

## Cheatsheet 1: Process

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1.

$$\text{Capacity} = \frac{1}{\text{Processing time of 1 unit}}.$$

2.

$$\text{Process capacity} = \text{Minimum}\{\text{Capacity of resource 1}, \dots, \text{Capacity of resource } n\}.$$

3.

$$\text{Flow rate} = \text{Minimum}\{\text{Available input}, \text{Demand}, \text{Process capacity}\}.$$

4. Utilization

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

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

5. Time

• For process

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

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$$\text{Task cycle time} = \text{Processing time at the resource}.$$

6. Time to fulfill  $X$  units

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$$\text{Time to fulfill } X \text{ units} = \frac{X}{\text{Flow rate}} = X \times \text{Cycle time}.$$

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

## 7. Labor productivity

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Labor content = Sum of processing times with labor.

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

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

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Idle time = Cycle time – Processing time of the single worker

## References

- [TC2006] C. TERWIESCH and G. CACHON, Matching supply with demand: An introduction to operations management (Chapter 2-4), McGraw-Hill 2006