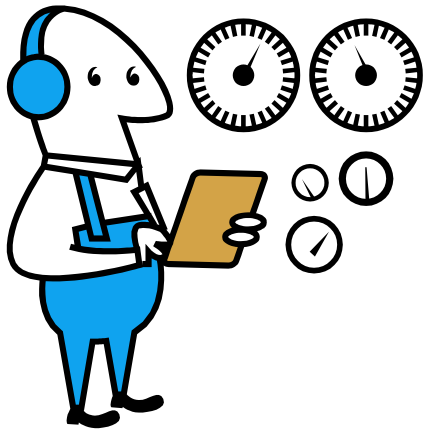
Continuous Improvement Toolkit

Lean Measures


Managing Risk
PDPC
FMEA
RAID Logs
Fault Tree Analysis
Risk Assessment*
Traffic Light Assessment
Deciding & Selecting
Pros and Cons
Importance-Urgency Mapping
Break-even Analysis
Cost -Benefit Analysis
Force Field Analysis
Voting
Pugh Matrix
Decision Tree
TPN Analysis
QFD
Matrix Diagram
Kano Analysis
Prioritization Matrix
Critical-to Tree
Paired Comparison
Planning & Project Management*
RACI Matrix
Stakeholders Analysis
PEST
PERT/CPM
Activity Diagram
SWOT
Roadmaps
Project Charter
Gantt Chart
PDCA
Control Planning
Gap Analysis
Hoshin Kanri
Kaizen
How-How Diagram
Tree Diagram**
Standard work
Lean Measures
KPIs
OEE
Capability Indices
MSA
RTY
Descriptive Statistics
Cost of Quality
Reliability Analysis
Graphical Analysis
Cause & Effect Matrix
Pareto Analysis
Confidence Intervals
Understanding Cause & Effect
Probability Distributions
ANOVA
Hypothesis Testing
Design of Experiments
Scatter Plot
Correlation
Regression
Identifying & Implementing Solutions***
Simulation
TPM
Mistake Proofing
Pull Systems
JIT
Ergonomics
Work Balancing
Automation
Bottleneck Analysis
Visual Management
Flow
Value Analysis
5S
Relations Mapping*
Understanding Performance
Run Charts
Control Charts
5 Whys
Chi-Square Test
Multi-Vari Charts
Benchmarking
Sampling
Fishbone Diagram
TRIZ***
Wastes Analysis
SMED
Focus groups
Interviews
Brainstorming
Analogy
SCAMPER***
Time Value Map
Process Redesign
Photography
Check Sheets
Nominal Group Technique
Mind Mapping*
IDEF0
Value Stream Mapping
SIPOC
Measles Charts
Surveys
Affinity Diagram
Attribute Analysis
Flow Process Chart
Process Mapping
Data Collection
Critical Incident Technique
Lateral Thinking
Visioning
Flowcharting
Service Blueprints
Observations
Creating Ideas**
Designing & Analyzing Processes

- Lean Measures

- Used to assess the Lean performance of a process or in an operation.
- Can be combined to calculate a range of Lean KPIs.
- The most important measures are those based on time.
- If we can improve the Lean performance, we can experience:
  - Increased quality and delivery performance.
  - Reduced cost.
  - Increased customer satisfaction.



- Lean Measures

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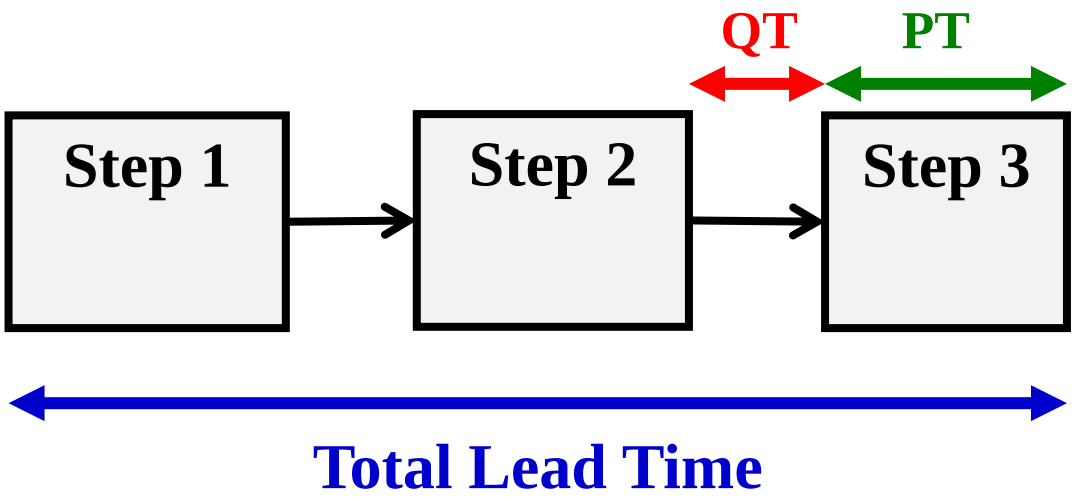
Process Time:

- **A Processing Time (PT)** is the lead time of an individual process.
- **Total Lead Time (LT)** is the total time for a product or service to pass through the whole process (from start to finish).



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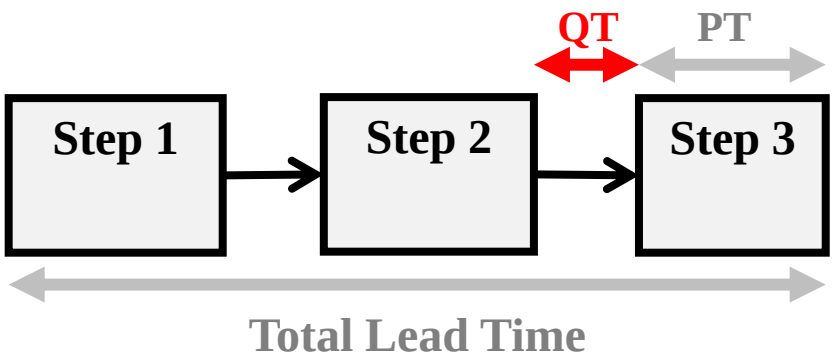
Delay Time:

- Includes the queuing time between two process steps (QT).
- Delays can be cause by waiting time, approvals, authorizations, rework, etc.
- **Ways of estimating delay times:**
  - Existing data.
  - Time trials and observation.
  - Count of inventory between process steps.



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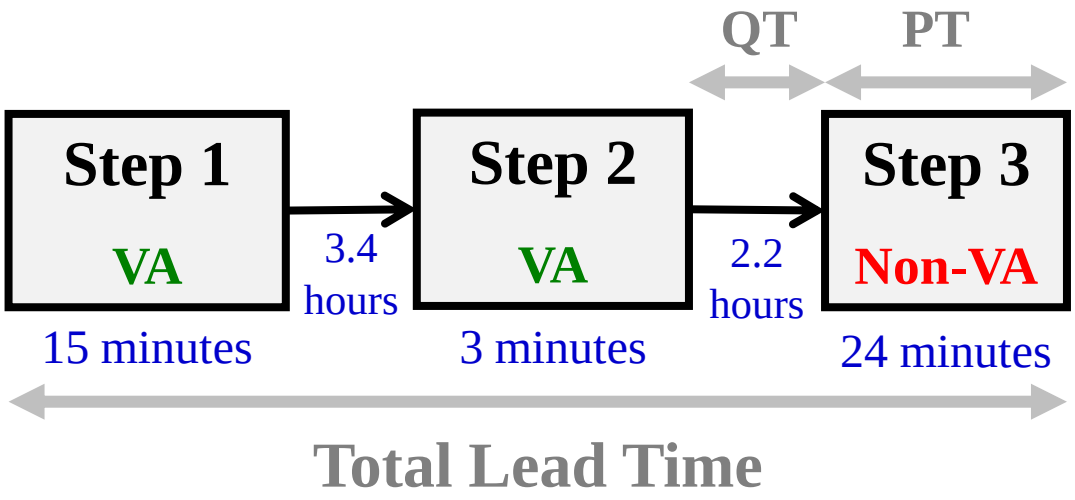
Value Added vs. Non-Value Added Processes:

- **Total Value Add Time** is the total processing time of the value added processes.



- Total Value Add Time = 18 minutes.
- Total lead Time = 6.3 hours.

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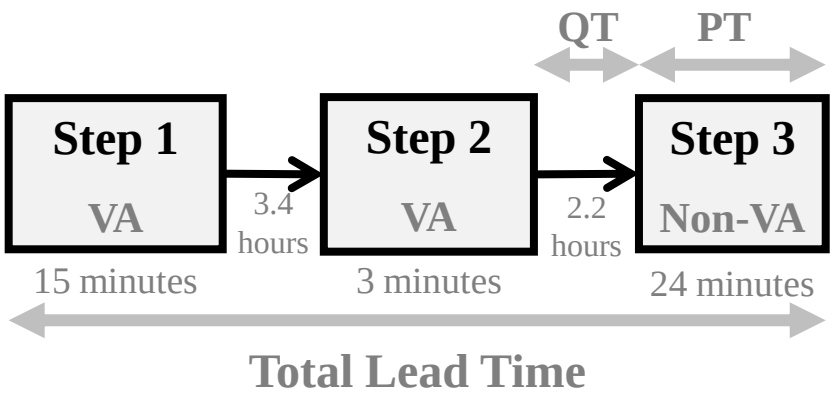
Value Stream Ratio:

- Some time it's referred to as the Process Cycle Efficiency (PCE).
- The proportion of time spent in the process that a product or service is actually being worked on a way that is adding value.
- Combines elements of both speed (lead time) and value.
- This can be very enlightening.

$$\text{VS Ratio (\%)} = \frac{\text{Total Value Add Time (sec.)}}{\text{Total Lead Time (days)}}$$

- VS Ratio = 18 / 378 = 4.8%



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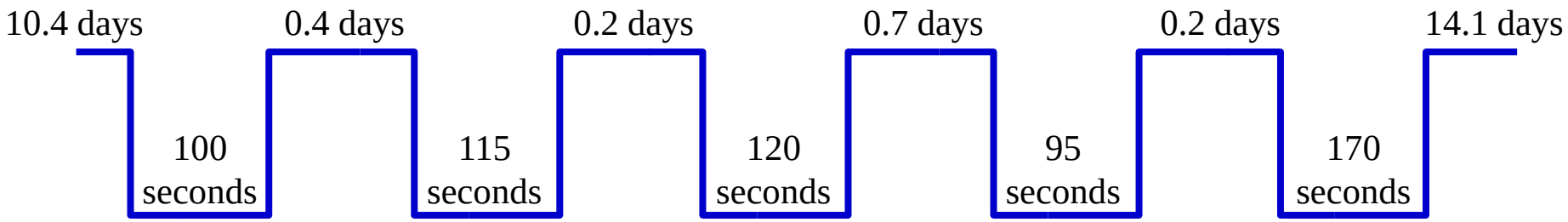
Example – Value Stream Ratio:



- Total VA Time = 600 seconds.
- Total NVA Time = 26 days = 2246400 seconds.
- Total Lead Time = 2246400 + 600 = 2247000 seconds.
- VS Ratio = 0.0267%

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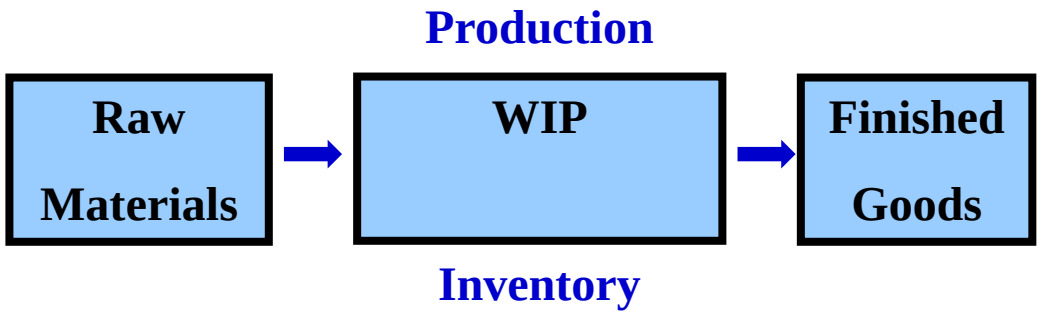
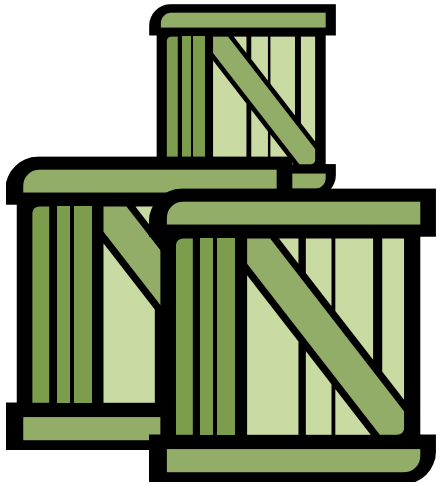
Work in Process (WIP):

- Partially finished goods waiting for completion.
- The number of products or services waiting between steps, and the products or services being processed within a step.
- WIP is a major cause of long lead times.
- Reducing WIP is one of the best ways of achieving a faster process.





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Production Rate (or Output Rate)**:**

- The number of products or services that are completed in a specific time.
- The goal is to match the output rate to the plan and staffing.
- To achieve the desired output rate:
  - Make sure to satisfy all precedence requirements.
  - Use balancing to assign every work element to a station.
- **Example:** If the plan is to produce 15000 units per week, and the line operates 60 hours per week, what is the desired output rate that could be produced each hour?
- Desired output rate = 15000/60 = 250 items per hour.

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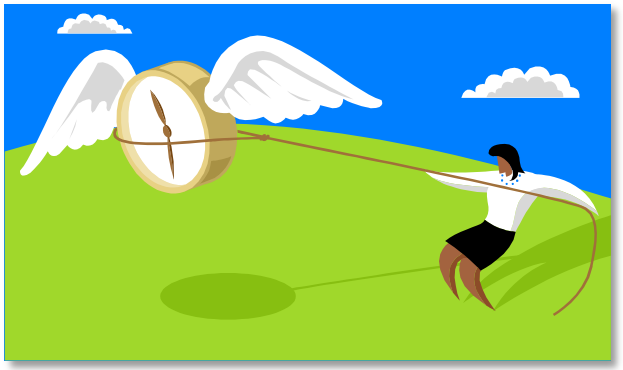
Cycle Time:



- The time a product or service takes to move from the start of the cycle to its conclusion.
- Used in **production** to indicate the total time required to produce a product.
- Used in **services** to determine the total time required to process an order.
- From a **management perspective**, it is used to evaluate time performance in all aspects of the business.

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Cycle Time:

- Cycle time improvements have been linked to reduced costs, reduced inventories and increased capacity.
- Cycle time is 1 divided by the desired production rate in units per time period.

$$\textbf{Cycle Time} = \frac{1}{\text{Desired Production Rate}}$$

- **Example:** If the line desired output rate is 60 units per hour, what is the desired cycle time in this case?
- Cycle time is 1/60 hours per unit, or 1 minute.

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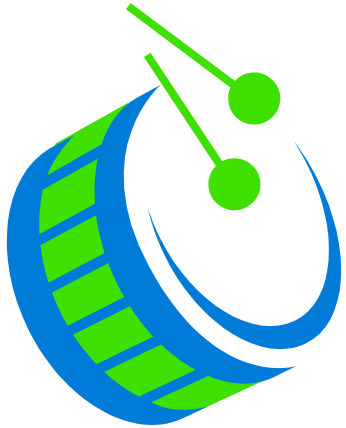
Takt Time:

- Matches the pace of the manufacturing process to the customer demand.
- The goals is to provide products or services at the rate the customers require them.
- Requires a concentrated efforts to:
  - Provide fast response to problems.
  - Eliminate causes of unplanned downtime.
  - Eliminate changeover times.
- A Takt time of 40 minutes indicates that on average, the customer demands the product every 40 minutes.



The drumbeat of a process

- Lean Measures

$$\textbf{Takt Time} = \frac{\text{Total Available Operating Time (per day)}}{\text{Units required by Customers (per day)}}$$

- **Total Available Operating Time (seconds):**
  - Net operating time per shift * Number of shifts per day.

- **Units required by Customers (quantity):**
  - We should take into account the Scrap Adjustment Factor.

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Example:

- **Question:** If there are a total of 8 hours in a shift (gross time), **1** hour breaks and **20** minutes basic maintenance checks, what is the Takt time if the customer demand was **400** units per day, noting that the plant is operating on a one-shift basis.
- **Answer:**
  - The Total Available Operating Time is 480 - 60 -10 = **400 minutes.**
  - The line would be required to output at the rate of a minimum of **one part per minute** in order to be able to keep up with customer demand.

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Net Available Time (NAT):

- The time available for work per shift (or per day) after allowances have been accounted for.
- Allowances may include breaks, stand-up meetings, clean-uptime, etc.
- Usually quoted in the same way as Cycle and Takt times (for example in seconds).
- **Example:**
  If a company works 8 hour shifts, and each shift has two 15 minutes tea breaks, and half an hour lunch break, then:
- **NAT = 28800 – 3600 = 25,200 seconds / shift.**

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Overall Equipment Effectiveness:

- A measure of the effectiveness of a process or a process step.
- Typically calculated on a weekly or monthly basis to account for C/O, etc.
- It monitors the six major losses in a manufacturing process:
  - Breakdowns.
  - Set-up and adjustment.

  } Availability

  - Idling and minor stops.
  - Reduced speed.

  } Performance

  - Start-up.
  - Quality defects.

  } Quality

OEE = Availability % x Performance % x Quality %

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Capacity:

- OEE would be 100% only in a perfect world.
- Process Capacity is determined by the resource with the smallest capacity.
- We refer to that resource as the bottleneck.

$$\textbf{Capacity}\ (\text{items/shift}) = \frac{\text{NAT x OEE}}{\text{Cycle time}}$$

- Care must be taken when estimating process capacity over a short periods such as a single shift.

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Example:

- A machining cell has cycle time of 40 seconds.
- OEE has been measured over the last month at 62%.
- NAT per shift (after breaks, etc.) is 25,200 seconds.
- What is the Capacity for this machining cell?

- **Answer:**
- Capacity = (25,200 X 0.62) / 40 = 390 items/shift.