# Homework 1 - Process Flow Diagram, Gantt Chart, Bottleneck Analysis

Question 1

Suppose that loading a tray of cookies into the oven takes Kristen's roommate 3 minutes instead of 1 minute as in the case discussed in class. What is the minimum amount of time it will take Kristen and her roommate to complete a rush order of 2 dozen cookies? Use a Gantt chart to find your answer. Please submit your Gantt chart.

Solution:

If loading takes 3 minutes per dozen instead of 1, the Gantt chart complete a rush order of 2 dozen cookies is as follows.
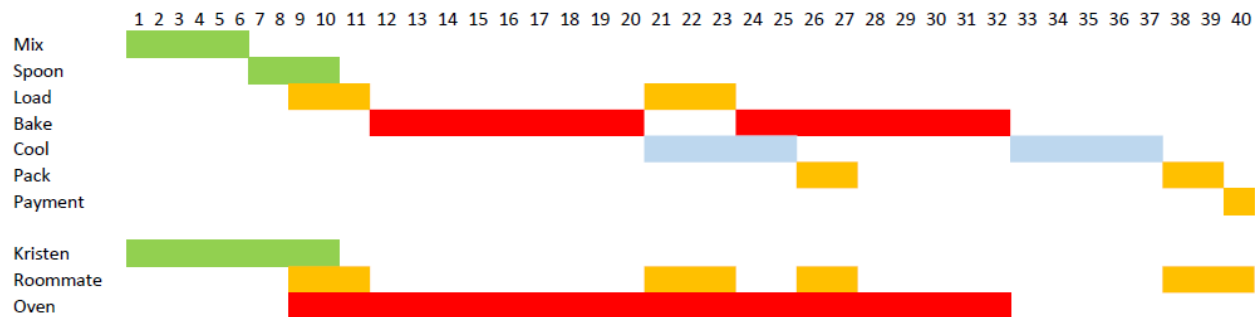
Therefore, the minimum amount of time to complete such an order is 40 minutes.

Question 2

Suppose that Jeff, Anna, and Paul are working in a bicycle factory. The bicycle making process consists of four activities: assembling the handlebars, placing the handlebars on the frame, attaching the wheels, and finally placing a kickstand on the bike. Jeff is responsible for the handlebars activity, Anna is responsible for the frames and kickstand activities, and Paul is responsible for the wheels activity. The process flow diagram looks as follows.
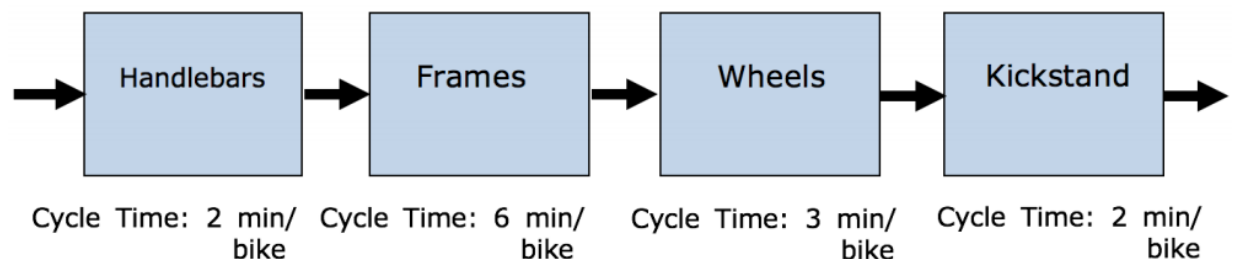

Figure 1: Process Flow Diagram for Question 2.

a. Calculate the capacity of each resource.

b. What is the bottleneck of the process, and what is the capacity of the process?

c. Calculate the utilization of each resource assuming that the process is operating at maximum capacity.

d. Suppose that Jeff is paid $20 per hour but only for the amount of time that he actually works, that Anna is paid $30 per hour but only for the amount of time that she actually works, and that Paul is paid $16 per hour but also only for the amount of time that he actually works. Suppose also that each bicycle sold generates a revenue of $200 and has raw materials cost of $60. Assuming that the bicycle factory is operating at its maximum capacity, what is the profit per hour after paying Jeff, Anna, and Paul their salaries?

Solution:

a. The capacity of each resource is calculated as follows.

Resource	Count	Activities	Cycle time (min/bike)		Capacity (bikes/hr)
			By activity	Total	
Jeff	1	Handlebars	2	2	60 / 2 = 30
Anna	1	Frames	6	8	60 / 8 = 7.5
		Kickstand	2		
Paul	1	Wheels	3	2	60 / 3 = 20

b. The bottleneck of the process is the resource with the lowest capacity: Anna.

Recall that:

> 💡 Capacity of single product process = Capacity of bottleneck resource

Therefore, the process's capacity is therefore Anna's capacity: 7.5 bikes per hour.

c. Maximum capacity implies the bottleneck capacity. Therefore, the throughput is 7.5 bikes per hour.

The utilization of each resource is therefore as follows.

Resource	Capacity	Utilization
Jeff	30	7.5 / 30 = 25%
Anna	7.5	7.5 / 7.5 = 100%
Paul	20	7.5 / 20 = 37.5%

d. At maximum capacity, 7.5 bikes per hour, the actual salaries per hour are as follows.

Resource	Salary per hour utilized	Utilization	Salary per hour
Jeff	20	25%	20 * (25%) = 5
Anna	30	100%	30 * (100%) = 30
Paul	16	37.50%	16 * (37.5%) = 6

$$200 - 60 - 5 - 30 - 6 = \$99$$

Therefore, the profit per hour after paying salaries is $99.