Standardized Work

Session 1 Slides
Role of a Leader

- Achieve the production plan
- Ensure quality parts are made
- Reduce cost
- Maintain a safe work environment
- Monitor 5S and PM tasks
- Educate and train team members
- Promote continuous improvement
5 Needs of a Leader

- Knowledge of work
- Knowledge of responsibility
- Skill in instructing
- Skill in improving methods
- Skill in leading
Basic Aims of TPS

- Provide the highest possible quality and service to the customer
- Develop employees potential based upon mutual respect and cooperation
- Reduce cost through elimination of waste in all aspects of production
- Develop a flexible production system capable of responding to changes in demand
Sales and Profit Trends

• Create for your own situation
  – Sales trend
  – Gross margin trend
  – Net margin trend
Overall Quality Trends

• Create for your own situation
  – Customer defects
  – Scrap
  – Rework
  – Etc.
On-Time Deliver Performance

• Create for your own situation
  – On-time delivery to customer
  – Expedited freight
  – Etc.
Price Cost Squeeze

• Create for your own situation
  – Average sales price trend
  – Cost trends
  • Material
  • Labor
  • Overhead
  • Etc.
Cost Plus & Reduction Principle

Example 1: Cost Plus Principle

<table>
<thead>
<tr>
<th>Sales Price</th>
<th>Cost 1</th>
<th>Cost 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Price A</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Sales Price B</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

Increase the sales price to increase profits. Works best with a monopoly!

Example 2: Cost Reduction Principle (TPS)

<table>
<thead>
<tr>
<th>Sales Price</th>
<th>Cost 1</th>
<th>Cost 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Price A</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Sales Price B</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

Sales price is the same. Reduce cost to increase profits!
Cost Structure

Generic Mfg. Corp.*

<table>
<thead>
<tr>
<th>Sales Price</th>
<th>Profit</th>
<th>Total Cost</th>
<th>Non Mfg. Cost</th>
<th>Mfg. Cost</th>
<th>Profit</th>
</tr>
</thead>
</table>

**Mfg. Costs**
- Direct & Indirect Materials
- Mfg. Overhead
- Direct & Indirect Labor

**Value Added vs. Waste**
- Value Added Actions
- Incidental Work
- Waste in the Process

*Note: Create for your own situation*
4 Main Goals of TPS

• Provide world class quality and service
• Develop employee potential through mutual trust and cooperation
• Reduce cost through elimination of waste
• Develop a flexible production system that can respond to changes in market demand
TPS Pillar Chart

Goal: Highest Quality, Lowest Cost, Shortest Lead Time

Just-in-Time
- Continuous Flow
- Takt Time
- Pull System

Jidoka
- Stop and notify of abnormalities
- Separate man’s work & machine’s work

Heijunka

Standardized Work

Kaizen

Stability

Toyota Production System "House"
TPS Main Pillars

Flow Production / Small Lot Production
Takt Time
Pull Production
Level Production

Build in quality at the process
Enable separation of man and machine

Slide 1-12
Objectives of Jidoka

- Always strive to build in quality at the process 100% of the time
- Automatically detect and prevent equipment breakdowns
- Enable labor savings by achieving separation of man and machine
Efficient Resource Allocation

- **4 People**: 265 Units per shift, 108 sec. Takt Time
- **3 people**: 205 Units per shift, 140 sec. Takt Time

Slide 1-14
Standardized Work

Session 2 Slides
Main Points Session One

• Work site management & the role of a leader
  – Many problems in production.
  – Standardization and improvement are parts of our job

• Company circumstances
  – Pursuit of profit
  – Competitive reality in our industry

• Basic TPS philosophy
  – 4 Goals
  – 2 Pillars
Benefits of Standardization

• Helps maintain and improve quality
• Stabilizes the work conditions
• Increases the level of safety
• Allow for easier judgment regarding “normal” versus “abnormal” situations
• Enables cost reduction
• Stabilizes operating time (if takt time included)
• Others
Subjects for Standardization

• Operational Methods (Human centric)
  – Work instructions & procedures
  – Safety instructions
  – Work policies (break times, etc.)

• Process Methods (Machine & Process centric)
  – Equipment
  – Tooling
  – Gauging
  – Conveyance

• Control Methods (Rule & Method centric)
  – Quality controls
  – Machinery maintenance
  – Inspection methods
  – Material storage
  – Etc.
# Documents in Manufacturing

<table>
<thead>
<tr>
<th>Work Standards</th>
<th>Standardized Work*</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Work instructions</td>
<td>- Process capacity sheet</td>
</tr>
<tr>
<td>- Operation drawings</td>
<td>- Work combination table</td>
</tr>
<tr>
<td>- Operation instruction sheets</td>
<td>- Standardized work chart</td>
</tr>
<tr>
<td>- Process conditions sheets</td>
<td></td>
</tr>
<tr>
<td>- Quality control sheets</td>
<td></td>
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<tr>
<td>- Tooling layout drawings</td>
<td></td>
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<tr>
<td>- Etc.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Job Instruction</th>
<th>Work study / Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Job breakdown sheet</td>
<td>- Time study</td>
</tr>
<tr>
<td>- Cross training skills matrix</td>
<td>- Motion study</td>
</tr>
<tr>
<td>- Operation instruction sheets</td>
<td>- Work element analysis</td>
</tr>
<tr>
<td>- Etc.</td>
<td>- Etc.</td>
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</tbody>
</table>

*True standardized work is only a small subset of documents in manufacturing at Toyota
List of Work Standards

• Product drawings
• Quality control plans
• Work instruction sheets
• Process condition sheets
• Tooling layout drawings
• Operation drawings
• Gauging instructions
• Maintenance instructions
• Etc.
Filling Out Work Instructions*

1. Process or operation name
2. Steps of the procedure
3. Key points
4. Operation conditions
5. Materials used, parts required, etc.
6. Special safety or quality concerns
7. Sketch of the job layout, or part if needed
8. Other related standards, remarks, etc.

*This needs to be customized regarding your specific situation
Quality Check Sheet

• Due to the sensitive and proprietary nature of these documents you’ll need to prepare an example from your own company
Operation Drawing

• Due to the sensitive and proprietary nature of these documents you’ll need to prepare an example from your own company
Tooling Layout Drawing

• Due to the sensitive and proprietary nature of these documents you’ll need to prepare an example from your own company
Process Condition Sheet

• Due to the sensitive and proprietary nature of these documents you’ll need to prepare an example from your own company
Operation Instruction Sheet

• Due to the sensitive and proprietary nature of these documents you’ll need to prepare an example from your own company
Job Procedure Sheet

• Due to the sensitive and proprietary nature of these documents you’ll need to prepare an example from your own company
<table>
<thead>
<tr>
<th>No.</th>
<th>Work Elements</th>
<th>Key Points</th>
<th>Sketch or Drawing</th>
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</thead>
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</table>
Standardized Work Overview

Definition: a document centered around *human motion* that combines the elements of a job into the most effective sequence without waste to achieve the most efficient level of production.

3 Requirements
- Repetitive cyclical work
- High process and part quality
- Low equipment downtime

3 Elements
- Takt time
- Work sequence
- Standard work in process

3 Forms
- Process capacity sheet
- Standardized work combination table
- Standardize work chart

If these forms and conditions are not met then it is not true standardized work. The task is probably best suited by creating some form of work instruction or other standard.
Job Instruction

Job Breakdown Sheet
OPERATION:__________________________________________
PARTS:______________________________________________
TOOLS & MATERIALS________________________________:
SAFETY EQUIPMENT:__________________________________

<table>
<thead>
<tr>
<th>MAJOR STEP</th>
<th>KEY POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go through the task or subject. Select suitable portions for the trainee to master.</td>
<td>Anything in a major step which might: Affect Quality, Cause Injury, Make the work easier, &amp; any special information</td>
</tr>
</tbody>
</table>

- Primary method for training in Toyota
- Only a small part of the basic teaching pattern in Job Instruction Training
- Is a simple tool for the trainer to organize his or her thoughts – it is not for the learner
- Requires skill in learning how to 1) Prepare, 2) Present, 3) Try out, & 4) Follow up in instruction

Slide 2-16
Summary of Main Points

• TPS and importance of standardization
• Work standards
• Elements of the operation
• Creation of operation instruction sheets
• True standardized work
• Job instruction
Standardized Work

Session 3 Slides
Main Points Session 2

• TPS & standardization
  – Without standards there is no baseline to measure improvement

• Work standards
  – Support JIT & Jidoka. Inputs for standardized work

• Operation instruction sheet
  – Main steps and key points

• Standardized work
  – Specific definition. 3 requirements, 3 elements, 3 forms.

• Job Instruction
  – Primary tool for training in TPS.
Ideal Conditions for Standardized Work

• Work point of view
  – Work is centered around human motion
  – Work is done the same way each time
  – Small variation in work content

• Equipment point of view
  – Minimal trouble with machines
  – Minimal fluctuation in production volume

• Quality point of view
  – Minimal trouble in process quality
  – Minimal trouble in parts and material
Three Elements of Standardized Work

• Takt Time

• Work Sequence

• Standard Work in Process
Takt Time

Time to produce one part or unit of production

\[
\text{Monthly production requirement} = \frac{\text{Number of working days}}{\text{Number of units per day}}
\]

\[
\text{Daily Takt Time} = \frac{\text{Hours available per day}}{\text{Average units per day}}
\]

\[
= \frac{7.5 \text{ hours}}{150 \text{ units}} = \frac{450 \text{ minutes}}{150 \text{ units}} = 3 \text{ minute takt time}
\]

*Assume one work shift in this example*
### Standard Work in Process

There are four basic patterns of standard work in process:

- **A + C**
- **A + D**
- **B + C**
- **B + D**

<table>
<thead>
<tr>
<th>Work sequence point of view</th>
<th>Work in same direction as part flow</th>
<th>Machine operation point of view</th>
<th>Automatic Machine</th>
<th>Manual Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

Slide 3-6
Auto Machine / Same Sequence

Case: A + C
1 Piece SWIP Each

Legend

Legend

= Auto Machine

= SWIP*

1 4

1 //-----------// 4

2 3

Raw Material

Machine 1

Machine 2

Finished Goods

*SWIP: Standard Work in Process

Manual Machine / Same Sequence

Case: A + D
0 Piece SWIP Each

Legend

Legend

= Auto Machine

= SWIP*

1 4

1 //-----------// 4

2 3

Raw Material

Machine 1

Machine 2

Finished Goods
Auto Machine / Opposite Work Flow

Case: B + C
2 Piece SWIP Each

Legend

= Auto Machine

= SWIP*

Raw Material

Machine 1

Machine 2

3

2

1

Finished Goods

Manual Machine / Opposite Flow

Case: B + D
1 Piece SWIP Each

Legend

= Auto Machine

= SWIP*

Raw Material

Machine 1

Machine 2

3

2

1

Finished Goods

*SWIP: Standard Work in Process
Main Forms of Standardized Work

- Process Capacity Sheet
- Standardized Work Combination Table
- Standardized Work Chart
Sample Process Sequence

• Part Number: 17111-24060
• Part Name: Intake Manifold

Steps:
1) Raw Material
2) Mill face
3) Drill bolt holes
4) Tap threads
5) Quality Check
6) Finished goods
Sample Process Capacity Sheet

Definition:

A basic tool used to measure process output capability considering the time available and time required for change over work. It represents the maximum output possible from the process under current operating conditions.

<table>
<thead>
<tr>
<th>Step #</th>
<th>Process Name</th>
<th>Machine Number</th>
<th>Manual Time</th>
<th>Auto Time</th>
<th>Total CT</th>
<th># Pcs. / Change</th>
<th>Time to Change</th>
<th>Time Per Pc.</th>
<th>Shift Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mill Face</td>
<td>MI1764</td>
<td>3”</td>
<td>25”</td>
<td>28”</td>
<td>100</td>
<td>60”</td>
<td>0.6”</td>
<td>965</td>
</tr>
<tr>
<td>2</td>
<td>Drill Holes</td>
<td>DR2424</td>
<td>3”</td>
<td>21”</td>
<td>24”</td>
<td>1000</td>
<td>30”</td>
<td>0.03”</td>
<td>1148</td>
</tr>
<tr>
<td>3</td>
<td>Tap Holes</td>
<td>TP1101</td>
<td>3”</td>
<td>11”</td>
<td>14”</td>
<td>1000</td>
<td>30”</td>
<td>0.03”</td>
<td>1967</td>
</tr>
</tbody>
</table>
# Blank Process Capacity Sheet

<table>
<thead>
<tr>
<th>Step #</th>
<th>Process Name</th>
<th>Machine Number</th>
<th>Manual Time</th>
<th>Auto Time</th>
<th>Total CT</th>
<th># Pcs. / Change</th>
<th>Time to Change</th>
<th>Time Per Pc.</th>
<th>Shift Capacity</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
Complete the Process Capacity Sheet, Standardized Work Combination table, and the Standardized Work Chart based upon the following conditions.

**Process Sequence**

<table>
<thead>
<tr>
<th>Mat’l.</th>
<th>GC-614</th>
<th>CH-228</th>
<th>GC-1444</th>
<th>GC-1445</th>
<th>TS-110</th>
<th>FG’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>5”</td>
<td>6”</td>
<td>6”</td>
<td>6”</td>
<td>7”</td>
<td>1”</td>
</tr>
<tr>
<td>0”</td>
<td>28”</td>
<td>7”</td>
<td>38”</td>
<td>30”</td>
<td>3”</td>
<td>0”</td>
</tr>
</tbody>
</table>

Assume working time is 460 minutes per shift and two shifts. Production volume is 1200 units per day. For each process the number of pieces run before tool change is 300. Tool change time is 120”. Assume 2 second walk time between stations.

---

**Slide 3-13**
<table>
<thead>
<tr>
<th>Step #</th>
<th>Process Name</th>
<th>Machine Number</th>
<th>Manual Time</th>
<th>Auto Time</th>
<th>Total CT</th>
<th># Pcs. / Change</th>
<th>Time to Change</th>
<th>Time Per Pc.</th>
<th>Shift Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gear Cut</td>
<td>GC614</td>
<td>5”</td>
<td>38”</td>
<td>43”</td>
<td>300</td>
<td>120”</td>
<td>0.4”</td>
<td>635</td>
</tr>
<tr>
<td>2</td>
<td>Chamfer</td>
<td>CH228</td>
<td>6”</td>
<td>7”</td>
<td>13”</td>
<td>300</td>
<td>120”</td>
<td>0.4”</td>
<td>2059</td>
</tr>
<tr>
<td>3</td>
<td>Gear Cut</td>
<td>GC1444</td>
<td>6”</td>
<td>38”</td>
<td>44”</td>
<td>300</td>
<td>120”</td>
<td>0.4”</td>
<td>621</td>
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<tr>
<td>4</td>
<td>Gear Cut</td>
<td>GC1445</td>
<td>6”</td>
<td>30”</td>
<td>36”</td>
<td>300</td>
<td>120”</td>
<td>0.4”</td>
<td>758</td>
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<tr>
<td>5</td>
<td>Test</td>
<td>TS1110</td>
<td>7”</td>
<td>3”</td>
<td>10”</td>
<td>300</td>
<td>120”</td>
<td>0.4”</td>
<td>2653</td>
</tr>
</tbody>
</table>

= Capacity constraint of the line

Slide 3-14
## Calculation of Machine Capacity

<table>
<thead>
<tr>
<th>Process Capacity</th>
<th>Operational Time per Shift (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total cycle time + Tool change time per piece</td>
</tr>
</tbody>
</table>

**Example:**

Operational time: 27,600 seconds  
Manual + Machine Cycle Time = 43 seconds  
Tool change time per piece = 0.5 seconds

**Capacity:**

\[
\frac{27,600 \text{ seconds}}{43 + 0.5} \text{ seconds}
\]

= 634 pieces per shift
Practice Analyzing Work Elements

1. Stand Up
2. Go to the flip chart
3. Pick up the marker
4. Write your name
5. Put down the marker
6. Return to chair
7. Sit down
8. Remain sitting
Plant Floor Observation Method

1. Draw the work layout – include the work sequence
2. Write down the work elements
3. Measure the total work cycle several times (3-5 times)
4. Measure / estimate each individual elements (combine several very short elements together if necessary)
5. Measure any irregular work that occurs and intervals outside of standardized work (if necessary)
6. Write down the times on the standardized work chart
Main Points of Session 3

• Ideal conditions for establishing standardized work

• Three elements of standardized work

• Process capacity sheets

• Basics of time measurement
Standardized Work

Session 4 Slides
Main Points Session 3

• Ideal conditions for establishing standardized work
  – Repetitive work, minimal downtime, minimal quality problems

• Three elements of standardized work
  – Takt time, work sequence, SWIP

• Process capacity sheets
  – Identifies process capacity

• Basics of time measurement
  – Key to determine measuring points
<table>
<thead>
<tr>
<th>No.</th>
<th>Major Steps</th>
<th>Manual Work</th>
<th>Walking</th>
<th>Wait</th>
<th>Time Graph (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>A</td>
<td>I</td>
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</tbody>
</table>

Acme Corp.

Date: By:
Line Takt:
Shifts:
Process:
Volume:
Manual Work
Automatic
Walking
Wait

Plant: Product:
Area: Op. _____ of _____
Process: Pg. _____ of _____

Volume: Manual Work | Walking | Wait
Automatic |   ---   |

Time Graph (Seconds) 5 10 15 20 25 30 35 40
# Standardized Work Combination Table

**Acme Corp.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Major Steps</th>
<th>Manual</th>
<th>Automatic</th>
<th>Walking</th>
<th>Wait</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pick up raw material</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>Load part and start machine (MI-1764)</td>
<td>3</td>
<td>25</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>Load part and start machine (DR-2424)</td>
<td>3</td>
<td>21</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>4</td>
<td>Load part and start machine (TP-1101)</td>
<td>3</td>
<td>11</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>5</td>
<td>Check threads</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>Place in FG pallet</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MI</th>
<th>AM</th>
<th>NE</th>
<th>ME</th>
<th>WO</th>
<th>TI</th>
<th>MT</th>
<th>IM</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Totals</strong></td>
<td>18</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Time Graph (Seconds)**

---

**Plant:** Acme  
**Product:** Intake Manifold

**Area:** Manifold Machining  
**Process:** Booster Machining

**Date:** 5/23/2006  
**By:** Art of Lean

**Line Takt:** 30 secs.

**Shifts:** 2  
**Volume:** 920 / Shift  
**Volume:** 920 / Shift

---

**Slide 4-3**
### Standardized Work Combination Table

**Acme Corp.**

**Standardized Work Combination Table**

**Plant:** Acme  
**Product:** 8” Pinion Gear

<table>
<thead>
<tr>
<th>No.</th>
<th>Major Steps</th>
<th>Time Graph (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pick up raw material</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Unload, load and start M/C GC-614</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Unload / Load and start M/C CH-228</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Unload / Load and start M/C GC-1444</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Unload / load and start M/C GC-1445</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Unload / load and start M/C TS-110</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Pack Part</td>
<td></td>
</tr>
</tbody>
</table>

**Shifts:** 2  
**Line Takt:** 46 secs.

**Line**

**Takt:** 46 secs.

**Volume:** 600 / Shift

**Walking Wait**

**Operation:** _1_ of _1_  
**Page:** _1_ of _1_

**Date:** 5/23/2006  
**By:** Art of Lean

---

**Slide 4-4**
### Standardized Work Chart

#### Acme Corp.

<table>
<thead>
<tr>
<th>Major Steps</th>
<th>Plant:</th>
<th>Product:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area:</td>
<td>Op. <em>1</em> of <em>1</em></td>
</tr>
<tr>
<td></td>
<td>Process:</td>
<td>Pg. <em>1</em> of <em>1</em></td>
</tr>
</tbody>
</table>

#### Standardized Work Combination Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Major Steps</th>
<th>Plant:</th>
<th>Product:</th>
<th>Shifts:</th>
<th>Takt Time:</th>
<th>Cycle Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Working Sequence

- [ ] Working Sequence
- [ ] Walking
- [ ] Return to Start

#### Safety | SWIP | Quality

- [ ]
- [ ]
- [ ]

---

*Slide 4-5*
# Standardized Work Chart

## Acme Corp.

### Standardized Work Combination Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Major Steps</th>
<th>M</th>
<th>I</th>
<th>A</th>
<th>M</th>
<th>E</th>
<th>N</th>
<th>E</th>
<th>T</th>
<th>A</th>
<th>I</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pick up raw material</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>Load part and start machine</td>
<td>3</td>
<td>25</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Load part and start machine</td>
<td>3</td>
<td>21</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Load part and start machine</td>
<td>3</td>
<td>11</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Check threads</td>
<td>5</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Pack part</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

**Plant:** Acme  
**Product:** Intake Manifold  
**Area:** Machining  
**Process:** Intake machining and pack  
**Volume:** 900 / shift  
**Shifts:** 2  
**Cycle Time:** 30 secs.  
**Takt Time:** 30 secs.  

---

### Working Sequence

- **Walking**
- **Return to Start**

---

### Raw Material
- MI-1764
- DR-2424

---

### Final Goods Material
- FG Mat'l

---

### Quality Control
- TP-1101

---

### Safety
- SWIP

---

**Date:** 5/23/2006  
**By:** Art of Lean  
**Approved By:**

---

**Volume:** 900 / shift  
**Shifts:** 2  
**Process:** Intake machining and pack  
**Area:** Machining  
**Plant:** Acme  
**Product:** Intake Manifold  
**Op.:** 1 of 1

---

**Slide 4-6**
# Standardized Work Chart

## Acme Corp.

### Standardized Work Combination Table

| No. | Major Steps                                      | M | A | N | E | T | A | U | I | T | M | I | E | M | E | A | U | L | K | T | I | M | E |
| 1   | Pick up raw material                             | 1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 2   | Unload, load part and start M/C GC614            | 5 | 38 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |-- |
| 3   | Unload, load part and start M/C CH228            | 6 | 7  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |-- |
| 4   | Unload, load part and start M/C GC1444           | 6 | 38 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |-- |
| 5   | Unload, load part and start M/C GC1445           | 6 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |-- |
| 6   | Unload, load part and start M/C TS110            | 7 | 3  | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |-- |
| 7   | Pack FG in pallet                                 | 1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |-- |

<table>
<thead>
<tr>
<th>Safety</th>
<th>SWIP</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>ø</td>
<td>QC</td>
</tr>
</tbody>
</table>

- **Plant**: Acme
- **Area**: Gear Machining
- **Process**: Gear cutting exercise
- **Volume**: 600
- **Shifts**: 2
- **Takt Time**: 46 secs.
- **Cycle Time**: 46 secs.

### Working Sequence

1. **Pick up raw material**
2. **Unload, load part and start M/C GC614**
3. **Unload, load part and start M/C CH228**
4. **Unload, load part and start M/C GC1444**
5. **Unload, load part and start M/C GC1445**
6. **Unpack FG in pallet**
7. **Pack FG in pallet**
8. **Return to start**

Records:
- **Date**: By: 
- **Volume**: 600
- **Process**: Gear cutting exercise
- **Shifts**: 2
- **Cycle Time**: 46 secs.
- **Takt Time**: 46 secs.

### Diagram:

- **Raw Mat’l**: CH-228
- **FG Mat’l**: TS-110
Main Points Session 4

• Standardized work combination sheet
  – Tool using takt time as a basis for work allocation
  – Highlights man machine combination problems and delays

• Standardized work chart
  – Three elements of takt time, work sequence, SWIP
  – Visual control and tool for improvement
Standardized Work

Session 5 Slides
Main Points Session 4

• Standardized work combination sheet
  – Tool using takt time as a basis for work allocation
  – Highlights man machine combination problems

• Standardized work chart
  – Three elements (takt time, work sequence, SWIP)
  – Tool for visual control and improvement in the work area
  – Must be changed when takt time changes
Typical Responses

- Increase Manpower
- Increase Equipment
- Work Longer
- Work Harder
- Eliminate Waste

Ways to Increase Production
Methods to Increase Production

Current
1 Man
1 Machine
1 Hour = 100 Units

How to Increase Production?

“Quantity” based approach
1) More Workers
2) More Machines
3) Work Longer

“Quality” based approach
4) Work Harder
5) Eliminate Waste & Make Easier!

Future
1 Man
1 Machine
1 Hour = 120 Units

TPS Goal
Slide 5-3
Waste and Work

TPS first focuses here in production.
7 Types of Waste

- **Overproduction**: Producing too much, or producing too soon
- **Conveyance**: Any nonessential transport is waste
- **Motion**: Any motion that does not add value
- **Inventory**: Any more than the minimum required
- **Correction**: Any repair, scrap, or rework
- **Waiting**: Waiting on parts, waiting for a machine to finish cycle
- **Processing**: Over-processing
Waste of Over-Production*

Overproduction is damaging as it requires:
- Extra people, equipment, and time
- Extra materials and parts
- Extra energy, oils, and consumable items
- Extra skids, pallets, and containers
- Extra material handling
- Extra space and warehousing
- Additional inventory control
- Covers up the need for improvement

*Producing too much or too little, too early or too late
Muda, Mura, Muri

Muda
Any form of waste in the process...

Muri
Unreasonable burden on people or machines...

Mura
Un-level workloads on people or machines
True versus Apparent Efficiency

Before we made 100 parts with 10 people. Now we can make 120 with the same manpower!

But we only need 100 parts to meet demand. The rest is over-production.

A real improvement would be to make 100 parts with only eight people on the production line!
Procedure for Kaizen

1. Clarify the Goal
2. Analyze the Current Situation
3. Generate Original Ideas
4. Develop Implementation Plan
5. Implementation the Plan
6. Evaluate the New Method
Key Points for Standardized Work

- Standardized work and the leader
- Standardized work and quality control
- Standardized work and safety
- Standardized work and improvement
One Piece Flow vs. Large Lots

Small lot size

- Shorter lead time
- Less WIP
- Fewer handling mistakes
- Rapid detection of errors
- Better visual control
- Easier communication

Larger batch size

- Longer lead time
- More WIP
- More handling mistakes
- Slow detection of errors
- Less visual control
- Harder communication
Typical causes for accidents in production

Unintentional unsafe acts are the leading cause of accidents in most workplaces in industry.

Properly establishing standardized work and following standardized work can prevent injuries.
Five S

Slide 5-13
Kaizen is Endless
## Summary of Training Sessions

| Session 1   | • Role of a leader  
|            | • Importance of cost reduction  
|            | • 4 Aims of TPS |
| Session 2   | • TPS & standardization  
|            | • Examples of work standards  
|            | • Example of job instruction |
| Session 3   | • Definition of standardized work  
|            | • 3 elements of standardized work  
|            | • Process capacity sheet |
| Session 4   | • Standardized work combination table  
|            | • Standardized work chart |
| Session 5   | • Ways to increase production  
|            | • Waste and work  
|            | • Kaizen process |