The distribution of work to meet customer demand

Amphenol Limited specialises in making electrical connectors and fibre optic connectors, producing the majority of the components required to make the connectors in-house, from machining, to plating, to moulding, right up to the final assembly of the connectors.

Each part needs to be made to a deadline and to a high degree of quality and accuracy, as the connectors are used in a wide range of applications, from military applications to aeronautical applications and are subjected to harsh environments.

Line Balance

"The distribution of work content, to balance cycle times to the rate of customer demand"

To aid in line balance a few equations are required:

- Takt time equation

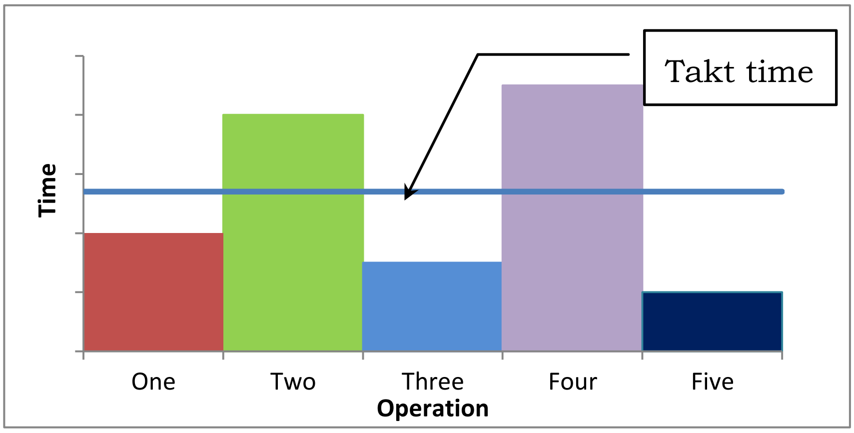
  The rate at which the customer requires product

- Line balance ratio equation (L.B.R)
- Line arrangement efficiency (L.A.E)
- Optimum manning equation

$$\text{Takt time} = \frac{\text{Available Production time (secs)}}{\text{Customer Demand}}$$

Once the Takt time has been calculated, recording the processes required to make the product, provides the remaining values required for the rest of the equations.

A graph can be created from the recorded times and calculated Takt time to give a visual representation of the findings.



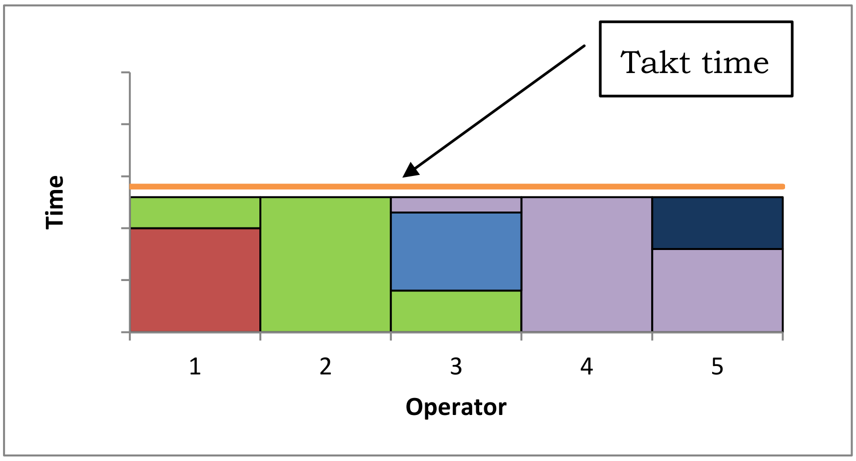
$$\text{Line Balance Ratio} = \frac{\text{Sum of Cycle Times}}{\text{Longest Operation} \times \text{No. of Operations}} \times 100\%$$

$$\text{Line Arrangement Efficiency} = \frac{\text{Sum of Cycle Times}}{\text{Takt time} \times \text{No. of Operations}} \times 100\%$$

$$\text{Optimum manning} = \frac{\text{Sum of cycle times}}{\text{Takt time}}$$

For both the Line Balance Ratio and the Line Arrangement Efficiency, the closer the final result is to 100%, the better the line balance is.

From the results gained the line balance can be adjusted, with the aim of keeping times below the Takt time.



Once adjusted, the Line Balance Ratio, Line Arrangement Efficiency and Optimum manning can be recalculated and a new graph created from the results, for a graphical representation of the improvement.

It may take multiple sets of recording times and making adjustments to get the best result possible.

Example

The following data was used to create the graph examples shown previously.

Operation	Time Before Improvement	Time After Improvement
1	20	26
2	40	26
3	15	26
4	45	26
5	10	26

Customer Demand:
4822 per week

Available Production Time:
7.5 Hours a day
5 Days a week
= 135000 Seconds a week

Takt time = Available Production Time ÷ Customer Demand
= 135000 ÷ 4822 = **28 seconds per part**

Optimum manning = Sum of cycle times ÷ Takt Time
= 130 ÷ 28 = 4.64 = **5 people**

Initial Values:

L.B.R = (Sum of Cycle times ÷ (Longest Operation × No. of Ops)) × 100%
= (130 ÷ (45 × 5)) × 100 = **57.78%**

L.A.E = (Sum of Cycle times ÷ (Takt time × No. of Ops)) × 100%
= (130 ÷ (28 × 5)) × 100 = **92.86%**

After Improvement:

L.B.R = (Sum of Cycle times ÷ (Longest Operation × No. of Ops)) × 100%
= (130 ÷ (26 × 5)) × 100 = **100%**

L.A.E = (Sum of Cycle times ÷ (Takt time × No. of Ops)) × 100%
= (130 ÷ (28 × 5)) × 100 = **92.86%**

Notes:

1. The L.A.E will only change if the number of operators changes during the adjustments.
2. The L.A.E will only reach 100% when the sum of the cycle times is the same as the Takt time multiplied by the number of operations.