How to Reduce Changeover Time and *Increase Throughput*
Whether choosing iPhones, detergent bottles, industrial motors, or even bread, customers these days want more options than ever before.

Marketing and product development departments recognize this and are pushing for more variety and more customization. And, in the quest for ever-increasing market share, they usually get what they want, leaving the manufacturing departments tasked with a production quagmire.

Whereas in the past an organization such as Procter and Gamble might order one or two different sizes or colors of a plastic container, they now order four sizes in twelve different colors. Whereas the local commercial bakery used to bake white, wheat and rye, they now bake low-carb, multi-grain, gluten-free, nut-free, and a myriad of other varieties. This is happening everywhere, regardless of the industry or end product.

These factors all contribute to one thing—increasing frequency of production line changeovers.
While it may be good for sales, customization and variety has the less than desirable effect of putting greater pressure on manufacturers to produce smaller production runs of more products. Equipment that used to run for weeks at a time making the same product now needs to be stopped and started—and stopped and started—multiple times, changing over from one product to the next with increasing frequency.

Product and package customization is not the only reason for this shift. Across the board there is a quest for faster turnarounds, smaller inventory levels, and just-in-time (JIT) delivery.

Unless it is carefully monitored, managed and optimized, production line changeovers (the time from the last part produced to the time the first good part of the next product comes off the line) leads to ineffective equipment utilization and lost revenue.
Changeovers cost more than just poor equipment utilization.

In fact, it is estimated that for a one-hour daily changeover on a fairly significant packaging project with the line running 240 days per year, the annual cost is $1.8 million.1

Because they are now performing significantly higher amounts of changeovers, manufacturers who are still allocating the same amount of time to a changeover as they did 10 years ago are losing money with increasing frequency.

The need for increased efficiency of the changeover process has never been higher.

Do the Math!

Excessive Changeover Time Causes

**Lost Production**

Line speed = 250PPM
Contribution = $0.50/Package
Average changeover time = 60 minutes
Cost per changeover = 250 x 60 x .50 = $7,500 ($125/minute)
*Annual cost* = 240 X $7,500 = $1,800,000

AND

**Lost Capacity**

Line speed = 250PPM
One shift operation (8 hours)
1 hour/day of changeover
Theoretical capacity = 120,000PPD
Actual capacity = 105,000PPD
Annual capacity loss = 15,000 X 240 = 3,600,000 Pkgs.
If contribution per package = $0.50,
**Cost of lost capacity is $1,800,000**

(Lost capacity is lost production from a different point of view)2

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Often company leaders don’t realize how much time they are wasting because they aren’t measuring and observing operations at a sufficient level of detail.

A prime example of this is when Overall Equipment Effectiveness (OEE) figures are calculated without taking changeovers into account. This makes the figures look good, but fails to address the real issue. Inefficient processes go unidentified and unresolved.

On the other hand, manufacturers that do recognize the need for process improvement are reaching into the toolbox, using well-established methods to solve these problems. Lean and Six Sigma tools are principle among them because they make it easier for companies to identify where they are being wasteful, what types of waste they are dealing with, and how to address them.

Profits can be made or lost in the changeover process—and Lean tools can help you come out on top in competitive situations more often than not.
Let’s Talk Changeover Time

Changeover can be divided into the 3 Ups:

**Clean-up**
the removal of previous product, materials and components from the line.

**Set-up**
the process of actually converting the equipment.

**Start-up**
the time spent fine tuning the equipment after it has been restarted.

Tasks commonly performed during changeover include:
- Getting tools and replacement parts
- Cooling down or heating up
- Making mechanical modifications
- Calibrating and adjusting
- Disposing of spent parts
- Putting tools and supplies away

“Changeover costs are seldom measured, but can total as much as tens of thousands of dollars per hour.”

*John Henry, President of Changeover.com.*

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Faster Changeovers = Multiple Benefits

Many Lean experts compare lean tools to the philosophy of a NASCAR crew during a pit stop. A good pit crew will move efficiently, saving a little bit of time each time the driver pulls in. Over the course of the race, these seconds add up and ultimately can make the difference between winning and losing. Lean follows the same thought process. Small changes can yield big results.

Quick changeovers do more than save time, they also

- **Reduce defect rates**—Quick changeover reduces adjustments as part of setup and promotes quality on the first piece.
- **Reduce inventory costs**—Elimination of, or reduction in numbers of batches, and their sizes, allows for recovery of operating cash and manufacturing space.
- **Increase production flexibility**—Increase output and improve timeliness of response to customer orders.
- **Improve on-time delivery**—Quick changeover supports the ability to meet customer demands.\(^5\)

No matter how many pit stops or changeovers your production line requires per day, you can focus on applying Lean Six Sigma methodologies to the steps you are taking in the changeover process to streamline them.

A Case Study: A Midwest supplier of molded and extruded thermoplastic components and assemblies for the automotive and commercial industries sought to reduce machine down time and increase production output capacity to avoid the purchase of new equipment. After consulting with an expert on quick changeover, they were able to video and identify 6 specific areas for improvement that totaled 38 minutes—a reduction of overall setup time of 37 percent.\(^6\)


There are many methods to reduce changeover time. These selections from Tim McMahon’s A Lean Journey represent a solid “core four” to focus on.

- **Eliminate non-essential operations**—Adjust only one side of guard rails instead of both, replace only necessary parts and make all others as universal as possible.

- **Perform External Set-up**—Gather parts and tools, pre-heat dies, have the correct new product material at the line… there’s nothing worse than completing a changeover only to find that a key product component is missing.

- **Simplify Internal Set-up**—Use pins, cams, and jigs to reduce adjustments, replace nuts and bolts with hand knobs, levers and toggle clamps… remember that no matter how long the screw or bolt only the last turn tightens it.

- **Measure, measure, measure**—The only way to know if changeover time and startup waste is reduced is to measure it!

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Embrace Lean Six Sigma

Lean Six Sigma provides a proven methodology to reduce changeover time and increase productivity.

Lean Six Sigma Tools Provide:

- A metric—a standard or measurement
- A goal—3.4 defects per million opportunities
- A rigorous, process focused methodology
  - the DMAIC process (Define, Measure, Analyze, Improve, Control)
- A management philosophy
- A scientific problem solving process

- Bill Soller, Lean Six Sigma expert -Principal/Master Black Belt, Supplier Six Sigma, LLC
Define, Measure, Analyze, Improve, Control (DMAIC)

This representation of how Lean Six Sigma tools work aptly captures how these steps continually cycle and function together. *Define, measure, analyze, improve, control*... and then do it again as new insights are revealed by following this business-boosting process.

Keep the cycle moving, and benefit from what each of these five steps makes easier.

The DMAIC process engenders continuous operational improvement.

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A Case Study: A large bakery had a problem with the amount of time it took to clean the line after making sheet cakes—it was taking 66 full minutes to clean the line and get it ready for the next product. Inefficiencies and lack of standard operating procedures were leading to lost time, too many re-dos, and a lack of a sense of urgency. Using the Define, Measure, Analyze, Improve, and Control (DMAIC) project model, changeover time was reduced by half. This netted the company a $72,000 productivity gain, and enabled them to keep up with customer demand and increase their profit. 

*Soller, Bill. Supplier Six Sigma, LLC.*
Examples of Lean Six Sigma Tools

Time studies, motion studies, and video analysis are a few examples of Lean Six Sigma tools that can boost revenue. Other methods to do it faster, better, and cheaper include

- **Single-Minute Exchange of Die (SMED)**—Developed in the 1950s by Shigeo Shingo, (who also developed the Just-in-Time (JIT) concept) this method of changing the die in less than 10 minutes has been esteemed since 1956, when Shingo used SMED to reduce the set-up time of hull assembly on a 65,000 ton supertanker; setting a record in shipbuilding.9

- **Kaizen continuous improvement training events**—These are attended by organization members of various levels with the goal of improving an existing process, or processes. Kaizen Event Steps include gathering all team members in one place, mapping the existing process, making improvements to it, and soliciting input from all parties in attendance.10

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Examples of Lean Six Sigma Tools, continued

- Polymer production quality control—Polymer producers seek technology that excels in controlling the polymer properties in a consistent way over the entire plant and in maximizing the production performance while keeping safety regulations. Online soft-sensing (inferential estimating) is just one of the ways this is achieved.11

- COT2 (Changeover tool-second generation)—“The tool consists of three pieces of hardware: the Windows-based tablet, a microprocessor-equipped wireless sensor bundled with the potentiometer and nonmagnetic brackets and hooks which are attached to the machine. Operators mount the sensor on a given bracket and run the potentiometer’s string to a hook on the movable machine part. LED indicators then guide the operator in dialing in the distance to within 0.7mm of a predetermined optimal setting. As many as 50 set points per machine are stored in the tablet’s memory, where all the changeover “recipes” also reside.”12

Sometimes people argue that a process change that shaves 10 seconds off is an insignificant improvement.

They couldn’t be more wrong. Think of the guy with the small hole in his pants pocket. A coin falls out every hour. At day’s end his pockets are empty and he wonders why.
Coming up with new, more efficient ways of doing things is only one part of the process. Lean Six Sigma tools are more than just a technical approach. They encompass a comprehensive methodology and mentality that must be understood, valued and shared within your structure. In order to achieve what lean processes make possible, employees across all levels of your organization must “buy in” and actively participate and bringing these changes about.

As Jim Jelinek, co-author of *Quick Changeover Simplified: The Manager’s Guide to Improving Profits with SMED* was quoted as saying in IndustryWeek, “It is imperative that a company attempting to implement a quick setup and changeover program clearly articulate to the workforce what such a program means both to the company and to the employees. Their commitment requires your (management’s) commitment… and that means in action as well as words…if you want to influence behaviors, you need to address your people… you need to know their beliefs and do they know yours?”

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Lean tools are proven and very effective, but like any other tool, they must be used properly in order to perform as intended. Let OH!Manufacturing and PolymerOhio help you apply these tools to improve efficiency and profitability. Our extensive industry experience has helped many manufacturers improve their changeover process. We can provide the training necessary to help your team to develop the appropriate skills, or run the implementation on your behalf. No matter what degree of expertise in Lean Manufacturing Methods your organization currently possesses, we can help you improve it, making it possible for you to reduce changeover times, increase profits and improve productivity.

Reach out to us today at 614-776-5720 to see how we can help you overcome your specific challenges, streamline your operations, and grow your business.
About PolymerOhio

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