

UGBA 141

Discussion 2

Agenda

- Review and practice problems covering :
flow rate, utilization, cycle time, time to produce
x items, labor content/cost/utilization**

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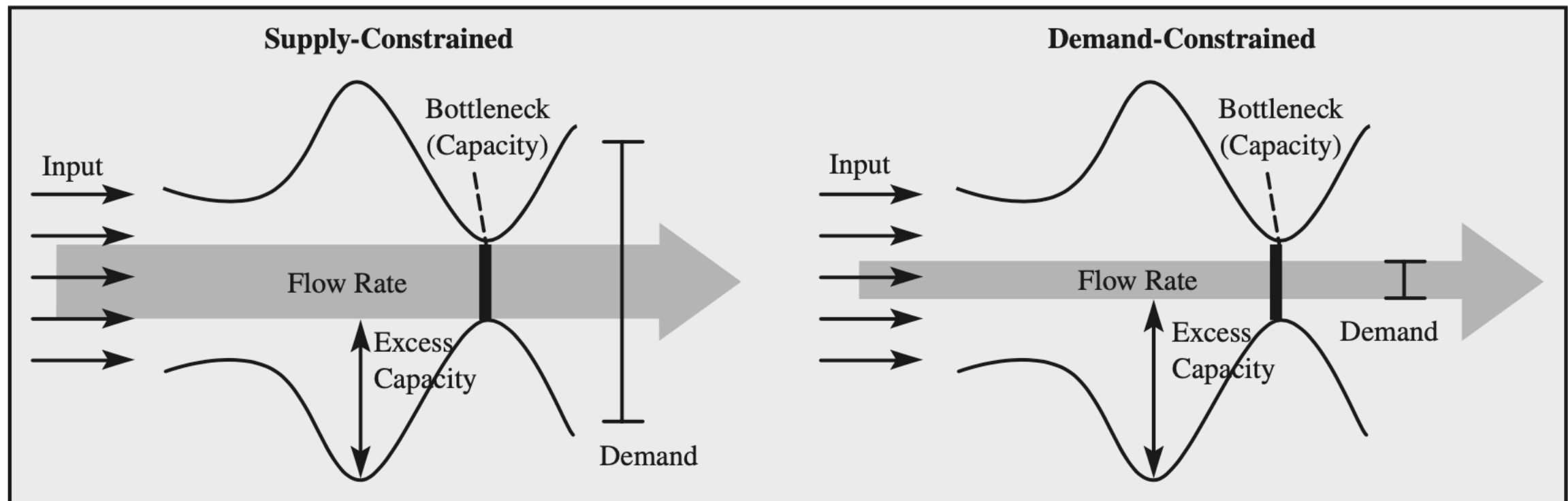
Recap

- Process capacity

Process capacity = Minimum { Capacity of resource 1, ..., Capacity of resource n }

- Flow rate

Flow rate = Minimum { Available input, Demand, Process capacity }



Review: Utilization and Implied Utilization

- Utilization

$$\text{Utilization} = \frac{\text{Flow rate}}{\text{Capacity}}$$

- Implied utilization

$$\text{Implied utilization} = \frac{\text{Demand}}{\text{Capacity}}$$

- It always holds that utilization \leq implied utilization

Review: Time to Fulfill Units

- Time to fulfill X units (with steady state)

$$\text{Time to fulfill } X \text{ units} = \frac{X}{\text{Flow rate}}$$

- Time to fulfill X units (starting with an empty system)

$$\begin{aligned} &\text{Time to fulfill } X \text{ units starting with an empty system} \\ &= \text{Time through an empty process} + \frac{X - 1}{\text{Flow rate}} \end{aligned}$$

Practice Problem

(Yoggo Soft Drink) A small, privately owned Asian company is producing a private-label soft drink, Yoggo. A machine-paced line puts the soft drinks into plastic bottles and then packages the bottles into boxes holding 10 bottles each. The machine-paced line is comprised of the following four steps: (1) the bottling machine takes 1 second to fill a bottle, (2) the lid machine takes 3 seconds to cover the bottle with a lid, (3) a labeling machine takes 5 seconds to apply a label to a bottle, and (4) the packaging machine takes 4 seconds to place a bottle into a box. When a box has been filled with 10 bottles, a worker tending the packaging machine removes the filled box and replaces it with an empty box. Assume that the time for the worker to remove a filled box and replace it with an empty box is negligible and hence does not affect the capacity of the line. At step 3 there are two labeling machines that each process alternating bottles; that is, the first machine processes bottles 1, 3, 5, . . . and the second machine processes bottles 2, 4, 6, Problem data are summarized in the table following.

Process Step	Number of Machines	Seconds per Bottle
Bottling	1	1
Applying a lid	1	3
Labeling	2	5
Packaging	1	4

Practice Problem: Solution

Process Step	Number of Machines	Seconds per Bottle
Bottling	1	1
Applying a lid	1	3
Labeling	2	5
Packaging	1	4

- What is the process capacity (bottles/hour) for the machine-paced line? What is the bottleneck in the process?
- If one more identical packaging machine is added to the process, how much is the increase in the process capacity going to be (in terms of bottles/hour)?
- How long does it take to produce 20 boxes if there is no drinks in the beginning? Recall that a box consists of 10 bottles.
- What is the implied utilization of the packaging machine if the demand rate is 60 boxes/ hour?

Review: Labor Productivity

- Labor content

Labor content = Sum of processing times with labor

- Cycle time

$$\text{Cycle time} = \frac{1}{\text{Flow rate}}$$

- Cost of direct labor

$$\text{Cost of direct labor} = \frac{\text{Total wages}}{\text{Flow rate}}$$

Review: Labor Productivity (Cont.)

- Average labor utilization

$$\text{Average labor utilization} = \frac{\text{Labor content} \times \text{Flow rate}}{\text{Number of workers}}$$

- Idle time across all workers at resource i

$$\begin{aligned} &\text{Idle time across all workers at resource } i \\ &= \text{Cycle time} \times (\text{Number of workers at resource } i) - \text{Processing time at resource } i \end{aligned}$$

- Idle time

$$\text{Idle time for a single worker} = \text{Cycle time} - \text{Processing time of the single worker}$$

Practice Problem

(12 Tasks to 4 Workers) Consider the following tasks that must be assigned to four workers on a conveyor-paced assembly line (i.e., a machine-paced line flow). Each worker must perform at least one task. There is unlimited demand.

	Time to Complete Task (seconds)
Task 1	30
Task 2	25
Task 3	15
Task 4	20
Task 5	15
Task 6	20
Task 7	50
Task 8	15
Task 9	20
Task 10	25
Task 11	15
Task 12	20

The current conveyor-paced assembly-line configuration assigns the workers in the following way:

- Worker 1: Tasks 1, 2, 3
- Worker 2: Tasks 4, 5, 6
- Worker 3: Tasks 7, 8, 9
- Worker 4: Tasks 10, 11, 12

Practice Problem: Solution

	Time to Complete Task (seconds)
Task 1	30
Task 2	25
Task 3	15
Task 4	20
Task 5	15
Task 6	20
Task 7	50
Task 8	15
Task 9	20
Task 10	25
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Task 12	20

The current conveyor-paced assembly-line configuration assigns the workers in the following way:

- Worker 1: Tasks 1, 2, 3
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- Worker 3: Tasks 7, 8, 9
- Worker 4: Tasks 10, 11, 12

a. What is the direct labor content?

b. What is the flow rate and what is the cycle time?

c. What is the idle time of each worker?

d. What is the average labor utilization (do not consider any transient effects such as the line being emptied before breaks or shift changes)?