SMED

IMPROVED FLOW THROUGH

SHORTER PRODUCT CHANGEOVERS

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AGENDA

- Why reduce changeover time?
- Origins of SMED ~ “Necessity is the mother………"
- The SMED process
- SMED tools
- Process plant challenges
- SMED beyond product changeovers
- SMED in real life
When the production equipment is reconfigured or modified, or controlled settings are changed….

- Product changeover
- Product transition
- Changeover
- C/O
- Set-up
CHANGEOVER ACTIVITIES

- Getting tools
- Getting replacement parts (gaskets, filters, guides)
- Cooling down
- Mechanical modifications
- Calibrating, adjusting
- Heating up
- Discarding spent parts
- Putting tools away
- Getting back to process conditions
- Getting back within product specifications
**WHY IS CHANGEOVER TIME IMPORTANT?**

- **Shorter changeovers reduce waste**
  - Overproduction
  - Inventory
  - Time
  - Labor
  - Defects, yield losses

- **Shorter changeovers allow faster production cycles**

- **Faster cycles reduce inventory**

- **Faster cycles increase production flexibility**

- **Simpler changeovers may be safer**
WHY IS CHANGEOVER TIME IMPORTANT?

Faster changeovers mean shorter production cycles

- **Short cycles** = less inventory
- **Short cycles** = more flexibility
- **Short cycles** = shorter lead times
ORIGINS OF SMED

Toyota, circa 1950
- Replacing a die on large body part press = several hours
- Shigeo Shingo devises a method of
  - Examining all set-up operations
  - Modifying the set-up process
  - Reducing time and waste

Toyota, circa 1960
- Replacing a die on large body part press = 15 minutes

Toyota, circa 1970
- Replacing a die on large body part press = 3 minutes

Shingo’s methods have become the standard for changeover reduction

*Single Minutes Exchange of Dies*
SMED IMPROVEMENT STEPS

Identify tasks which can be external

Move external tasks outside the changeover window

Simplify Internal tasks

Perform Internal tasks in parallel
SMED TOOLS

- Direct observation
- Video
- Detailed flowchart of tasks
- Activity list
- Cross-functional process map
- Point-to-point chart
PROCESS PLANT CHANGEOVER COMPONENTS

FOLLOW THE MONEY

PRODUCT A  MANUAL TASKS  BEGIN PRODUCT B

PHYSICS AND CHEMISTRY REACH EQUILIBRIUM

FIRST QUALITY PRODUCT B

CHANGEOVER
Categories of Process Industry changeover

How SMED applies to them
A C/O WITH ONLY MANUAL TASKS

Changing the knife positions on a slitter Between rolls……

- Loosen the knife fittings
- Measure/mark the new positions
- Move the knives to the new positions
- Tighten the fittings

SMED possibilities

- Detailed examination of all specific steps for simplification
- Are there any tasks which could be external?
- Could a second operator speed up the task?
- Consider more positive positioning mechanisms - detents
- Is laser positioning of the knives feasible?
A C/O WITH ONLY MANUAL TASKS

Changing the bag size or box size on a cereal (or fertilizer, or plastic pellet …) packaging line……

- Remove old bag stock
- Clean out the pneumatic lines
- Adjust the bag holding fixtures
- Position new bag stock
- Restart the line – test a few bags for fill and sealing

SMED possibilities

- Detailed examination of all specific steps for simplification
- Are there any tasks which could be external?
- Could a second operator speed up the task?
- Has the product sequence been optimized to minimize material cleanouts?
- Could there be a complete second set of fixtures, pre-loaded with the new size stock?
A C/O WITH CHEMICAL OR PHYSICS CHANGES

Changing the temperature on the bonding (heat treating) roll in a sheet manufacturing process……

- Set the new temperature
- Wait for the roll to reach the new temperature and stabilize

SMED possibilities

- Structured brainstorming workshop with
  - Mechanical engineers
  - Physicists
  - Mechanics
  - Operators

to conceive practical techniques for more rapid heating & cooling
Other examples......

- Changing the oven baking temperature in a bread plant
- Changing the temperature in a polymerization autoclave
- Changing the raw material feed concentrations in a chemical reaction
- ...............
- Others??
In the application of the photosensitive emulsion to x-ray films
Changing to the next emulsion type……

- Valve off the current emulsion
- Remove the coating applicator
- Clean the applicator
- Re-attach the applicator
- Open the valve for the next emulsion
- Run the film – apply the new coating
- Allow time for the flow to stabilize and thickness to reach uniformity
- Take samples to the test lab
- Once results are in limits, begin the next roll
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SMED possibilities

- Analyze the applicator removal – cleaning – replacement process
  - Internal → External?
  - Simplify the process?
  - Purchase a 2nd applicator - have it ready to go on?

- Analyze the test lab operations
  - Simplification
  - Lab lead time improvement

- Structured brainstorming with coating experts and physicists – to improve coating uniformity and repeatability
Other examples

- Changing the dyeability of synthetic carpet fibers
- Changing the particle size in a pigment grinding – milling operation
- .......
- .......
- Others?
The current state VSM can show where SMED will have the biggest impact

- Not always the steps with the longest C/O time
- The steps with long EPEI cycles
- Steps with large C/O losses
After changeover time has been reduced…..

Be sure to re-examine campaign length to how much reduction is possible

Show the improvement results on the Future State VSM
Some process equipment must be taken out of service

- *Not because of a product changeover*
- *But for a periodic overhaul*
- *Some equipment requires this every 6 months, 12 months, or 24 months*

- Pipes get blasted out
- Tanks have residue removed
- Corroded parts are replaced
- Precision rolls get resurfaced
- Catalyst beds get restored
- Extrusion dies get cleaned
Even if managed very well, these periodic shutdowns can cause all of the wastes that product changes do.

- Inventory is created to maintain supply during the outage
- Bringing tools and replacement parts to the area creates movement and transportation waste
- Yield loss, defect waste can occur as the process is restarted.

**SMED can reduce these wastes just as it does with product changeovers**

*This is the primary application of SMED in many process pants*
SMED SYNERGY WITH OTHER LEAN TOOLS

SMED is very complementary with other Lean tools

- **5S**
  - A better organized workplace will enable faster changeovers

- **Visual Management**
  - A more visual workplace enables better changeovers
  - Visual metrics help to sustain the improvements

- **Kaizen Events**
  - Kaizen events are a good way to conduct SMED activities
  - BUT… may require more planning
  - BUT… may require specific skills
  - BUT… may not be able to demonstrate results during the week
Many books and articles use a race car pit crew as an example of changeovers done very well.

Anyone who has seen a professional automobile race can appreciate the

- Precision
- Coordination
- Purposefulness
The pit crew operation is a very strong visual image of SMED principles at work

- All tasks that can be done externally are
- All tasks have been thoroughly analyzed and simplified to be done as quickly as possible
- All internal tasks are done in parallel
- Technology has been applied where appropriate
- Everyone understands their role, and has practiced it frequently
- All pit stops are timed
- There is an intense on-going effort to continue to reduce the time

SMED IN REAL LIFE
The pit crew operation is a very strong visual image of SMED principles at work

- All tasks that can be done externally are
- All tasks have been thoroughly analyzed and simplified to be done as quickly as possible
- All internal tasks are done in parallel
- Technology has been applied where appropriate
- Everyone understands that the race can be won or lost in the pits
- Manufacturing teams should realize that operating excellence can be achieved or lost in the changeovers
Summary

- Long product changeover time adds a LOT of waste
  - Drives long campaigns, drives overproduction
  - Makes the operation less flexible, less responsive
  - Creates Inventory
- To attack this waste, Shigeo Shingo developed the SMED methodology
  - Identify external tasks - move outside C/O window
  - Simplify internal tasks, do in parallel if possible
- In Process operations, most of C/O time can be in getting back to specs
  - So SMED must identify and address this also
- After SMED has been successfully done
  - Do it again
  - Make sure to take advantage of the improvement
- SMED can have great value applied to annual shutdowns/overhauls
Questions?

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SHAMELESS PLUG

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