Applying lean to your stamping shop

Part I: Overcoming common changeover barriers

By Drew Locher

Editor's Note: This is the first part of a two-part article on lean manufacturing in stamping shops. Part I discusses how to eliminate several barriers that prevent shops from achieving quick changeover. Part II, which will appear in the May issue, examines tools that can help stamping operations maintain good product flow.

Domestic stamping shops face significant challenges in today's market. Customers request relatively smaller orders in shorter lead-times and at lower prices. They attempt to reduce the amount of inventory that they carry by pushing the inventory back onto the stampings suppliers, forcing them to process shorter runs with a greater product mix through shared resources.

This situation has made it necessary for stamping shops to cope with a higher degree of demand variability, such as different order quantities, which translates to variable capacity loading. Furthermore, customers often have looked to stamping shops to perform more value-added operations, such as assembly, with little or no increase in prices (see Secondary Operations Performed Lean sidebar). As a result, stamping operations have experienced considerable downward pressure on product margins.

In light of these challenges, stamping shops need a high degree of flexibility, shorter lead-times, and reduced costs. Implementing lean concepts can help them reach those goals.

SMED in the Lean Toolbox

In the lean "toolbox" is a key technique called single-minute exchange of die (SMED), which involves changing over a die from one job to the next in nine minutes or less (single digits). The term has become generic and encompasses all types of changeover or setup processes, even those that don't involve a die.

SMED allows for diversified, small-lot production, and the impact of quick changeover of all equipment can be significant. Setup time reductions of 50 percent to 90 percent are typical when SMED concepts are applied.[1]

However, while most stamping shops are now familiar with the concepts, few have actually achieved the ultimate goal of being able to change over equipment consistently in less than 10 minutes. What is standing in their way?

Poor Organization

One of the most common reasons most shops cannot achieve the SMED goal is an unorganized workplace. About half of the opportunity to reduce changeover time lies in simply getting better organized, with the other half involving the more technical changes,

Secondary Operations Performed Lean

Many stamping operations have added secondary operations to their value-added services. These include assembly operations such as welding or attaching mechanical fasteners. Traditionally, companies have *batched* products through the secondary operations process, typically with the opportunity for a queue to form at each step. However, the application of cellular/flow concepts may be applicable in these situations.

Some stamping operations have learned to design and quickly set up highly flexible cells to perform these operations in very efficient ways. Flexible equipment and workstations—often on wheels—are used for this purpose. One-piece or near-one-piece flow often can be achieved by applying cellular or flow concepts, thereby significantly reducing lead-time throughout the entire production process by 50 percent to 90 percent.

such as altering tooling or equipment to facilitate more rapid changeovers.

Why do so many companies fall seriously short in this area? Most use the excuse that they don't have time to get organized—yet somehow they find the time to work around their lack of organization.

In the lean toolbox is a methodology to achieve and maintain organization in the workplace, often referred to as 5S.[2] With this standard, everything in a shop can be located in 30 seconds or less (see The 5S Methodology for Workplace Organization sidebar).

Lack of Standard Work Practices

Still another barrier to the rapid changeover of equipment is the lack of defined standard work practices for changeover processes. Operators and setup technicians often are left on their own to determine the best way to change over a machine—a process that is critical to the success of the business. This adds tremendous variability.

A standard work practice is the best-known sequence to perform a process in a predictable time frame, resulting in acceptable quality every time. It is a foundation concept of lean—and probably the least often practiced. The goal for every changeover is to create a process much like that of a racecar pit crew—the "pit-crew ballet." Could your current changeover process be described as a well-choreographed ballet?

Insufficient, Rigid Training

A third barrier to rapid changeover success is lack of employee skill flexibility, achieved by employee cross-training. Most often the excuse is that training takes too long, and there isn't enough time. However, time often is short because work practices are poorly defined, and too often a shop depends on individuals who are ill-equipped to teach others. Experience and seniority do not guarantee that an employee will be a good trainer.

Another foundation concept of lean manufacturing is Training Within Industry (TWI),[3] which dates back 60 years. During World War II, the U.S. War Department developed a technique known as Job Instruction (JI) to define standard work elements and teach them to others. The technique defines the desired sequence of steps, the expected time to complete each, and the key points.

Speed or efficiency, quality, and safety are always key points. JI also defines a seven-step process to teach the standard work to another person. In essence, it is standard work to train others.

The use of this simple technique led to well-documented reductions of 75 percent to 95 percent in the time to develop an individual's proficiency. By applying this technique today, stamping shops can make cross-training a reality and increase the flexibility of their work forces.

The 5S Methodology for Workplace Organization

1. Sort—Identify all items that are not in the correct place. Relocate necessary items, discard items that are no longer needed.

2. Set in Order—Identify a location for every item. The location should be easily accessible by the user.

3. Shine—Not just cleaning, but "inspect through cleaning" to identify equipment problems before they become significant. This also involves "countermeasures" to prevent contamination from being created in the first place.

4. Standardize—Standardize work practices and establish standards for the first three steps. For example, establish a "red tag" program to promote continuous sorting. Implement cleaning and inspection check lists.

5. Sustain—Develop a model to sustain the benefits achieved in the first four steps. This involves periodic audits, recognition programs, ongoing education, and practice in all five concepts.

With 5S methodology, everything in a shop can be located in 30 seconds or less.

Drew Locher is a principal of Change Management Associates, 31 Lexington Court, Mt. Laurel, NJ 08054, 856-235-8051, drewlocher@comcast.net, www.cma4results.com.

Notes

1. Shigeo Shingo, Single Minute Exchange of Die: A Revolution in Manufacturing, *(Florence, Ky.: Productivity Press), 1985.*

2. Hiroyuki Hirano, 5S for Operators – 5 Pillars of the Visual Workplace, *Shop Floor Series (Florence, Ky.: Productivity Press), 1996.*

3. Donald A. Dinero, Training Within Industry – The Foundation of Lean, *(Florence, Ky.: Productivity Press), 2005.*

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Part II: How to maintain good product flow

By Drew Locher

Editor's Note: This is the second part of a two-part article on lean manufacturing in stamping shops. Part I, which appeared in the April issue, discussed how to eliminate barriers that keep shops from achieving quick changeover. Part II examines tools that can help stamping operations maintain good product flow.

After shop flexibility has improved, the focus turns to maintaining flow. In the lean toolbox is a concept called *quality at the source* (QATS). QATS implies that operators are given the means to control the quality of their output. The ultimate in QATS is poka-yoke, or mistakeproofing.[1] It is not always possible to achieve this level of control, but at the very least, methods can be put in place to prevent defects from escaping to the next stage of processing.

Quality Control

Quality problems can be common causes for the stoppage in the flow of product. Too often problems are discovered after the process—sometimes by the customer. By this time, a large number of defects have been created, causing the need for additional inspection, sorting, and possibly rework and scrap. Many stampers rely on first-piece inspection as a means to control quality, but this cannot be the only approach.

There are three levels of control:

1. Detecting a defect after it has been created
2. Detecting an error before a defect has been created
3. Preventing an error from occurring (mistakeproofing)

To clarify, an error (mistake) is the action that creates a defect. Many organizations rely on defect detection—the lowest level of control. However, numerous mistakeproofing devices should be considered for use in particular situations (see sidebar). Stampers should be sure to mistakeproof their mistakeproofing device.

Equipment Reliability

Another common cause for the interruption in flow is equipment unreliability. Unplanned equipment stoppages can be addressed by the lean tool *total productive maintenance* (TPM).[2] The goal of TPM is to achieve zero stoppages.

At the core of the TPM concept is an important measure called *overall equipment effectiveness* (OEE), which has three main components:

1. Availability
2. Performance efficiency
3. Rate of quality

Within these three main components are six subcomponents:

1. Start-up
2. Setup or changeovers
3. Unplanned downtime
4. Minor stoppages and idling
5. Speed loss
6. Loss caused by the processing of defective products

Most companies measure several of these components, such as setup and unplanned downtime. However, few measure all of the components and summarize them in a single measure of OEE. Typically, OEE is as low as 60 percent—in other words, there is 40 percent equipment downtime. (Planned downtime, such as off-shift time and periods of low or no demand, is not included in this calculation.)

With the application of TPM concepts, OEE can reach 90 percent and higher—considered to be a world-class standard. Stampers should calculate the true OEE of equipment in their operations, and imagine the benefits to the organization if the OEE were improved by 30 percentage points.

TPM goes beyond simple preventive maintenance (PM) practices, such as lubrication and cleaning, to include predictive maintenance, operator or autonomous maintenance, and pro-

Mistakeproofing Devices

1. Guide/reference/interference pin—A solid piece of material that positions or orients something to guarantee its correct placement
2. Template—A pattern that represents an accurate copy of an object or to guarantee accurate position
3. Limit switch/microswitch—An electrical device that confirms the presence, position, and dimension with light contact
4. Counter—A mechanical or electrical device that keeps track of numbers
5. Odd part out—A form of counting that does not rely on a counting device, but rather visual techniques
6. Sequence restriction—A means to permit only the desired sequence
7. Standardize and solve—With weight, dimension, or shape standards, devices often can be developed to identify nonstandard conditions
8. Critical condition indicator—A device that detects two types of conditions: the presence or absence of a specific, visible, preset quantity, weight, volume, and so forth, and fluctuations in a nonvisible condition such as pressure, temperature, current, and fluid flow
9. Detect delivery chute—A passageway where detection devices can be used
10. Stopper/gate—An obstruction that prevents an operation from being performed
11. Sensor—An electrical device that detects and responds to fluctuations in characteristics

ductive maintenance.

To understand these concepts, consider an automobile example. PM dictates that the operator should change the oil every 3,000 miles or three months. Predictive maintenance triggers maintenance when the condition of the automobile has changed—for instance, it is operating with more noise than usual. This is why the operator must be proactively involved — autonomous maintenance—in the ongoing maintenance of the equipment. Only the operator of an automobile can detect subtle changes in its operation.

Finally, productive maintenance involves the ease of providing maintenance, and it often includes design elements of the equipment itself. For example, in many automobiles, the oil filter now is easily accessible toward the top of the engine, rather than underneath.

Scheduling and Inventory

For a stamping operation that stocks finished product for its customers, a *pull system* for finished goods inventory can simplify the scheduling process, free up space while reducing inventory (typically by 50 percent), and help improve customer service.

Proper sizing and implementation of the pull system starts with an analysis of the batch, lot, or run size, as well as the amount of inventory that should be carried. It takes into account machine cycle times by part; OEE, including setup or changeover time; and other considerations such as customer demand and demand variability.

Value Stream Mapping

To be sure, questions remain unanswered such as "Where to start?" "Which techniques will be most beneficial?" and "What results can be expected?"

To learn how to apply lean concepts and to understand their benefits, a stamping shop can use value stream mapping[3,4] as an assessment and planning tool. It involves three main steps:

1. Create a *current-state* value stream map for a selected product family—a visual depiction of how things currently operate, including key data elements such as setup time, downtime, quality performance, and cycle times.

2. Create a *future-state* value stream map by applying key lean concepts, many of which were reviewed in this two-part article, such as quick changeover, standard work, and TPM. Included on the future-state map are the projected benefits.

3. Develop an *implementation plan* to make the envisioned future state a reality, often within a three-month time frame.

A value stream map can provide a road map for a stamping company's lean effort. This is why it is often the first step on the lean journey.

Drew Locher is a principal of Change Management Associates, 31 Lexington Court, Mt. Laurel, NJ 08054, 856-235-8051, drewlocher@comcast.net, www.cma4results.com

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1. Shigeo Shingo, Zero Quality Control: Source Inspection and the Poka Yoke System *(Florence, Ky.: Productivity Press, 1986).*

2. TPM for Every Operator, Shop Floor Series *(Florence, Ky.: Productivity Press, 1996).*

3. John Shook and Michael Rother, Learning to See *(Cambridge, Mass.: Lean Enterprise Institute, 1999).*

4. Drew Locher, The Complete Lean Enterprise: Value Stream Mapping for Administrative and Office Processes *(Florence, Ky.: Productivity Press, 2004).*