1. Introduction to Line Balancing

Line balancing is the process of allocating tasks to workstations so that each station has roughly the same workload, minimizing idle time and improving efficiency.

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2. Key Definitions

- **Cycle Time (CT)**: Maximum time allowed at each workstation to meet production rate.

$$CT = \frac{\text{Available production time per period}}{\text{Units required per period}}$$

- **Line Efficiency (E)**:

$$E = \frac{\text{Sum of task times}}{\text{Number of stations} \times \text{Cycle Time}}$$

- **Balance Delay (BD)**:

$$BD = 1 - E$$

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3. Methods for Line Balancing

a) Largest Candidate Rule (LCR)

1. List tasks in descending order of task time.

2. Assign tasks to stations without exceeding cycle time, respecting precedence.

b) Ranked Positional Weight (RPW)

1. Compute the sum of each task's own time + times of all successor tasks.

2. Rank tasks by positional weight.

3. Assign to stations while respecting precedence.

c) Kilbridge & Wester Method

- Group tasks by precedence level and assign sequentially.

4. Applications

- Automotive assembly lines
- Electronics manufacturing
- FMCG packaging lines
- Service operations requiring sequential processes

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5. Benefits of Line Balancing

- Higher throughput
- Reduced bottlenecks
- Increased worker utilization
- Shorter lead times