

◀ As the need for flexibility increases in a shop, the need for high-production-volume cutting decreases.



# So what if one saw cuts faster than another?

*Cutting speed is not the same as process efficiency*

By Werner Rankenhohn

Comparing one saw to another might reveal quite a few differences, even though the saws might be similar in many ways. One difference might be cutting speed. To many fabricators, this may seem like a significant issue and raise important questions about throughput. In actuality, the main question might be, So what if one saw cuts faster than another?

Over the past 50 years or so, saw manufacturers have come a long way. Today's circular and band saws have little in common with early reciprocating power hacksaws with ratchet feed. Up-to-date production saws with frequency-controlled feeds and speeds are modern machine tools. While in the early days the saw blade was the limiting factor for a machine's performance, today's machines use carbide cutting tools and outperform their predecessors many times over.

Modern design elements—ball lead screws, linear guides, and composite materials, just to name a few—together with the latest CNCs and programmable logic controllers allow not only a much larger variety of material grades and shapes to be cut, but the saws can

cut these jobs efficiently, precisely, and consistently.

Quite a bit of time and a great amount of R&D money were spent to turn industrial saws into the modern machine tools they are today. However, one element remains unchanged: the human element.

### So What If My Saw Cuts Faster Than Your Saw?

This is one of the most important questions to be answered if the job at hand is mass production cutting (cutting 10,000 or more identical pieces per day, day in and day out). When the choice is between two saws, the faster saw, with all other parameters being equal, gets the nod every time. Nevertheless, mass production cutting is only one kind of cutting performed in manufacturing. With the advent of flexible manufacturing, mass production is becoming less and less necessary.

As the need for flexibility increases, the need for high production volume decreases. Subsequently, the saw, normally the first machine in the manufacturing process chain, has to be able to cut small quantities—even one-of-a-kind items—as efficiently and accurately as it cuts mass quantities. The questions about throughput are still

valid, but the answers are less obvious than before.

Let us assume two machines, A and B, are cutting the same material with the same cutting tool. In this example, Machine A needs 30 minutes to make the cut, and Machine B needs 33 minutes for the same cut. Machine A is 10 percent faster than Machine B, resulting in 10 percent more productivity. Or so it seems.

In fact, the actual cutting time of Machines A and B is only one part of the cutting process. The other important factor is the time needed for material handling: getting the cut piece off the machine, getting the remnant away from the machine, and loading the next workpiece into the machine. After the new piece is loaded, it takes time to reference it and move it to the correct cutoff length before the next cut begins. All this time the saw is idle.

If the material handling time is 15 minutes, Machine A can start the second cut 45 minutes after it started the first. Machine B starts the second cut 48 minutes after the first. Now the 10 percent advantage is down to only 6 percent. If the handling times are even longer, the benefits of a faster saw become even less important.

## Automating for Efficiency

What if the saw were capable of tackling the material handling jobs without the need for an operator? What if the cut piece could be removed from the saw automatically, deburred, and stacked or palletized, without an operator? What if the new material could be delivered to the saw and put into a queue while the machine is still processing the previous cut job, without an operator? What if the remnant could be measured and put back into storage automatically—while the saw is still cutting—so that it could be used again (if the length is sufficient)?

That makes four “what-ifs,” but these aren't theoretical what-ifs. Such sawing systems do exist.

While it is relatively easy to automate processes that repeat (as in mass production cutting), the big challenge is automating material handling for single-piece cutting.

### Sawing Center 101

Six elements are necessary for automating a saw that makes one-of-a-kind or two-of-a-kind cuts.

1. An automatic storage and retrieval system (AS/RS) designed to store all the raw materials that need to be cut in a specific time period (for example, three weeks).

2. An automatic crane capable of handling individual workpieces. It must first load each piece of raw material into the AS/RS as inventory; pick the workpiece from its storage location; and deliver it to the infeed conveyor of the sawing machine. The crane is also responsible for storing the remnants after the cutting process is complete.

3. A quick-change station that facilitates feeding the workpiece to the saw while returning the remnant to the crane.

4. A CNC sawing machine capable of sawing all the materials stored in the AS/RS.

5. A sorting unit on the outfeed side of the saw to put the cut pieces into boxes or onto pallets for further processing.

6. An inventory management system (IMS) that controls and monitors all the processes in the sawing center.

The last item, the IMS, is the system's brain. An industrial-grade server

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provides the connections between the system's programmable logic controller and the other five elements. To manage and control the sawing and storing operation effectively, the IMS must have a detailed master record of every piece of raw material that goes into the AS/RS. The master record stores all relevant data of each SKU (stock-keeping unit), such as the physical dimensions, inventory levels, reorder points, and most important for a sawing center, the appropriate speed and feed rates for the integrated sawing machines.

Cut orders can come from any of several sources. The two most common are your management resource planning (MRP) system or a keyboard on the shop floor. Modern technologies also enable orders from remote locations that are transmitted via the Internet to the IMS.

Regardless of the source, any saw order must have the following information:

**1. The material's SKU.** This number tells the IMS the material shape, grade, and heat number; it tells the saw the appropriate feed rate and cut speed.

**2. The cut length.** If the IMS finds a remnant piece with the requested ID number and a length that is sufficient to fulfill this order, it uses that piece.

**3. The cut quantity.** Depending on the required number of pieces, several full-length workpieces or remnants are selected automatically.

**4. The drop-off location.** Depending on the AS/RS layout and the options on it, the cut pieces are sorted into several locations; nonusable remnants and trim cuts go into a scrap container; the other pieces are sorted according to preset rules.

After receiving the order, the IMS server checks for the necessary inventory and starts the sawing process if the right material is available in sufficient quantities. After the order is complete, an order confirmation is sent back to the order's originating location and the inventory level inside the AS/RS is adjusted for the just-finished order.

The AS/RS of a sawing center is typically a cantilever system with enough cantilever arms to store enough inventory for a given production run (typically two or three weeks).

Since the cantilever arms require a certain material strength, additional cassettes are often used to store material that is too thin or too warped to be stored on cantilever arms.

If the inventory management computer is the brain, then the saw is the heart of the sawing system. Before a system can be designed, some analytical work is needed to determine the:

- Type of saws necessary.
- Number of saws necessary.
- Type of sorting necessary.

The type of saw (band or circular) depends almost entirely on the material spectrum that needs to be handled and cut. If the majority of cuts are in material sizes 6 in. and larger, a band saw is likely the most suitable. If the majority of cuts are on workpieces smaller than 6 in., a circular cold saw is likely to be the best choice. However, these are just guidelines. Only a detailed sawing analysis will show which saw is the right one for a given application. Some sawing center installations have both machine types. Again, the choice depends on the work to be done.

Like the type of saw, the quantity of saws depends on the cutting to be performed. Because the material handling is done automatically, and because the system is a truly lights-out cell, the rule of thumb is that one fully integrated saw replaces three to five stand-alone saws.

### Unattended Postcutting Handling

The process of sorting and handling the material after it is cut has a big impact on system efficiency. Getting the cut parts into a container so they can be moved to the next machine shouldn't be a bottleneck.

The easiest (and least expensive) way is to "let 'em drop." Unfortunately, this doesn't do the trick. Depending on the job requirements, the random position of the cut pieces in the box together with a 2-ft. free fall into the container might be unacceptable.

A machine-mounted chute that directs the cut pieces into the container is an improvement, but this doesn't lend itself to lights-out operations. Such a system can run unattended only until the sorting containers fill up.

An efficient solution is a robot. Depending on the shape and weight of the piece, the robot automatically selects the right tool, either a gripper or a suction cup.

If the cut piece is too short (less than 2.5 times its diameter) for a gripper to hold it securely, the robot automatically changes to a vacuum system and picks the appropriate suction cup. After the cut piece is removed from the machine, the robot places it into or stacks it onto the container or pallet. To make this solution work in a lights-out factory, the robot measures the container and optimizes the stacking pattern based on the workpiece dimensions and those of the container.

As it was with the precutting processes, the goal of postcutting operations is to maximize throughput by having all of these processes run continuously and unattended. ■

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