SMED
A Set-Up Reduction Tool for Continuous Improvement
Definition – Setup Reduction (Quick Changeover)

- A Lean Manufacturing Tool
- It supports building products \textit{after} a customer order is received, not on market forecasts.
  - Allows an operation to fully utilize its assets by producing a wide variety of parts.
  - Eliminates or reduces non-value added activities in all types of process setups to quickly change from one product to another.
  - Reduces batch sizes and shortens lead time eliminating the expense of excess inventory.
Definition - Single Minute Exchange of Dies

- Subset of Setup Reduction focused on die exchange
- Term is sometimes used to define all quick changeover initiatives
- SMED targets changeovers completed in less than 10 minutes (single minutes).
  - Uses focused problem-solving
  - Low-cost or no cost approach.
Benefits of Quick Changeover

- More frequent changes
- Smaller batches
- Lower inventory
- Better quality
- Less waste
- More Flexibility
- Less STRESS!!!
- Improved teamwork
Setup Reduction – 4 Step Method

**Changeover Time:** The time between the last good piece of one production run and the first good piece of the production run after the changeover.

**Internal:** Activities performed while the machine is shut down.

**External:** Activities performed while the machine is safely running.

1. **Document current change over elements**
   - Run A: External, Internal, External
   - Run B: External

2. **Separate Internal/External Activities**
   - Run A: Internal, Run B: External
   - Reduction: 50%

3. **Shift Internal activities to external**
   - Run A: Internal
   - Run B: External
   - Reduction: 75%

4. **Streamline Internal/External Activities**
   - Run A: Internal
   - Run B: External
   - Reduction: 90%
4 Step Method - Step 1

**STEP 1**
Document the setup and separate events into internal or external

**STEP 2**
Convert Internal to External events

**STEP 3**
Streamline internal events (Simplify, Reduce, Eliminate)

**STEP 4**
Eliminate adjustments internal to the setup

"Corresponding" DMAIC phase for a stand-alone Setup Reduction project
Step 1 Application

- Pre-Workshop Preparation
- Document Setup Activities by Performing “Dry-Run” of the Setup
- Document the Actual (Live) Setup
  - Video allows operators to review and explain their activities
  - Record All Events and Times in the “Setup Timeline”
- Separate Events into Internal Setup and External Setup
- Brainstorm Around Setup Reduction Opportunities
Step 1 Tools - Setup Reduction Worksheet

The Setup Reduction Worksheet is used to document the events performed during the setup.

- Provides a time stamp for each event during the setup.
- The worksheet is used to identify internal and external events.

Setup Reduction Worksheet

<table>
<thead>
<tr>
<th>Team:</th>
<th>Machine/Tool:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Setup Element</td>
<td>Internal</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

Waste Categories:

1. Setup waste, external - activities such as searching, finding, or transporting tools, jigs, fixtures, bolts, instructions.
2. Setup waste, internal - alignment activities required to remove or install tools (example - using a fork truck to remove/install tools)
3. Replacement waste - activities related to removing items from the 'A' tool to be placed in the 'B' tool (example - fasteners, etc.).
4. Adjustment waste - any activity which would require the machine to cycle without producing a good part (stroke/stop adjustments, etc.).
Step 1 Tools - Using the Area Layout
Step 1 Tools
Before and After Setup Timelines

- "Before and After" Setup Timelines will visually compare and illustrate the improvements.
- Improvement Worksheet is a list of brainstorming ideas for improvement.
Step 2 of 4

STEP 1
Document the setup and separate events into internal or external

STEP 2
Convert Internal to External events

STEP 3
Streamline internal events (Simplify, Reduce, Eliminate)

STEP 4
Eliminate adjustments internal to the setup

Step 2 is drastically cut internal setup time

“Corresponding” DMAIC phase for a stand-alone Setup Reduction project
Step 2 Application

Convert Internal to External Setup

- Convert any internal setup events to external setup events using focused, engineered methods.
- Re-examine internal events from Step 1 and verify that they are actually internal.

The most important step in implementing successful Quick Changeover is distinguishing between internal and external Changeover elements.
Step 2 Tools

- Organization
- Checklists
- Check Tables
- Battle Plans
- Functional Checks
- Improving transportation
Step 2 Tools - Organize for Setup

- **Fact:** Significant setup time is lost searching for setup hardware and setup information.
  - Setup Hardware:
    - Tools
    - Fixtures
    - Nuts and Bolts
    - Clamping Devices
    - Measuring Devices
  - Setup Information:
    - Data (Tool and Machine Settings)
    - Procedures
Step 2 Example - Preassemble Parts

OLD – 60 min

1. Die attached to machine
2. Die heated to temperature by injecting molten metal
3. First casting made
4. First casting removed and scrapped
5. First good casting made

NEW – 15 min

1. Die pre-heated
2. Die attached to machine
3. First good casting made
Step 3 of 4

**STEP 1**
Document the setup and separate events into internal or external.

**STEP 2**
Convert Internal to External events.

**STEP 3**
Streamline internal events (Simplify, Reduce, Eliminate).

**STEP 4**
Eliminate adjustments internal to the setup.

Step 3 “fine-tune” the internal events.

“Corresponding” DMAIC phase for a stand-alone Setup Reduction project.
Step 3 Application

Streamline Internal Setup by:

- **Simplifying Movement**
  - “One-touch tools”
  - Single thread bolts

- **Reducing Movement**
  - Reduce the number of bolts
  - Add Parallel Operations

- **Eliminating Movement**
  - Prepare Operating Conditions in Advance
  - Replace bolts with hydraulic or cam-operated clamps.
Step 3 Example - Nut/Bolt Improvement Methods

- Reduce/eliminate need for hand tools
- Reduce/eliminate nuts and bolts, hex nuts, etc.
- Replace with quick fastening/releasing devices:
  - Single motion securing
  - U-slot method
  - Pear shaped hole method
Step 3 Application - Nut/Bolt Improvement Methods

- Reduce Number of Screws
- U-Slot Method
- Single Motion Connections
- Clamps
- Snap Method
- Use of Cams
- Pear Shaped Hole Method
- Magnets
- Toggle Clamps
- One-Turn Method
- Use Only 1 Type/Size of Fastener
Step 4 of 4

STEP 1
Document the setup and separate events into internal or external

STEP 2
Convert Internal to External events

STEP 3
Streamline internal events (Simplify, Reduce, Eliminate)

STEP 4
Eliminate adjustments internal to the setup

Use Step 4 to remove additional time

“Corresponding” DMAIC phase for a stand-alone Setup Reduction project
Eliminating Adjustments and Trial Runs

- Turn intuition and guessing into data and settings.
- Elimination means *elimination* – not *reduction* in the time required to perform adjustments.
Step 4 Tools - Eliminating Adjustments

Abandon reliance on intuition for settings

- Intuitive settings are inexact and do not provide the required precision as data based settings
- Converting intuition to DATA is the surest way to consistently avoid adjustments and test runs
Step 4 Application - Centering Method

**Before**

- Machine Base
- Machine Center
- Fixture
- Adjustments

**After**

- Machine Base
- Machine Center
- Fixture
- Centering Ball
Step 4 Application Results - Centering Method

**Before**
- Place fixture onto base
  - Load and cut part
    - Take measurements
      - Correct dimensions
        - Make adjustments
          - Start production

**After**
- Place fixture onto base centering using centering ball
  - Start production

Average 2 Scrapped Parts
Step 4 - Six Steps for Analyzing Effectiveness of Adjustments

(1) What is the step’s function and is it necessary?
(2) Determine why the step is needed
(3) What is the skill level of the Changeover operator?
(4) Why is it necessary to perform it this way?
(5) What conditions create the need for repeated adjustments?
(6) Consider the alternatives that can eliminate or drastically reduce Steps 1-5 above, and then implement.
Establish Effective Measurement System

(1) OEE (Operational Equipment effectiveness)
(2) Number of steps in changeover process.
(3) Total time for an average changeover.
(4) Reduced lead time.
(5) Machine “run time” / utilization time.
(6) Number of products produced
(7) Lot Sizes.

Insures projects take on a “results orientation” that is measurable and positively impacts performance parameters.
Service and Office Opportunities

Service Waste
- Errors in documents
- Transport of documents
- Doing unrequested work
- Waiting for the next step in the process
- Process for getting approvals
- Unnecessary motions
- Backlog in work queues
- Under-utilized employees

Office Process Waste
- Too many signature levels
- Unclear job descriptions
- Obsolete databases/files/folders
- Purchase orders not matching quotes/receiving/invoices
- Errors – typos, misspellings, wrong data
- Waiting – for information, at meetings
- Poor office layout
- Unnecessary emails
Other Quick Changeover Opportunities

- **Separate internal from external time**
  - Printer Out of ink - Internal time from last printed sheet to next printed sheet
  - Have the next task or project prepared and waiting for you in a folder instead of searching for it and the instructions

- **Cut-out Waste**
  - An office machine requires multiple settings use a one-touch method
  - Reduce the number of clicks to access information from a computer system

- **Parallel Systems (Pit crew mentality)**
  - Cleaning an office w/multiple people doing specific tasks
  - Have a team make sales phone calls by using aides to prepare the customer information ahead of the Sales Rep’s call
  - Surgery preparation for the patient and the actual procedure
  - Catering a dinner with appetizer, entrée, salad, and desert teams

- **Tools**
  - Add RAM to your computer to speed up processing
  - Use multiple monitors instead of flipping through multiple screens
  - Use vacuum cleaners instead of brooms
# Standardized Work in a Doctor’s Office

## Standard Work Combination Table

<table>
<thead>
<tr>
<th>Process</th>
<th>Patient Visit</th>
<th>Version</th>
<th>Revised</th>
<th>As Was</th>
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<tbody>
<tr>
<td>Author</td>
<td>Dean Ziegler</td>
<td></td>
<td>6/24/09</td>
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<table>
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<tr>
<th>Seq</th>
<th>WS</th>
<th>Work Element</th>
<th>Walk</th>
<th>Work</th>
<th>Wait</th>
<th>Misc</th>
<th>Comments</th>
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<tr>
<td>1</td>
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<td>Replace exam table sheet</td>
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<td>0.5</td>
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</table>

**Total:** 29

## Problem

**Long Cycle Time**
- Less patients
- Less money

### Cycle Time
- **Takt Time:** 30 minutes
- **Cycle Time:** 29.0 minutes
What Have We Learned….

- Setup Reduction (Quick Changeover) is a Lean Tool
- The term SMED is sometimes used in place of Setup Reduction, but refers to die change improvements
- Setup reduction is a requirement for batch size and overall lead time reduction.
  - Apply this to the key “time traps” first.
- Use the four step method – it works…
- Measure It
- Use it on all types of process (even when you get coffee from a vending machine).
- A key element is 3C+C. (Communication, Cooperation, Consideration, &+ Commitment (to action)
Thank You

Any Questions?

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