MIT 2.008 Design and Manufacturing II

Spring 2023

Quiz 2 - Part B, Take-Home Component

- All work for CREDIT must be completed in this quiz document
- All work must be completed individually and cannot be discussed with classmates.

Name:

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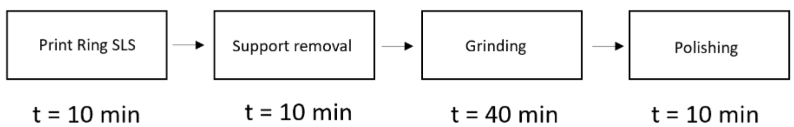
Part A, In-Class Component		
Problem 1		Out of 10 points
Problem 2		Out of 40 points
Part B, Take-Home Component		
Problem 3		Out of 50 points
Total		**100 points**

Problem 3: Manufacturing Systems Analysis

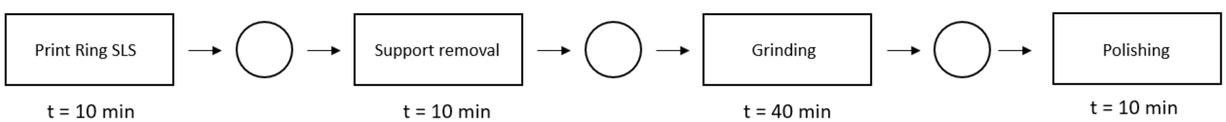
Expanding on the scenario from Part A, to better analyze and improve the SLM brass rat assembly line, you have been asked to perform a more in-depth manufacturing systems analysis. Upon a site visit to the facility, you learn that the manufacturing line used to produce a final Brass Rat is more complex with buffers being used between the major stages in the system. Ever the manufacturing engineer, you also take measurements of machine cycle times, as well as up and down times and compile all your information in the table below.

Your task will be to use this information, as well as some of your MATLAB simulations on Canvas to make a set of informed decisions about the process in the subsequent parts of this exercise.

Original Assembly Line assumed in Part A



Observed Assembly Line for Part B



Station	Tau (hr)	MTTR (hr)	MTTF (hr)	p	r	e
Printing	0.166667	5	20	0.008333	0.033333	0.8
Support Removal	0.166667	2	25	0.006667	0.083333	0.925926
Grinding	0.666667	1	3	0.222222	0.666667	0.75
Polishing	0.166667	1	6	0.027778	0.166667	0.857143

a) If you had the option to place a single infinite buffer in this manufacturing line from part A, where would you place it and why?

b) Let's move on to the "observed assembly line for part B" shown above. You suggest the purchase of an identical grinding machine to improve the line. What's the new effective production rate of the grinding step? How many machines would you have to add for this to no longer be the bottleneck in the process. Note: You can only add a discrete number of machines

c) What simplifications or assumptions about line B with buffers and the addition of a single grinding machine do you need to make in order to utilize the analytical solutions in MATLAB? Draw this new line and write any new values for tau, MTTR/MTTF under the machine(s)?

d) The factory with the non-dedicated machinery has a size limit of 10 rings in the allotted buffers for free. What is the production rate in the scenario highlighted in part c? Is this sufficient to meet the production rate of 500 rings in 1 month (assume a 24 hour day and 7 day week, 4 week month)? **Note, it is best to keep at least 4 digits after the decimal for the MATLAB script**

e) Is it more effective to improve the reliability of the bottleneck (MTTF increase) or the cycle time (Tau decrease) in order to increase production rate? **Using the MATLAB script collect at least 5 data points for each independent scenario and sketch two plots, one of MTTF vs average production rate, and Tau vs average production rate to help you answer this question.** Be sure to state the parameters you use and label your plots. You may use Excel or Google Sheets to help with your plots if desired.