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# What Can SMED Do for You?

By Gary Gathen, Contributor

**SMED – single-minute exchange of dies – refers to the process of reducing die-change time to less than 10 minutes. A lean cornerstone, SMED concepts can also help anyone seeking to improve continuous-flow.**

SMED: It's not just about setting up dies. Dies were the first improvement target and the reason SMED came to be, but the thinking carries over into many other areas. SMED has to do with every kind of changeover setup, from high volume, low mix (HVLM) to mass production to the job shop's high mix, low volume (HMLV) manufacturing process. It can be used in tool and die making where each tool, die or fixture is different. Dr. Shigeo Shingo's book, *A Revolution In Manufacturing: The SMED System*, is a key reference for SMED activities, and a sort of cookbook for implementing such a system in your plant.

Currently most manufacturers who haven't implemented SMED still use EOQ (economic order quantity) to determine production-run batch sizes. For many years, it was believed that optimum inventory levels should be calculated by spreading the setup for changeover across as large a batch as possible, within the production requirements of the plant. This is why inventory levels grew and grew. New, larger storage areas and warehouses became the rule. Industrial engineers reasoned that you will never have product outages if you carried enough inventory.

Shingo, often referred to as Japan's Edison, developed the SMED system in 1959 while working as a consultant for Toyo Industries. Taiichi Ohno, vice president of manufacturing, assigned him the task of matching a German company's die-changeover speed of an astounding two hours for an entire tandem press line. The company's previous time had been 10 hours or more.

To meet the challenge, Shingo first targeted the Germans' two-hour mark, then realized that by the time he achieved that goal, the Germans would be even faster. He decided to set his own goal of less than 10 minutes, leapfrogging the competition. The "single minute" part of SMED refers to a single-digit time limit — nine minutes or less, not a single, 60-second minute (although small dies are regularly changed in less time that that).

Shingo and his team discovered that if setup time was greatly reduced, batch sizes could shrink proportionately. Today, inventory is the enemy of production efficiency and effectiveness. More than 50 years ago, Shingo realized that inventory costs more than originally thought. Materials "on the shelf" have to be bought and paid for much sooner, and so does the labor used to make and store finished and work-in-process goods. The cost of floor space and new warehouses is considerable, as is the cost of insuring those facilities and the products they contain.

The fundamental reason to implement SMED is to reduce lead time and cut manufacturing costs, while maintaining quality. SMED allows for setup times to be reduced so parts can be produced in a short timeframe and become deliverable as fast as if they were already sitting on the shelf. But there are many factors to address before SMED can be implemented. Chief among them are Shingo's seven kinds of waste in manufacturing. These are:

- Early production
- Excess production
- Delay
- Product and process complexity
- Inspection
- Transportation
- Defects

**Large automotive fascia molds are ready for inspection (above right and below), and for SMED tryout (above left).**

While all of the above are important, delay can cause the most damage to production. Often the least understood form of waste, delay exists everywhere

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in a plant and is the largest contributor to overall lead time. It adds no value and is unnecessary. And unlike inspection and transportation, delay is not required. It can be eliminated.

Evidence of this is found in a recent time study my firm conducted for a small tool-and-die shop of 80 employees. We determined that processing amounted to no more than 7% of the shop's total scheduled calendar time. Inspection and transporting of materials and people were 3% each. The remainder of the company's time – 87% of it – was caused by delays in various design and build processes. Surprised, the company's management immediately began an improvement program.

A belief among many U.S. plant executives is that processing can best be improved by throwing money at the problem. Using the tool-and-die example from above, this might occur in the purchase of a new five-axis milling machine with high-speed spindles. On the positive side, this machine will likely be able to handle 95% of the shop's expected future work. The negative is that the machine will probably cost $1 million or more, which burdens the entire plant, and that it will likely boost shop productivity only by 50%. Using the figures from above, this would bump productivity to only 11% of the shop's total time expenditure, up from 7%. By focusing on this improvement, managers might conclude that the entire plant operation improved the same amount. They would be wrong.

A better, and less costly way to improve the operation would be to skip the new machine, and create a flow production process where parts are moved to successive operations one at a time. SMED can make this happen by reducing set-up time for machinery to a few minutes. Inventory will shrink in direct proportion to the speed of changeover. And, if you can set up new production runs in just a few minutes, you can change more often, resulting in lower inventory.

As with any improvement program, the key ingredient to implementing SMED is commitment from senior management to the team that performs the setups. Employees also need to believe in its value. As Shingo said, know-how is important, but know-why is even more important.

To establish a clear picture of what's to happen, first determine the exact types of internal and external set-up used in your operation. Internal setup involves tasks which are done while the machine or operation is physically stopped. In the case of a metal press, this involves die positioning on the bolster, die fastening to the bolster, moving the die into the working area of the press and shut-height adjustment. External setup involves tasks that can be performed while the press is running. These include die maintenance; incorporation of part changes; cleaning the die; moving the die from storage to a position convenient to the press; and collecting chains, clamps and hoses that will be needed during setup. A goal of SMED is to convert as many internal steps, those done when the machine is stopped, to external, those that can be done when the machine is running.

One way to do this is to change the way dies are positioned. For example, positioning or centering the die on the bolster can be done by means of a pair of large pilot pins mounted on the bolster onto which all dies, with matching holes, are placed. Or the bottom of the die may have slots which are mated with a set of plugs on the bolster to align centerlines of die with press. Small dies can be slid by hand or fork lift directly into the press, while large ones can be equipped with a set of rollers or a rolling bolster for each press. (Before incurring the $80,000 cost of installing moving bolsters, however, consider the cost-to-benefit ratio.)

Mounting the die to the bolster and to the press ram can be done quickly by a


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variety of methods. Standardizing the clamping area thickness of all dies, for example, permits a set of standard clamping devices to be used. The actual tightening of the fasteners or clamps should be done with minimal turning by using screws of proper length. In fact, on some large dies, the lower die is not fastened to the bolster at all because its weight keeps it in place, and the upper half is tied to the ram or slide with a hydraulic clamping system.

Shut-height adjustment is a critical factor in achieving a quality part and protecting the die from damage. If the die does not close completely, the resulting part will not be within specification, while closing the die too much can destroy it. This is typically done by trial and error with production stopped, bringing the slide down in small increments until a quality part is made. Under SMED, however, settings are used, rather than adjustments. This is done by using a dial indicator and recording the setting for each die or by tonnage monitor readouts. Standardizing the shut height for all dies used in a given press is desirable because the shut height remains constant, and because it can be done with the machine running.

In metal dies, these SMED tactics would convert most traditional internal setup to external. Other kinds of production setups may offer additional opportunities, such as in the case of plastic injection molding. Here, dies or molds must be preheated after installation. This is easily done beforehand with a heating device next to the press during the last part of the current run. Another time-consuming task for plastic-injection mold setup is attachment of numerous heating or cooling lines. By using a manifold with quick-disconnects, set-up time can be cut by 80%. Other setups, such as mills, lathes and grinders can also benefit from application of SMED.

**The end product of the molds shown: automotive fascias ready to be deburred and shipped.**

A variety of internal activities, of course, cannot be converted. These include teardown of the previous die setup, cleaning the press, die maintenance and part changes. To speed such internal processes, however, use a setup cart for each press. It should be of appropriate size for the job and contain everything needed, such as clamps, studs, cleaning cloths, all tools and spares. Production material should be at the press, checked and ready to go, as well. Also, moving the next die to be set up close to the press will shorten setup time, but it must not interfere with the die coming out of the press.

All of these steps can first be worked out on paper. When agreed upon by the team, the steps can be put into action. A videotape that shows a running timer is suitable for testing. Study the tapes together and brainstorm for more ideas.

As setup time drops, which it will for as much as a year, everyone should practice, practice, practice. And in order to sustain the advantages generated from the improvement, the team needs to be recognized for doing so.

A cornerstone of lean manufacturing, SMED is, likewise, more than a process. It's a philosophy that allows you to get anything done more efficiently. Concurrent engineering between customer and supplier amounts to application of the SMED system. Parallel processing or multitasking versus doing the activities sequentially is also SMED.

Frank Gilbreth, a renowned industrial engineer and building contractor, invented motion study in the 1920s and by applying SMED principles (before they were called by that name), improved the bricklaying process from 19 separate motions to five. He did this by inventing an adjustable scaffold, mixing and delivering mortar to the masons, and presorting and orienting the bricks. He developed the system as a teenage laborer, and masons everywhere still use the same method today.

SMED works in everyday life as well. Each time we run out of anything, from gas in the tank or charcoal for the cookout, we experience the cost of our time to correct the problem. Consider kitchen work if pots, pans, utensils and towels were anything but immediately at hand. In essence, SMED principles dictate they be nearby.

To learn more about SMED, buy the Shingo book mentioned above and study it. Then find the point in your manufacturing system where work in process always piles up, waiting for the next operation. Next, select a team and team leader and follow Deming's steps to quality: plan, do, check, adjust and repeat. If your leader doesn't have the experience or time to gain it or is too busy, hire an expert. The savings will start sooner and the cost can be very affordable. Done properly, in fact, a SMED implementation program can even be self-funding. ■

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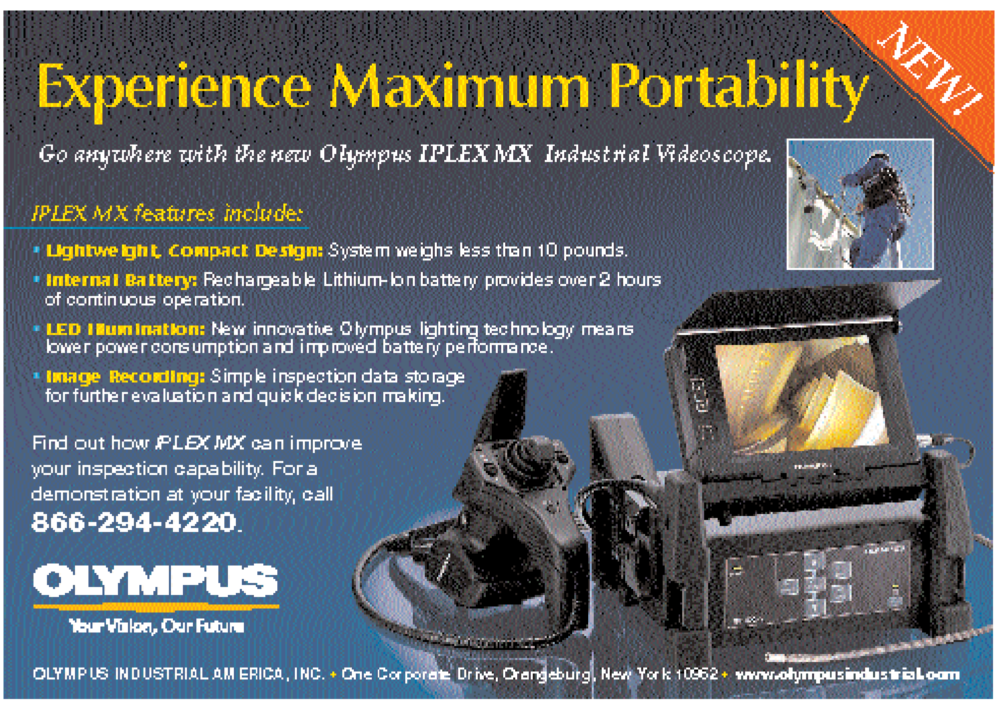


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