LEAN SIX SIGMA TRAINING: Robot Exercise

“THE ONLY TIME YOU SHOULD BATCH – IS WHEN YOU’RE MAKING COOKIES.”
-ANNA KAROUSIS
Lean Enterprise

Give some love for The Parker Lean System
What is Lean - Meghan
What is Lean?

“A systematic approach to identifying and eliminating waste (non-value added activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection”
Key Principals of Lean

Lean thinking is based on two assumptions
- Elimination of waste improves performance
- and many minor improvements can lead to perfection.

The lines between Lean and Six Sigma are blurring. Six Sigma is focused on reducing process variation, while lean drives out waste and promotes work standardization and flow. You should be versed in BOTH.
Seven Key Principals of Lean

- Specify value in the eyes of the customer
- Identify the value stream for each product
- Make value flow without interruptions
- Reduce defects in products and deficiencies in processes
- Let customers pull value
- Pursue perfection – Six Sigma levels
- Drive out variation (short and long term)
Key Definitions of Lean

- **Waste** (muda) is defined as any activity that consumes resources but creates no value.
- **Flow:** moving the product or service uninterrupted through the system to the customer.
History of Lean

Taiichi Ohno
1950’s
Just in Time, teamwork, communication

Eli Whitney
1796
Mass Production, interchangeable parts

James Womack
1990
“The Machine That Changed the World”
International Attention

W. Edwards Deming
Build in Quality

Sakichi Toyoda
1896
Mistake Proof

Henry Ford
1910
Continuous flow, eliminate waste, continuous improvement

Supermarkets
Pull System

Lean Enterprise
2000

Eli Whitney
1796
Mass Production, interchangeable parts
What is Lean Thinking?

What are the 5 key principles on which Toyota Production System is based?

- Identify value through the customer’s eyes (Muda)
- Define the value stream
- Flow (Start and Stop Drive Home)
- Pull
- Perfection
Standard Work- Meghan

“ANY MOVE TOWARD STANDARDIZATION IS A MOVE IN THE RIGHT DIRECTION.”
-DAVE WILLIAMSON
A Standard Process Is...

- The best combination of people and resources balanced to customer requirements

- **Efficient**-using the minimum amount of people, space, materials, and equipment while meeting customer requirements
Standard Processes

Why Implement Standard Processes?
- To make it possible to identify and eliminate variations in staff work
- To sustain the gains achieved from a Green Belt or Black Belt project or a Kaizen event
- To provide a baseline for future improvement activities

How Do You Use Standard Processes?
- Document each standard process
- Display the documentation
- Ensure that all staff are trained
Standard Work: Make it Work

- Each operation is analyzed at a 5,000 foot level.
- Employees are given the tools they need to work efficiently and quickly.
- Process should be documented in writing and with photos.
- Standard Work provides the baseline for continuous improvement and stability through reduced variation.
Creating Standard Work

- What is the ideal ordering of steps?
- Where should decisions be made?
- What knowledge or skills are truly required to perform the steps?
- Can the steps be simplified so they are less dependent on knowledge and skills?
Standard Work: Process

- The steps required to provide the service or product to the customer
- The sequence or order to produce the service
- The expected time to complete the steps based on the lowest repeatable time observed
- Criteria and expectations on quality provided
A Standard Process Is...

Paced-Takt Time

*From the German Taktzeit for “metronome”*
Takt Time

7hrs/day x 5 days = 35 hours X 60 = 2100 minutes (available to wrap candy)

20 pcs./box ... 40 boxes sold daily x 5 days = 4000 (pcs.candy per week)

31.5 seconds per candy

Lucy and Ethel must wrap a candy every ~30 seconds

* Time periods must be consistent (shift, day, week ...)

\[ T = \frac{T_a}{T_d} \]
A Standard Process Is...

Pacing to takt time

Establishing work sequences

Step 1 → Step 2 → Step 3
Creating Standard Work

• Now we have completed the exercise let's have you create standard work.

• Teams of Four (Get in Pairs)
  • One pair stays in this room
  • Second pair goes into breakout room

  • Directions, write standard work to create the object you have been assigned.
  • Have your partners (other group) follow your directions only to create the item.
Calculating Cycle/Lead Time-
Meghan
Quality at the Source

Techniques for Catching Defects as Close to Source as Possible

- Visual controls (for normal verses abnormal comparisons)
- Standard procedures (both work process & requirements)
- Mistake Proofing (automatic error detection)
- Process Checks (checklists)
Quality at the Source

Examples:

- Checklists
- Required fields on a form and or computer entry screen
  - Date format specification (mm/dd/yyyy)

Reference: Lean Enterprise Institute
Standard Work

- The forms / documents used in the development of Standard Work include the:
  - Time Observation Sheet
  - Cycle Time / Takt Time Bar Chart
  - Standardized Work Combination Sheets
  - Standardized Work Layout
  - Consolidated Standard Work Form
Time Observation Sheet Example
Time Observation Sheet:
- Elements are listed in the sequence they are performed.
- Numerous cycles are observed, time to complete element is recorded.
- A lowest repeatable time is identified for each element.
- Other waste observed is recorded.
## Time Observation Form

<table>
<thead>
<tr>
<th>Task #</th>
<th>Component Task</th>
<th>Task Time</th>
<th>Task Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stand up from Chair</td>
<td>3 10 4 4 9 11 23 29 58 90 32 23 38</td>
<td>#7 Operator stopped to pick up trash</td>
</tr>
<tr>
<td>7</td>
<td>Sit Down</td>
<td>60 20 0 4 7 16 25 52 98 15 18 32 46</td>
<td></td>
</tr>
</tbody>
</table>

### Task Time

| Operator Cycle Time | 60 60 64 64 69 69 87 67 69 69 74 74 | 60 | Low est Repeatable Cycle Time |

### Process Improvement Ideas:

1. **Operator Cycle Time**
2. **Sit Down**
3. **Stand up from Chair**
Requirements of Standard Work

Stop Watch Usage

- One person on the team will need to use a stopwatch. Practice before conducting observation
  - Start and stop
  - Reset
  - Start, lap feature, stop
## Time Observation Sheet

### Time Observation Form

<table>
<thead>
<tr>
<th>Task #</th>
<th>Component Task</th>
<th>Task Time</th>
<th>Task Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stand up from Chair</td>
<td>3</td>
<td>1'04</td>
</tr>
<tr>
<td>2</td>
<td>Walk to Flip Chart</td>
<td>4</td>
<td>1'04</td>
</tr>
<tr>
<td>3</td>
<td>Pick up marker and remove cap</td>
<td>5</td>
<td>1'04</td>
</tr>
<tr>
<td>4</td>
<td>Write name on the board</td>
<td>6</td>
<td>1'04</td>
</tr>
<tr>
<td>5</td>
<td>Replace Cap and set Marker down</td>
<td>7</td>
<td>1'04</td>
</tr>
<tr>
<td>6</td>
<td>Walk back to chair</td>
<td>8</td>
<td>1'04</td>
</tr>
<tr>
<td>7</td>
<td>Sit Down</td>
<td>9</td>
<td>1'04</td>
</tr>
</tbody>
</table>

### Process: Name Printing

- Stand up from Chair
- Walk to Flip Chart
- Pick up marker and remove cap
- Write name on the board
- Replace Cap and set Marker down
- Walk back to chair
- Sit Down

**Operator Cycle Time:** 60

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**Process Improvement Ideas:**

- Work with operator to define work elements before timings starts. It is important to clearly identify the start/stop point of each element.

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**Lowest Repeatable Cycle Time:** 60
Time Observation Sheet

In the top box, insert the stop watch run time at the end of each work element

Continue doing this for successive work elements

<table>
<thead>
<tr>
<th>Observation Form</th>
<th>Date</th>
<th>Operator: Sandy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9-01-05</td>
<td>Observers: Larry / Jenny</td>
</tr>
<tr>
<td>Task</td>
<td>Shift</td>
<td>Task Time</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1'04</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>903</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>38</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>38</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>43</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>38</td>
</tr>
</tbody>
</table>

Process Improvement Ideas:

Operator Cycle Time 60 60 60 60 60 60 74 74 60

Lowest Repeatable Cycle Time 60
### Time Observation Sheet

**Process:** Name Printing  
**Date:** 9-01-05  
**Operator:** Sandy  
**Observers:** Larry / Jenny

<table>
<thead>
<tr>
<th>Task #</th>
<th>Component Task</th>
<th>1</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Stand up from Chair</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Walk to Flip Chart</td>
<td>17</td>
<td>14</td>
<td>18</td>
<td>16</td>
<td>17</td>
<td>16</td>
<td>36</td>
<td>18</td>
<td>20</td>
<td>15</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Pick up marker and remove cap</td>
<td>24</td>
<td>21</td>
<td>25</td>
<td>29</td>
<td>32</td>
<td>44</td>
<td>8</td>
<td>20</td>
<td>29</td>
<td>42</td>
<td>50</td>
<td>131</td>
</tr>
<tr>
<td>4</td>
<td>Write name on the board</td>
<td>33</td>
<td>33</td>
<td>36</td>
<td>41</td>
<td>45</td>
<td>56</td>
<td>25</td>
<td>30</td>
<td>40</td>
<td>53</td>
<td>124</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Replace Cap and set Marker down</td>
<td>41</td>
<td>37</td>
<td>42</td>
<td>47</td>
<td>52</td>
<td>602</td>
<td>32</td>
<td>36</td>
<td>46</td>
<td>58</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>Walk back to chair</td>
<td>55</td>
<td>56</td>
<td>300</td>
<td>403</td>
<td>512</td>
<td>20</td>
<td>47</td>
<td>54</td>
<td>M</td>
<td>1114</td>
<td>27</td>
<td>42</td>
</tr>
<tr>
<td>7</td>
<td>Sit Down</td>
<td>60</td>
<td>200</td>
<td>4</td>
<td>7</td>
<td>16</td>
<td>25</td>
<td>52</td>
<td>59</td>
<td>18</td>
<td>18</td>
<td>32</td>
<td>46</td>
</tr>
</tbody>
</table>

**Operator Cycle Time:** 60, 60, 60, 64, 63, 69, 87, 67, 69, 60, 74, 74, 60

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**Process Improvement Ideas:**

1. Choose the lowest repeatable for each task.
2. Choose lowest repeatable total cycle time.
3. Reconcile both for standard.

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Basic Observation Techniques

• Introduce yourself and make sure the operator(s) understand that you are there to help improve productivity.

• While observing, do not distract the operator by talking or getting in the way. You want an accurate understanding of how things operate.

• Does standard work exist and are operators following the standard?
Basic Observation Techniques

• Look at upstream and downstream buffers to gauge current state (downstream buffers empty, the area is constraining output etc.).

• Is each operator meeting the planned cycle time? Do some operators finish early? Do operators wait while a machine cycles?

• Is there an unevenness between operators – look at method between fastest and slowest operator?
Standard Work for Non-Manufacturing Work

• Much more difficult to understand since:
  • Process time is longer
  • Interruptions are more frequent
  • Employees may be doing multiple tasks
  • Employees have less exposure to the lean techniques.

Staffing Calculator

<table>
<thead>
<tr>
<th></th>
<th>Working Time</th>
<th>Monthly Demand</th>
<th>Takt Time</th>
<th>Process Time ***</th>
<th>Number of ISR’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFQ (Line Item)</td>
<td>4500</td>
<td>1.9</td>
<td>5.4</td>
<td>2.89</td>
<td></td>
</tr>
<tr>
<td>Q Follow-Up</td>
<td>100</td>
<td>84.0</td>
<td>10.0</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Orders</td>
<td>900</td>
<td>9.3</td>
<td>9.5</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>ATR</td>
<td>39</td>
<td>215.4</td>
<td>35.0</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>Expedites</td>
<td>800</td>
<td>10.5</td>
<td>20.3</td>
<td>1.93</td>
<td></td>
</tr>
<tr>
<td>Credit/Debit</td>
<td>48</td>
<td>175.0</td>
<td>13.7</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>6.21</td>
<td></td>
</tr>
</tbody>
</table>

Administrative

Staffing Calculator from Chomerics Div.
Video Examples

- View Video Number One
- View Video Number Two
Kanban

- **Kanban:** Kan meaning “card,” ban meaning “signal”
- Kanban is a system used to minimize WIP (Work in Progress)
- Creates a pull system, which places a cap on WIP, while maintaining focus on minimizing the process lead-time.
- Can be mechanical or electronic.
- Kanban establishes a “sign” for the release of material, need to replenish stock, or to produce more of an item.
- Kanban is a chain process in which orders flow from one process to another, the production or delivery of components is pulled to the production line.
Total Productive Maintenance: (TPM)

Before an area can flow it needs to be stabilized.

Total Productive Maintenance:
- Reducing unscheduled downtime
- Allowing equipment to be easily maintained
- Determining abnormal/normal conditions at a glance
- Improving product quality through reduced equipment variation
TPM: Goal

Improved quality, productivity, delivery and safety.

- Equipment is ready when needed.
- Equipment performs as expected
- Equipment is better than new.
Six main categories of losses:

- Equipment downtime
- Changeover
- Minor stops
- Speed Loss
- Scrap
- Rework
How to Implement TPM

- Restore Equipment Condition
- Standardize Routine and Preventative Maintenance
- Train Personnel on Responsibilities
- Monitor, Improve and Sustain
Quick Changeover – “A systematic process of minimizing equipment downtime between part number changeovers to facilitate small lot production.”