

# Problem 04

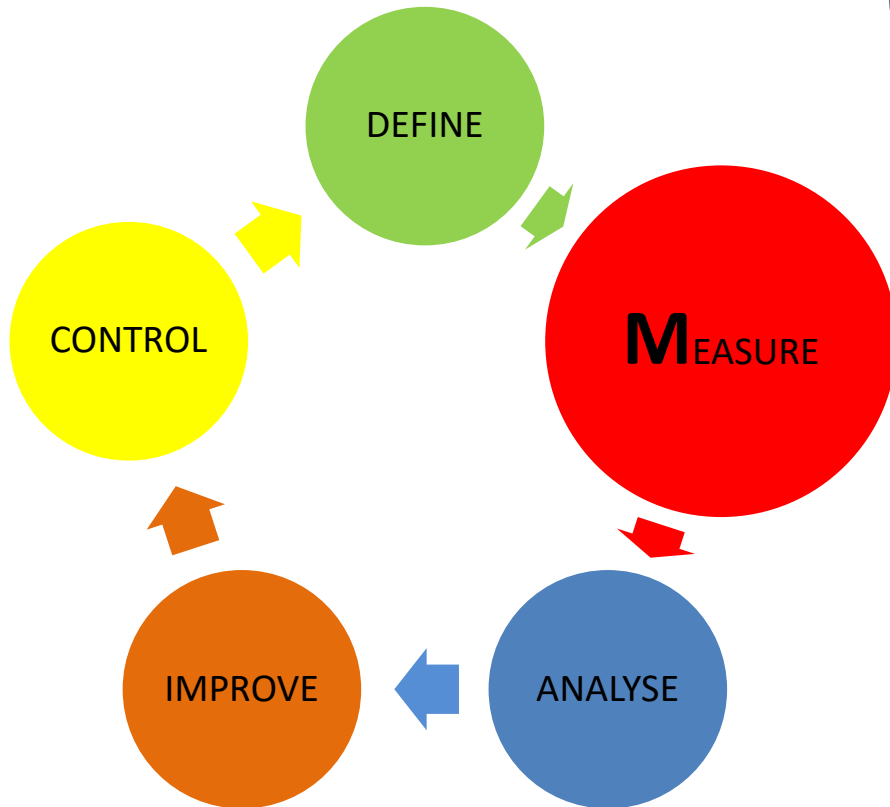
Time taken for “Something” to travel  
through the sequence of activities

E326 – Lean Manufacturing & Six Sigma

SCHOOL OF  
ENGINEERING



## Value Stream Mapping



### Objectives of Measure phase:

- To identify critical measures that are necessary to evaluate the success, meeting critical customer requirements and begin developing a methodology to effectively collect data to measure process performance
- To understand the elements of the six sigma calculation and establish baseline sigma for the process the team is analysing

# Problem 04

## Suggested Solution

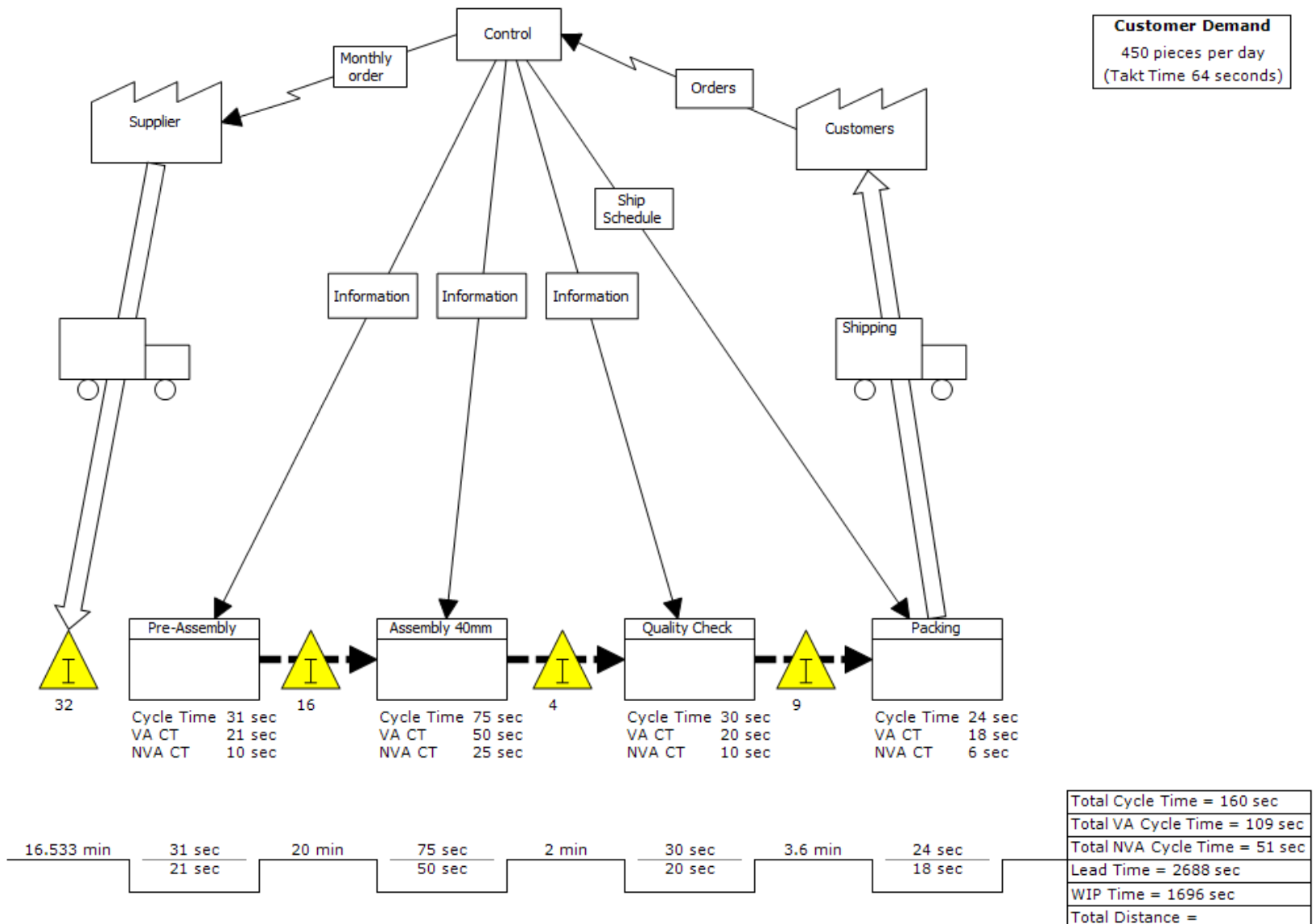
# Scenario

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- You and your team had successfully observed the Lean Production Line in building the Pneumatic Cylinder and had trained the operators to understand the line through the process maps you have created.
- The CEO of the Cylinder line received an average of 450 units of cylinders ordered per day by customers.
- Michelle, the process engineer will have the operators perform pre-production so that your team could develop a Value Stream Map for the Cylinder process.
- Your team is required to share with Michelle on the value added activities, the non value added activities, the types of work cells available and the possible improvements observed.

# Value Stream Map – Pneumatic Cylinder



# Analysis of current VSM

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- The WIP inventory is almost everywhere in between the process steps.
- In the data box of process steps, we put “Cycle time”, “VA or NVA” and “batch size” only for today. People may put other process data like “first pass yield” of quality etc. depending on the data availability.

# Analysis of current Cylinder line

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- Value-Added Time =  $21 + 50 + 20 + 18 = 109$  seconds  
(Look at the time line at the bottom)
- “Inventory holding” is being regarded as Non-value-adding here.
- Non-Value-Added Time = 51 seconds
- Total throughput (lead) time (from material supply to finished product completing packaging here) = 2688 seconds
- VA% (a.k.a. PCE) =  $109 / 2688 = 0.041 = 4.1\%$ , there are too much non-value-added time! That means, many opportunities for the company to cut waste!

# Discussions – Pneumatic Cylinder



## TAKT Time & Speed:

- The Minimum **Cycle Time** of the process is equal to the *longest task cycle time*. Looking through the VSM, the longest process is “Assembly of 40mm” with a cycle time of 75 seconds for a single unit. Thus cycle time of the process is 75 seconds.
- The calculated **TAKT Time** is:  $(8 \times 3600) / 450 = 64$  seconds, i.e. 1 unit of product to be produced every 64 seconds in order to meet customer's demand. Hence, the allowable time for the process of “Assembly of 40mm” will be 64 seconds.
- Current process Cycle time > TAKT time, will cause problems for the production to be unable to meet customer's demand.



# Discussions



Considerations and suggestions for improvement to reduce the cycle time:

Workstation	Non-Valued Activities	Waste	Improvement
1	<ul style="list-style-type: none"><li>- Removal of sleeve before clamping cylinder rod</li><li>- WIP waiting for the next process</li><li>- Operators are not manufacturing to customers order but to work order</li></ul>	<ul style="list-style-type: none"><li>- Over-processing</li><li>- Inventory</li><li>- Overproduction</li></ul>	<ul style="list-style-type: none"><li>- Introduce non-sleeve rod</li><li>- Do not produce Just-In-Case (JIC), to produce Just-In-Time (JIT)</li><li>- Make customers' order be the trigger to produce</li></ul>
3	<ul style="list-style-type: none"><li>- Defects causing line down</li><li>- Operators are not manufacturing to customers order but to work order</li></ul>	<ul style="list-style-type: none"><li>- Defects</li><li>- Overproduction</li></ul>	<ul style="list-style-type: none"><li>- Re-design the process steps so that reworks are not required (especially for the use of the jig)</li><li>- Make customers' order be the trigger to produce</li></ul>
4	<ul style="list-style-type: none"><li>- WIP waiting for the next process</li></ul>	<ul style="list-style-type: none"><li>- Waiting</li></ul>	<ul style="list-style-type: none"><li>- Line balancing</li></ul>
5	<ul style="list-style-type: none"><li>- Operator moved unnecessarily to Station 4 to obtain tested cylinders to pack</li></ul>	<ul style="list-style-type: none"><li>- Motion</li></ul>	<ul style="list-style-type: none"><li>- Inventory shelf near to station 5 to reduce non-needed motion</li></ul>

# Discussions

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The current layout (similar to traditional straight line layout except that it is more compact) may make it hard to balance the processes because work may not be divided evenly.

Proposal: U-shape layout may reduce employee movement and space requirements while enhancing communication, reducing the number of workers and facilitating inspection.

# Learning Objectives

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- Develop Value Stream Mapping and Process Flow Tools
- Apply Value Stream Mapping in Lean Manufacturing
- Define Lead Time, Cycle Time in Value Stream Mapping
- Create Value Stream Mapping on a process
- Differentiate Batch process and Single piece flow
- Define and apply VA%, TAKT
- Explain Process Cycle Efficiency (PCE)
- Identify the different types of work cell configurations