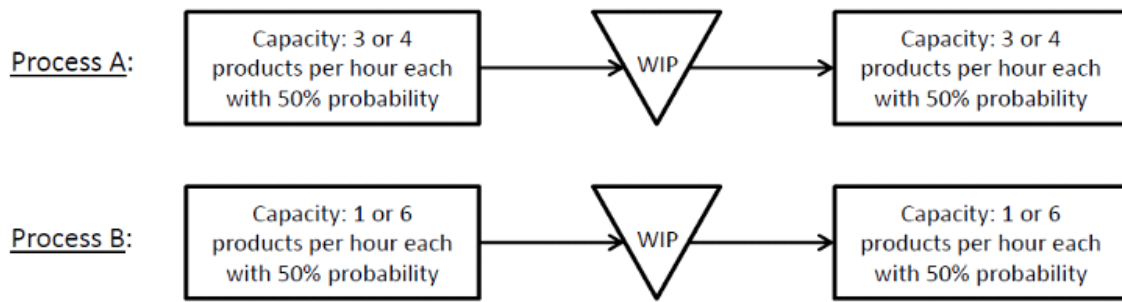


Fig. 2

(d) The product structure for an end item is described in Fig. 3. The number in parentheses indicates the lead time (in weeks) for making or purchasing each item.

End Item: Composed of 2 units of A, 2 units of B and 3 units of C.

Item A (1 week): Composed of 2 units of B and 1 unit of D.

Item C (2 weeks): Composed of 1 unit of B and 2 units of D.

Item B has a lead time of 2 weeks and item D has a lead time of 4 weeks.

What is the “order-to-delivery” lead time?

[5%]

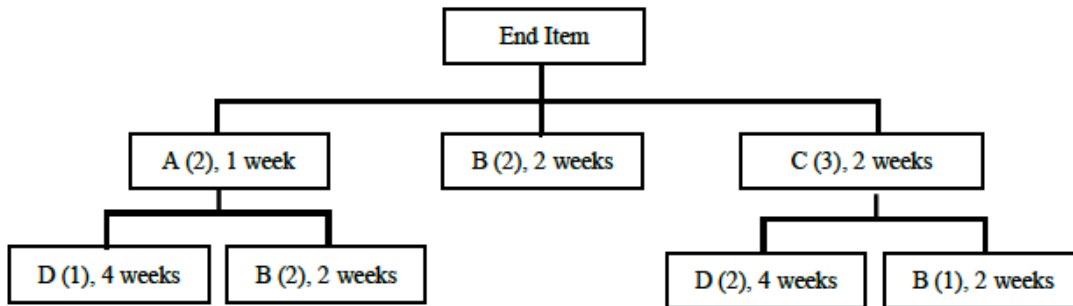


Fig. 3

(e) What is a P:D ratio? What implications does the P:D ratio have for supply chain strategy?

[25%]

2 (a) A local service station is open 7 days per week, 365 days per year. Sales of 10W40 grade premium oil average 25 cans per day. Inventory holding costs are £0.75 per can per year. Ordering costs are £9 per order. Lead time is 1.5 weeks. Backorders are not practical – motorists will simply drive away. The standard deviation of demand was determined from a data sample to be 2.5 cans per day. The manager wants a 95% service level. Determine the optimal inventory plan (i.e., calculate the economic order quantity, EOQ and reorder point, ROP) based on this information. [20%]

(b) Fig. 4 shows optimal economic order quantity, EOQ inventory policies for two different companies and for the same time horizon. [10%]

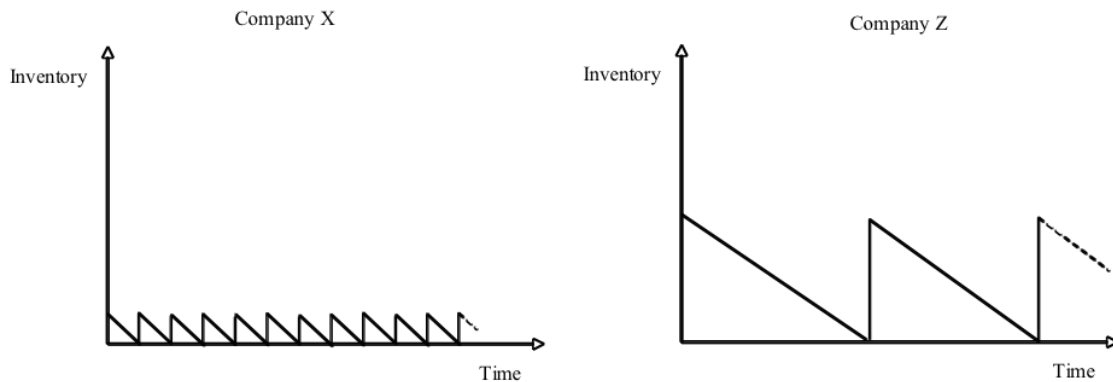


Fig. 4

- (i) If both companies have the same annual demand, D , and the same fixed cost, K , per order, please briefly explain which of the companies you believe has a higher unit inventory holding cost, h ?
- (ii) If both companies have the same annual demand, D , and the same unit inventory holding cost, h , please briefly explain which of the companies you believe has a higher fixed cost K per order?
- (iii) If both companies have the same annual demand, D , then on average, please briefly explain which of these companies you believe holds less inventory for the same time horizon?

(c) Annual demand for a product is deterministic and constant, but the value is not specified. A firm uses an order quantity of $Q = 1,100$ units. The firm’s annual inventory holding cost is £900 and their annual setup cost is £1,200. Discuss whether the order quantity that the firm uses is appropriate. What inventory decisions should the firm change? [15%]

- (d) Discuss, with examples, when the fixed time period inventory model should be preferred to the fixed-quantity inventory model and vice versa. [20%]
- (e) Why is forecasting an important operations process? Illustrate with examples. [15%]
- (f) Which forecasting method would be appropriate in each of the following scenarios? [20%]
- (i) Camilton is attempting to predict next year's demand for hotel rooms based on a history of demand observations.
 - (ii) NewPaint has developed a new type of outdoor paint. The company wishes to forecast sales based on new housing starts.

- 3 (a) Materials Requirements Planning (MRP) provides a means for scheduling the ordering of raw materials and parts. [20%]
- (i) What are the main inputs to an MRP system?
 - (ii) How is a Bill of Materials used in MRP calculations?
- (b) There are two fundamental approaches to scheduling production operations, pull and push scheduling. [30%]
- (i) Discuss the key differences between pull and push scheduling.
 - (ii) What is the role of inventory in a pull-scheduled production system?
 - (iii) What is the role of inventory in a push-scheduled production system?
- (c) Discuss the key wastes which lean production seeks to address. Illustrate with examples of each. [20%]
- (d) Discuss whether a Just-In-Time (JIT) system can perform better than an MRP system when demand has a trend and is seasonal. [10%]
- (e) Indicate whether the following statements are true or false. Provide reasons for your answers. [20%]
- (i) Assume that the demand is deterministic, time-varying, and the variability of demand between periods is high. In such a setting, use of a fixed economic order quantity, EOQ, based on the average demand during the planning horizon would be effective.
 - (ii) Strategies like everyday low pricing to eliminate forward buying of bulk orders can cause the bullwhip effect.
 - (iii) The actual capacity of a system is equal to its theoretical capacity.

END OF PAPER