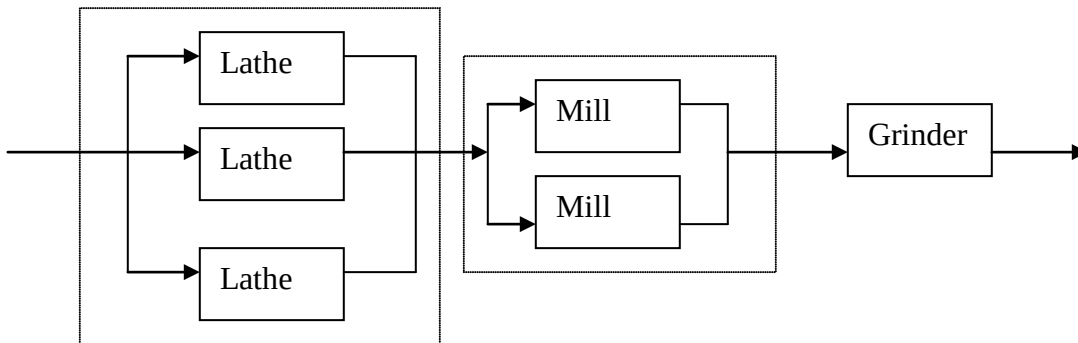


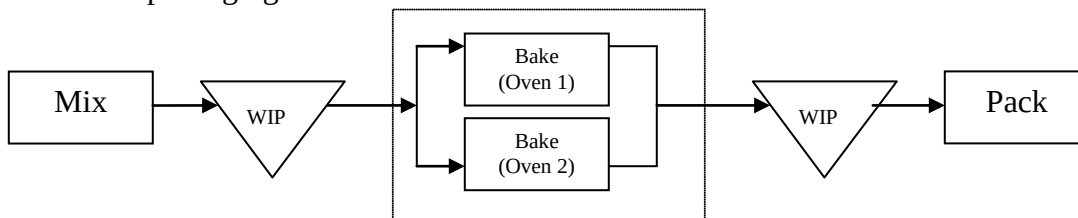
TOPIC 5: PROCESS AND CAPACITY DESIGN

Practice Problems

1. An existing factory has the production process shown in the figure below. Manufacturing fittings must be processed through each of the three operations (lathe, mill, and grinder) in sequence, but it does not matter which lathe or mill is used. Each lathe is capable of handling 25 fittings per hour, each mill can handle 30 per hour, and the grinder can handle 80 per hour.



- a. Assuming an 8-hour work day, find the overall daily capacity of the entire manufacturing process.
 - b. If the factory were to add a third mill that has the same process time as each of the current mills, what would be the new overall daily capacity of the entire manufacturing process?
 - c. Suppose (after adding the third mill) that the lathe operation has a reliability of 95%, i.e., each lathe machine produces 95% *nondefective* products. Furthermore, suppose the mill operation has a reliability of 90%, i.e. each operation produces 90% *nondefective* products. The grinder operation produces 100% good products. In addition, suppose only good parts will be sent to the next operation. What is the new daily capacity of the entire manufacturing process (expressed as *nondefective* parts per day)?
2. A bread-making factory has the production process shown in the figure below. There are three operations (mixing, baking and packaging) in sequence, but it does not matter which oven is used. The mixing machine is capable of handling a batch of 100 loaves in 15 minutes, each oven in the baking operation can handle a batch of 100 loaves in 20 minutes, and the packaging machine can handle a batch of 100 loaves in 12 minutes.



- a. What is the process time of the entire bread making process?
 - b. Assuming an 8-hour work day, what is the daily capacity?
 - c. The factory is considering **replacing** some of its existing equipment with more advanced and faster equipment. The choice is between: (i) purchasing two new ovens that are each capable of baking a batch of 100 loaves in 16 minutes, or (ii) purchasing a new mixing machine that is capable of packaging a batch of 100 loaves in 10 minutes. Which option is better? Explain your reasons. Furthermore, what is the new overall daily capacity?
3. Suppose that $USL = 160$, $LSL = 110$, $\mu = 140$, and $\sigma = 20$. Is the process capable?
 4. The management of West Allis Industries is concerned about the production of a special metal piece used by several of the company's largest customers. The "center" of the production is set at 70. The upper spec limit is 75, and the lower spec limit is 50. The production process has a process variability of $\sigma = 10$ inches. Is the process capable producing within the spec limits?
 5. Consider a drilling process with a target hole length of 2.6 inches. The upper spec limit is 2.8 inches, and the lower spec limit is 2.55 inches. The machine has a natural process variability of $\sigma = 0.12$ inches. Holes that are drilled too short cost \$3.00 to fix, and holes that are drilled too long cost \$10.00 to fix. If monthly production is 20,000 units, what is the expected fixing cost per month using this machine?
 6. Consider a normally distributed process that cuts steel panels with a "process center" of 12 inches and a standard deviation of .06 inches. The lower specification limit is 11.8 inches, and the upper specification limit is 12.15 inches. A piece of steel panel that is cut too short must be scrapped at a cost of \$5.00. A piece of panel that is cut too long must be re-cut by hand at a cost of \$3.00. The firm runs 250 pieces of steel panels through the machine per day. What is the expected fixing cost per day of this process?