UNIVERSITY BUSINESS • EXERCISE SHEET

10.1 Processes and capacity

Name: _____ Class: _____ Date: _____ **Total: 15 marks**

KEY WORDS bottleneck • Little's law

Objective

Find the bottleneck of a line, compute utilisation, and apply Little's law to work in progress.

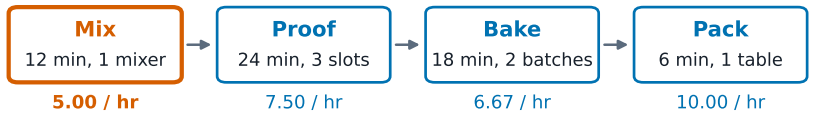
1 Key knowledge and worked examples

■ Capacity, cycle time, Little's law

Station capacity $= 60 \times \text{slots}/t$ batches an hour. The line runs at the smallest. Cycle time $= 60/\text{capacity}$. Utilisation $=$ throughput / capacity. $WIP = TH \times FT$.

The bake line: the slowest station sets the pace

BOTTLENECK: cycle time 12 min



utilisation at the festival demand of 4 batches an hour

80% 53% 60% 40%

Little: WIP = TH x FT = 4 per hour x 1 hour = 4 batches in the line | 480 buns an hour

The line runs at its slowest station

■ Worked example. The bake line at 4 an hour

Mix 12 min: 5.00/hr - bottleneck, cycle time 12 min. Utilisations 80 / 53 / 60 / 40%. Flow time 60 min, so WIP $= 4 \times 1 = 4$ ✓.

2 Practice

2.1 A pastry line: roll 10 min (1 table), fill 16 min (2 slots), bake 24 min (2 batches), cool 30 min (4 racks). Capacity of each station, the bottleneck, and the cycle time. [4]

2.2 Demand is 4 batches an hour. Utilisation of each station. [4]

2.3 Flow time through the four stations, and the work in progress at 4 batches an hour by Little's law. [3]

2.4 A second oven is bought. Where is the bottleneck now, how much does the line gain per hour, and in pastries at 90 a batch? [4]

Solutions

2.1

- Roll $60/10 = 6.0$; fill $60 \times 2/16 = 7.5$; bake $60 \times 2/24 = 5.0$; cool $60 \times 4/30 = 8.0$ batches an hour.
- Bottleneck bake at 5.0; cycle time $60/5 = 12$ min.

2.2

- Roll $4/6 = 66.7\%$; fill $4/7.5 = 53.3\%$.
- Bake $4/5 = 80\%$; cool $4/8 = 50\%$.

2.3

- Flow time $10 + 16 + 24 + 30 = 80$ min $= 1.33$ h.
- $WIP = 4 \times 1.33 = 5.3$ batches.

2.4

- Bake becomes $60 \times 4/24 = 10$; the bottleneck moves to roll at 6.0.
- Gain $6.0 - 5.0 = 1.0$ batch an hour $= 90$ pastries an hour - not the doubling the oven's price suggests.