Chapter 6

Setup Reduction

Traditional Approaches

- Setup Time
  Elapsed time from the last unit of one lot to the first good unit of the last lot.

- Traditional ways of addressing setups
  - Increase the skills of setup personnel
  - Minimize product variety
  - Combine different jobs with the same setup requirements
  - Use large lots

- First way above puts setup responsibility into the hands of highly skilled workers; the other ways reduce the number of setups.
Traditional Approaches

- Restricting the setup operations to a relatively few workers limits the number of setups to what those people can do.
- Moving with constrained product variety is directly opposed to what most customers want.
- Sequencing the products to minimize the total time lost precludes any opportunity for achieving smooth flow through multiple operations.
  Jobs waiting at any operation will be preempted by any job that arrives that does not require a setup.
  What would this tend to do to batch sizes?

Benefits of Simplified Setups

- Quality
  With standardized setup procedures, trial-and-error adjustments and inspection (along with scrap) are eliminated or reduced.
- Costs
  Reduced WIP and FG inventory investment. Reduced labor hours and skill level, plus less scrap.
- Flexibility
  More adaptable to changing demand and/or product mix.
**Benefits (Cont.)**

- **Worker utilization**

  Focus is on simplifying the setup so that operators can perform them. Less waiting time is generated.

- **Capacity and lead times**

  Reducing setup times obviously increases capacity with no or little capital. Make-to-order becomes possible for a make-to-stock producer.

  Why would I say that?

- **Reduced process variability through standardization.**

**Why So Late?**

- **Requires a set of full-time teams given the responsibility for improvements in machines, tools, and fixtures.** These people must be supported by toolmakers and process and manufacturing engineers.

- **Managers prefer to buy new equipment rather than improve existing equipment.**

  Do you believe this? And if so, why would it be so?

- **Engineers with training and experience in factory automation come up with complex setup improvements, which are rejected as being too costly.**
Why So Late?

- Reducing setup on just a few machines or processes has little impact so individual setup projects are hard to justify.
  - Must take a global, plant-wide view.
  - Major benefits accrue only as a result of a dedicated effort.
  - Improvements happen setup by setup, machine by machine.
  - It takes a while to see the benefits.

- Setup procedures are infinitely varied, but ---

  Most of the experience gained at reducing setups at a few operations or machines can be readily transferred elsewhere.

Setup Reduction Methodology

- Steps common to most industrial setup procedures.
  - Type 1: Retrieving, preparing, and checking materials, tools, etc.; cleaning the machine and workstation; checking and returning tools and materials.
  - Type 2: Removing tools, parts after completion of the last lot; mounting tools, parts, prior to the next lot.
  - Type 3: Measuring, setting, and calibrating the machine, tools, fixtures, and parts to perform the operation.
  - Type 4: Producing a test piece after the initial setting, measuring the piece, adjusting the machine, and continue this process until a good part is made.
Stage 1: Identify internal and external steps.

An **internal setup** element consists of those steps that must be performed while the machine or operation is stopped.

An **external setup** consists of those steps that can be performed while the operation is running.

On previous page (four steps), most Type 1 steps are external, while most Types 2, 3, and 4 are internal.

Primary focus is on reducing the internal setup time, not total setup time or total labor time.

### Figure 6.1
Setup Worksheet

| Operation: 10 ton press | Total Setup Time: 80 Minutes | Elapsed Setup Time: 65 minutes |

<table>
<thead>
<tr>
<th>Step No</th>
<th>Int</th>
<th>Ext</th>
<th>Time (min)</th>
<th>Performed By</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>E</td>
<td>5</td>
<td>Setup Person</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>E</td>
<td>8</td>
<td>Setup Person</td>
</tr>
<tr>
<td>3</td>
<td>I</td>
<td></td>
<td>10</td>
<td>Setup Person</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>E</td>
<td>10</td>
<td>Setup Person</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>E</td>
<td>15</td>
<td>Operator</td>
</tr>
<tr>
<td>6</td>
<td>I</td>
<td></td>
<td>12</td>
<td>Setup Person</td>
</tr>
<tr>
<td>7</td>
<td>I</td>
<td></td>
<td>20</td>
<td>Setup Person</td>
</tr>
</tbody>
</table>

42 38
Figure 6.2 Setup Procedure: no distinction between internal and external setup steps (times from Figure 6.1)

Internal and External Steps Performed Separately

See Figure 6.2

- Every step is done after the machine is stopped
- Steps 1 and 2 could have been done before the machine stopped.
- Step 4 (return old die to storage) could have been done after machine was running with a new die and adjustments made.
Stage 2: Convert Internal Steps to External

Some external steps performed by the operator as machine is running

Setup Person

Operator

- Initial principle objective of setup improvement: reduce **internal** setup time whenever possible.
- Steps done while the machine was stopped should be done while machine is running.
- See Figure 6.3
  - Assumes that operator can leave the machine (while running) to perform steps 1 and 2.
  - Assumes that operator can perform steps 4, 5 while setup person is performing steps 3, 6, 7.
  - Doing steps while the machine is stopped does not affect internal setup time of 42 seconds
Stage 3: Improve All Aspects of the Setup Operation

- Converting internal to external setup will get you approximately 50% reduction in time, but not less than 10 minutes in most cases.
- Must focus on both external and internal setup time eventually.
- Emphasis in Figure 6.1 should be on internal setup time, because the 42 minutes acts to increase minimum lot sizes.
- If the average running time is less than 13 minutes, then must focus on tasks 1 and 2; or these tasks will have an impact on downtime and lot sizes.
- Should continue to work on setup time reduction until you can effectively smooth production.
- Rule-of-thumb -- less than 10 minutes; OTED (one-touch exchange of dies).
- Setup procedure should be simplified so that operators can do the work themselves.

Stage 4: Completely Eliminate the Setup

- Reduce or eliminate differences between parts (product design approach -- common parts are better).
- Make multiple kinds of parts in one step (blanking press - two or more parts with one die).
- Dedicate machines to make just one item. Must have inexpensive machines for this to be viable.
Goals of Setup Reduction

- Maximize the transfer of responsibility to operators.
- Minimize machine downtime due to setups.
- Abolish setup.
- It is not to abolish setup specialists. Their skills should be used in other activities.
  - Standardize setup activities.
  - Modify procedures, tools, fixtures to improve setups.

Definition of Terms

- **Machine** -- Piece of equipment that is fundamental to the operation. It is always there regardless of what is being produced.
- **Fixture** -- Device attached to a machine to adapt it for a particular purpose. Examples include --
  - Dies, nozzles, blades, drill bits, cutting heads, etc.
- **Tool** -- Device for adjusting fixtures and machines or for attaching fixtures to a machine.
  - Want to minimize the need for **special** tools.
Separate Internal and External Activities

- Reference checklists should be required for all setups, regardless of how frequently they occur.
  - Information about setups
  - Steps and sequence
  - All parts, tools, dies, etc. required
  - Numerical values for all settings
  - Important dimensions and measures for machines and/or tools
  - Specifications of product

- Maintained by operators and others responsible for setups and revised when procedures are modified.

- Equipment performance should be routinely checked as part of the external setup -- steps should be included in the checklists.

Setup Schedules

- Setups should be scheduled in advance so effective preparations can be made.

- Daily setup schedules prepared by departmental supervisors based on the production schedules.

  Major issue here. MRP systems quite often change the priority of schedules on a day-to-day basis.
**Improve Internal Setups**

- Perform parallel setup tasks (multiple workers)
  
  Can present some problems if team needs to be assembled.
  
  Should be a temporary solution for that very reason.

- An entire house was built in a little over two and one-half hours. Contest in California (including concrete driveway and landscaping).
  - 740 people involved
  - Project management of all tasks
  - Everyone knew exactly when they were to do their work and estimated times for tasks were in the seconds.

**Attachment Devices**

See Figure 6.5 next page

Targets would be any method that requires more than one tool, more than one person, or more than a single motion.

Bolts
- Number of bolts?
- Different size bolts? (greater than one tool?)
- Standardizing fasteners in a setup

One turn bolt attachment devices
- U-shaped washers
- Pear-shaped hole
- Split-thread bolts
- T-shaped heads (no tool needed)
Improve Internal Setups - Standard Sized Holders and Pins

See Figure 6.6 on following page:

Improve Internal Setups - One-Motion Devices Such as Clamps

See Figure 6.7 on Next Page
Improve Internal Setups - Eliminate Adjustments

See Figure 6.8

Run-measure-adjust cycle is often the most time-consuming portion of the internal setup time.

Keep measurement and setting mechanisms clean and calibrated

Kinds of adjustments
- Mounting parts and fixtures on a machine
- Setting the parts and fixtures for the correct position
- Right combination of settings

Improve Internal Settings - Variable Height Dies

See Figures 6.10 and 6.11

Keep bed or ram stroke fixed and accompany each die with right-sized shims so you obtain correct shut height without adjustment.
**Improve External Setups - Storage**

- Everything needed for a setup should be stored as close as possible to where the setup is done.
- The more that items are dedicated to one operation, the more external setup time can be reduced (depends on costs).
- Items used more frequently at one machine or cell should be stored there - shared with others from that location.

**Miscellaneous Comments**

- Scope of projects
- Setup reduction Team
- Generating and selecting Ideas
- Use of video tape