Capacity

one worker	1 / activity time	tells how many minutes to complete one product
multi workers (m)	m / activity time	

True Bottleneck

	1	2	3	4
	% input arriving at recource	***Capacity requested (actually filled)***	***Capacity available***	***Implied Utilization***
Process step		- % of last steps input that makes it through as output - break out across product mix	= resources * activity time	

Time to process = time for first product + (x-1) / flow rate (of BN if supply constrained)

- worker paced --> sum of activity times
- continuous flow --> number steps * BN activity time

different from Little's law b/c not an avg

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direct labor cost total wages / unit of time / (# product / unit of time)

wage rate / process Flow rate

direct labor content sum of activity times of steps

Average labor utilization - either

a) Labor content / (Labor content + idle time)

b) averae utilization across all workers = $1/m * (u_1 + \ldots + u_m)$

Capacity

a) Batch Size Batch size / [set up time + (batch size * activity time per unit)]

Time in queue

$$\text{activity time } X \quad \frac{\text{utilization}}{1-\text{utilization}} \quad \frac{CVa2 + CVp2}{2}$$

Little's Law

a) Generally $I = R * T$

b) simple process w/ variability $I = R * T = 1/a(T_q + p)$ includes

+ buffered inventory = 1/a * Tq
+ processing inventory) = utilization

Service Level

a) if only wait time targetted wait time = -LN(1-service level) * Tq

b) if total process time targetted process time = [-LN(1-service level) * (Tq+p)]