ENGINEERING TRIPOS PART IIA

Module 3E10: Operations Management for Engineers

Examples Paper III

Examples class: March 1, 2016 (4pm-6pm, Engineering LT1)

Question 1: A manufacturer of boilers needs to deliver 10, 10, and 20 boilers, respectively, during Weeks 3, 4, and 9. It is currently at the end of week 0. It takes 2 weeks to assemble the boiler from a number of sub-assemblies. This includes two of sub-assembly A, each of which takes one week to make, and requires 12 of component B and 20 of component C. Current stocks are 4 boilers, 7 of sub-assembly A, 60 of component B, and 900 of component C. Current stocks and scheduled receipts (which arrive at the beginning of the week) are given on Table 1.

	Current Stock	Scheduled Receipts
Boiler	4	2 in each of weeks 2 & 6
Sub-assembly A	7	8 in each of weeks 3, 5 & 8
Component B	60	60 in each of weeks 2, 5 & 8
Component C	900	500 in each of weeks 1, 5 & 9

Table 1

(a) Calculate the net requirements for components B and C using an approach based on a Materials Requirements Planning system. *[Answer: For B: week 1 - 180; week 6 – 120; For C: None]*

(b) Based on your answer, and assuming that this product represents the bulk of business to this company do you think that this manufacturing process is well-managed? Explain your answer and suggest how you can improve it.

(c) Would you recommend the implementation of Just-in-Time (JIT) practices to this company? Explain.

(d) An ideal JIT system would have a batch size of one, no stock and full utilisation of all resources. What are the implications of this ideal for the design of the whole system?

(e) What should a company with relatively low stock holding costs learn from the JIT/TPS approach?

Question 2: POM Incorporated would like to determine its 2016 production plan for its top selling item, black mechanical pencils. The plan will include the optimal production quantity and production frequency for black pencils, a planned order release schedule for the two subcomponents necessary to assemble black pencils – pencil casings and lead pieces, and a high-level hiring and firing schedule for the facility where POM assembles pencils. The assembly plant schedules production and orders on a **quarterly** basis. **The annual holding cost interest rate for end-items and subcomponents is 20%.**

A complete pencil consists of two subcomponents – 1 pencil casing and 5 pieces of pencil lead. Both subcomponents are ordered from upstream suppliers. The setup cost for an order (for either item) is $150.

Pencil casings have a 2 quarter delivery time and cost $2.50 per unit. To determine reorder lot sizes, POM uses a lot-for-lot reorder system. At the start of the 1st quarter there are 1,600 pencils on-hand, with a previously scheduled receipt of 500 pencils arriving at the start of the 2nd quarter.

Lead has a 1 quarter lead time and cost $0.50 per piece. To determine reorder lot sizes, POM uses a least-unit-cost reorder system. At the start of the 1st quarter there are 7,500 pieces of lead on-hand. There are no previously scheduled receipts.

Assume that 1,000 black mechanical pencils are produced each quarter and determine the quarterly planned order releases (when POM should order and how much) for pencil casings and lead. *[Answer: For pencil casings: 900 and 1,000 in quarters 1 and 2, respectively; For lead: 7,500 and 5,000 each in quarters 1 and 3, respectively.]*

Question 3: The product structure for an end item is described below. The number in parentheses indicates the leadtime (in weeks) for making or purchasing each item.

End Item: Composed of 1 unit of A, 5 units of B and 2 units of C.
Item A (1 week): Composed of 2 units of B and 1 unit of D.
Item C (2 weeks): Composed of 2 units of D and 3 units of E.

Item B has a leadtime of 2 weeks, item D has a leadtime of 1 week, and item E has a leadtime of 2 weeks.

(a) Draw the product structure diagram.
(b) What is the leadtime for making the end item from scratch? *[Answer: 4 weeks]*
(c) Assume the master production schedule (MPS) for end item from weeks 4 to 12 is as follows:

Week	4	5	6	7	8	9	10	11	12
Net Req	100	50	100	200	100	50	100	200	100

Assume that lot-for-lot scheduling is used throughout and that the scheduled receipts for part B in period 4 is 200 and in period 6 is 100. Fill in the blanks in the following tables (using the same method shown in lecture) and determine the planned order releases for component B. *[Answer: 200, 400, 450, 800, 1200, 600, 450, 900, 1200, 500 in weeks 1-10, respectively]*

Item A	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Gross Requirements												
Scheduled Receipts												
On-hand Inventory												
Net Requirements												
Planned Order Release												

Item B	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Gross Requirements												
Scheduled Receipts												
On-hand Inventory												
Net Requirements												
Planned Order Release												

Question 4: Lean production techniques offer the possibility of substantial improvements in manufacturing performance. What are the limitations of the lean production approach? Explain, with examples, where lean approaches might be less effective.

Question 5: Students arrive at Administrative Services Office at an average of one every 15 minutes, and their requests take on average 10 minutes to be processed. The service encounter is staffed by only one clerk, Judy Gumshoes, who works eight hours per day. Assume Poisson arrivals and exponential service times.

(a) What percentage of time is Judy idle? *[Answer: 33.33%]*
(b) How much time, on average, does a student spend waiting in line? *[Answer: 20 minutes]*
(c) How much is the (waiting) line on average? *[Answer: 1.33]*
(d) What is the probability that an arriving student (just before entering the Administrative Services Office) will find at least one other student waiting in line? *[Answer: 0.4444]*

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