➤BY BILL KENNEDY, CONTRIBUTING EDITOR

Winning at Setup

Tool standardization, preplanning and documentation tactics help shops maximize productivity when setting up multitask machines.

Multitask machining is the "Las Vegas" of the machining world, offering high risk and high reward. Bet right on these expensive units and you can consistently produce high-value parts. Bet wrong and your investment will sit idle much of the time, wasting precious capital.

To succeed in multitasking, shops must stack the odds in their favor. One method is for operators to develop setup strategies that allow multitask machines to do what they do best: perform multiple operations on one machine, eliminating the need to move parts from one machine to another and refixture them.

CUTTING TOOL ENGINEERING asked several shops to share practical methods for minimizing setup time. While strategies varied, the shops all focused on three areas: standardization, preplanning and detailed documentation.

Superior Standardization

The shops interviewed pursue setup standardization in different ways. One shop focused on how its multitask machines allow it to operate a standard set of tools in a standard sequence of operations. Another shop focused on the importance of pursuing customers with ongoing product programs and making the customers' product lines its product lines. The key to multitasking for a Pennsylvania-based shop is to standardize toolholders, while a Wisconsin company's ticket to success has been an in-house-developed software program that generates bar code labels

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Melkes Precision Parts applies lean manufacturing setup concepts in the turning, milling and drilling of a variety of aerospace components in cells.

with tool-length offset information.

The parts made at CNC Industries Inc., a Fairmont, W.Va., job shop, vary widely in size, complexity and workpiece material. They range from small exotic-alloy aerospace and medical parts to large steel tooling and components for the plastics, hydraulics and pneumatics industries. Production runs and lead times can be long or short.

About 4 years ago, the shop acquired a twin-spindle Super Quick Turn 15 multitask lathe from Mazak Corp. The machine features 8" and 6" chucks and live tooling capacity for milling and drilling. CNC Industries President Greg Morgan said the multitask lathe generally is used for more complex parts than the shop would produce on a standard lathe. CNC Industries does mostly turning and some milling. The biggest advantage, according to Morgan, is getting the job done in one machine. The shop recently added a Mazak Super Quick Turn 250 MSY that has Y-axis capability and is fitted with a 3"-dia.-capacity Hydrobar bar feeder from LNS America.

Quick changeovers between different parts is essential. Rather than reinventing the (tooling) wheel each time a new part is set up, Morgan keeps a set of standard tools on the machine. The shop has a group of six tools that are applied on most jobs for rough turning,

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Jeff McGaffic checks the control of the Haas TL-15 dual-spindle lathe at his Vista Manufacturing shop. The machine features a bar feeder that permits untended operation and helps maximize machine uptime.

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CNC Industries President Greg Morgan inspects a 12L4 mild-steel hydraulic component.

finish turning, grooving, threading, drilling or center drilling.

CNMG-style (80° nose angle) inserts are used for general turning and boring, VNMP (35°) for finish turning, and TNMC and TNMC-NV (based on 60° triangles) for grooving and threading. The other tools vary depending on the part shape and complexity. "If a job has a need for a horizontal drilling or tapping operation, we will add those tools," Morgan said.

The sequence of operations is somewhat standardized, too. CNC Industries typically uses the machine as a lathe first and then comes back in with vertical machining center operations. A typical sequence is to do rough and finish turning, and then endmilling, drilling or tapping as the final step.

For example, when a cross-hole is required "we would usually turn first, and then do the cross-hole," Morgan said. This avoids turning with an interrupted cut, which is harder on tooling and requires reduced cutting parameters.

Steady Loads

Maintaining consistent and predictable workloads is another way to keep multitasking machines in operation. Jeff McGaffic said his Midland, Pa.-based shop, Vista Manufacturing Inc., pursues customers who have ongoing programs, resulting in a steady workload. McGaffic said the customer's product line "in a way becomes our product line, because we keep doing the same job over and over again. It works out pretty nice."

The shop machines valves, HVAC parts and fire suppression equipment components. It also does work for the railroads. Workpiece materials include carbon and stainless steels, aluminum, brass and cast iron. Vista machines many of the parts on a TL-15 dual-spindle lathe from Haas Automation Inc. The machine's main spindle has an 8" chuck, its subspindle a 5" chuck and it features live tooling. A bar feeder permits unattended operation.

While McGaffic occasionally tests new tools and replaces prior setups if productivity gains are significant, "usually, we just pull the same program back up and run it. We just keep plugging away," he said. "The key to productivity is how quick can we go from not running to running when the machine needs personal attention, like setup." It is crucial to amortize the cost of the machine and labor over as many jobs as possible, he added.

McGaffic standardizes tools whenever possible. "We'll use the standard CNMG OD type of toolholder. It may not be the absolute optimum for every job, but we can make up for a shortcoming on one particular tool by [improving productivity through] not having to change toolholders." In addition, the tool turret usually contains a toolholder to take an endmill or drill.

When hole diameter changes are needed, McGaffic often can save time by using an inserted-blade spade drill and changing only the blade. One holder from Allied Machine & Engineering Corp. holds the range of inserts the shop needs—usually for diameters from 7⁄16" to 7⁄8".

Another way to standardize is to use preferred suppliers with products that perform consistently in different applications. That is the strategy of small-parts specialist MiniMachine Inc., Bend, Ore.

The shop operates Swiss-style automatic lathes from Marubeni Citizen-Cincom Inc. and Star CNC Machine Tool Corp., as well as gang-tool machines from Hardinge Inc.

Mike Rosenboom, co-founder and vice president, said that while he buys tools from several manufacturers, Mitsubishi Materials USA Corp. "is in the lead" in offering tools the shop needs for small parts on Swiss automatics. Manchester Tool Co. is another strong player, he said.

Rosenboom prefers cutoff tools from Applitec Moutier S.A. (distributed by FLP Tooling). The tools are "very expensive but they last a long time and they work really well," he said. "They use a side-holding screw and have matching serrations on the insert and on the holder. That creates a huge surface area so the tool remains stable and repeats very accurately."

In addition, he said the inserts are "long enough that we can actually sharpen them and do a little bit of modification to the geometry. We do a fair amount of that. We take an insert and 'dress it' to what we need for some applications." On the other hand, Rosenboom said he doesn't use much brazed tooling. "It means you have to grind a whole new tool when a tool goes dull. You may be able to dress it, but if you do, you change your tool geometry."

Turn to Swiss

On the Swiss machines, Rosenboom often uses 35°-nose-angle inserts, with 10mm or 3⁄8" square-shank tooling. Depending on the chipbreaker, and especially on 3⁄8"-dia. and larger parts, the shop uses the 35° tools for both front and back turning. That means that, together, right- and left-hand configurations of one tool can provide profiling capability.

The shop machines materials ranging from exotic alloys to plastics, and "when we change to different materials, we are not changing our turning tool [bodies] as much as we are changing inserts," said Rosenboom. "If we are running titanium one day and nylon the next day, we use the same tooling and just change our inserts."

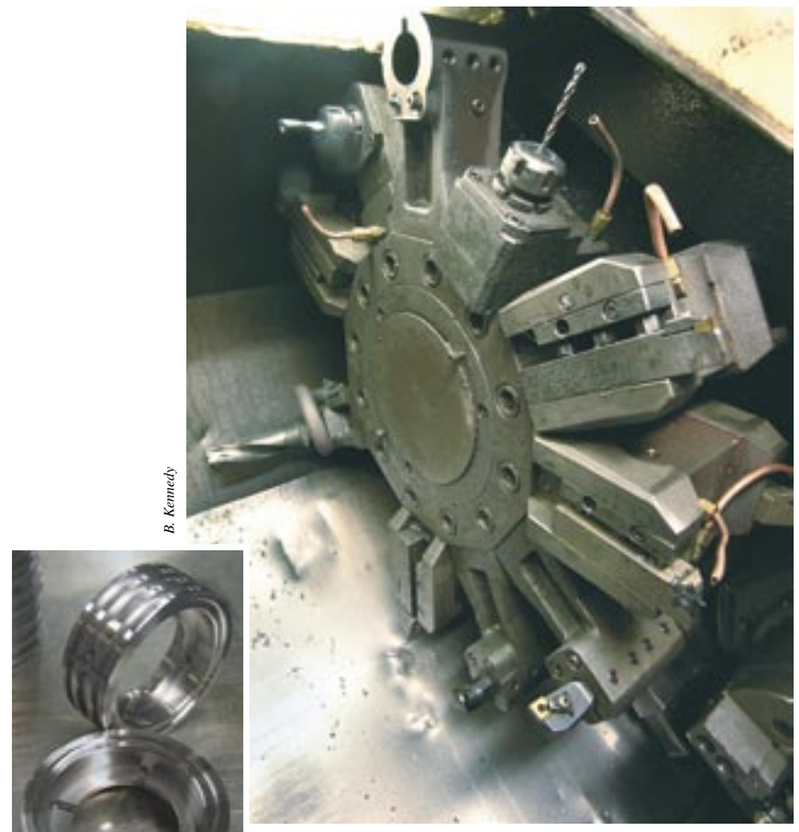
Such a change can make a big difference. Rosenboom recounted the case of a nylon job where chips jammed, inserts failed and drills broke. Burrs on the part required secondary operations. After successfully using thin-film diamond-coated inserts on a Teflon turning job, Rosenboom replaced the high-positive TiCN-coated inserts he had been using with the diamond-coated inserts. The shop saw a sixfold increase in burr-free parts.

That kind of continuing process improvement is also crucial at Dynamic Tool & Design Inc., a Menomonee Falls, Wis.-based mold builder, according to Randy Lee Meissner, CNC department manager. "We are competing against [companies] overseas and we are doing everything we can do to make better quality products faster."

Although not a multitask machine, one tool the shop uses to reach that goal is a V33 VMC from Makino equipped with a 25-tool magazine and automatic toolchanger. The machine is gauged in metric, which provides the shop greater flexibility in sourcing tools globally. It also features a pallet system that is loaded offline, speeding workpiece changeovers.

Meissner said that among the shop's most significant setup improvement efforts was the in-house development of software that enables an off-machine presetter to generate bar code labels with tool-length offset information for individual tools. Tools are preset offline, and the dimensional information is printed on a bar code that goes with the tool. When the tools in the cart get to the machine tool, the bar code is swiped into a reader on the machine, and the offset information is sent directly to the PC.

The same results can be accomplished with the machine tools' built-in tool offset measurement systems, but in that case, Meissner said, "you're using the machine tool as a very expensive presetter. I'm doing it all offline while



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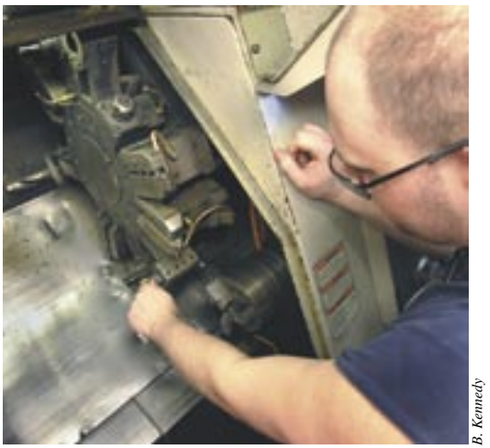
By supplementing a standard group of tools that stay on the machine with additional tools to produce specific part features, CNC Industries efficiently machines 12L4 mild-steel hydraulic components (inset) on a Mazak Super Quick Turn 15 CNC lathe (above).

my machines are running."

Dynamic Tool personnel wrote the software that enabled the offset data, gathered on the company's Zoller CNC presetter, to be put into bar code format. "It took about a year to write the software," Meissner said, noting that it was a complex job, but "we have guys who are just wizards here."

The bar code for each tool is printed on a label pressed lightly onto the tool, but the label doesn't go into the machine. After the label is swiped, it is put on the program so that the operator has the actual printout next to the tool he is picking up. "I can put all the tools in the machine in minutes by swiping them, vs. a half hour using the machine to do it," said Meissner.



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CNC Industries machine operator Josh McBee changes the CNMG insert in toolholder that is one of the group of standard tools the shop keeps on its Mazak Super Quick Turn 15 CNC lathe to speed setups and part changeovers.

He stressed that the system's prevention of setup errors is as critical as time savings. Math errors, taking an incorrect micrometer reading on the cutter or transposing a number in the program can be costly. "With one cutter comp error, I could end up throwing away a 60"x40" mold plate into which I can have 10 or 20 grand [invested]," he concluded.

Preplanning

It is tempting to jump right into new jobs when they come into the shop, but taking time to plan—particularly on more complex multitasking machines—can improve quality and avoid major errors. As the saying goes, "It pays to plan ahead. It wasn't raining when Noah built the ark."

The lean manufacturing approach—which focuses on continuous improvement, team-based problem solving, feedback loops and waste reduction—has helped one shop dramatically reduce setup time through better planning. Preplanning workholding setups using quick-change jaws works for another shop, and still another reduces setup time by batch scheduling similar parts from different customers.

Brent Melkesian, who with his brother, Brian, runs Melkes Precision Products, South El Monte, Calif., said the company's evolving adoption of lean manufacturing practices paid dividends in reducing setup time. Melkes Precision's work includes a broad range of products and customers, with a strong focus on aerospace subcontracting.

Many of the parts are produced on six Mori Seiki CL-200 lathes and two CNC mills arranged in dedicated machine cells based on lean's kaizen concepts. Lean, Melkesian said, "makes a difference. For years I thought it was smoke and mirrors. Twenty-minute setups; how can you do that? We've reduced setups from 5 or 6 hours down to less than an hour. And we know we can take it even further."

Lean practices include preplanning and preparing tooling kits for jobs. He said, "We took a full-time machinist off the floor and put him in the toolcrib. Now, before a job hits the machine, all the tools, fixtures and vises are there so the operator doesn't have to forage for them."

Preplanning of workholding setups can also reduce downtime. Pacific Tool Inc., Redmond, Wash., employs duplicate sets of quick-change chuck jaws fitted with collet pads on its Mori Seiki MT2000 integrated turning center to match various workpiece diameters. Previously, changing the pads on the machine took minutes or longer, and the pads were difficult to handle. Quick-change jaws, on the other hand, can be removed with a turn of a wrench.

Pacific Tool has duplicate jaws and changes the pads outside the machine. When products change, the preloaded jaws can be switched in less than a minute. Products change often at the busy shop, as it serves a wide range of industries, including aerospace, auto and medical. Workload generally is "spread evenly between all three," said COO Scott Garbarino, although the balance between the activities "goes up and down, depending on what month you are talking about."

Vista Manufacturing's Jeff McGaffic said a key preplanning tactic at his shop is arranging for similar parts to be processed in batches. "Right now, we have five jobs that take the same OD threading tool, so we'll put them in consecutive order," he said. Occasionally, the strategy produces conflicts with the expected delivery date for a group of parts. If there is an immediate need, McGaffic will produce a part on a priority basis. But, if the deadline is flexible, he will keep customers informed of the changes.

The following companies contributed to this report:

CNC Industries Inc.
(304) 366-8262
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Dynamic Tool & Design Inc.
(262) 783-6340
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Melkes Precision Products
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MiniMachine Inc.
(800) 854-9806
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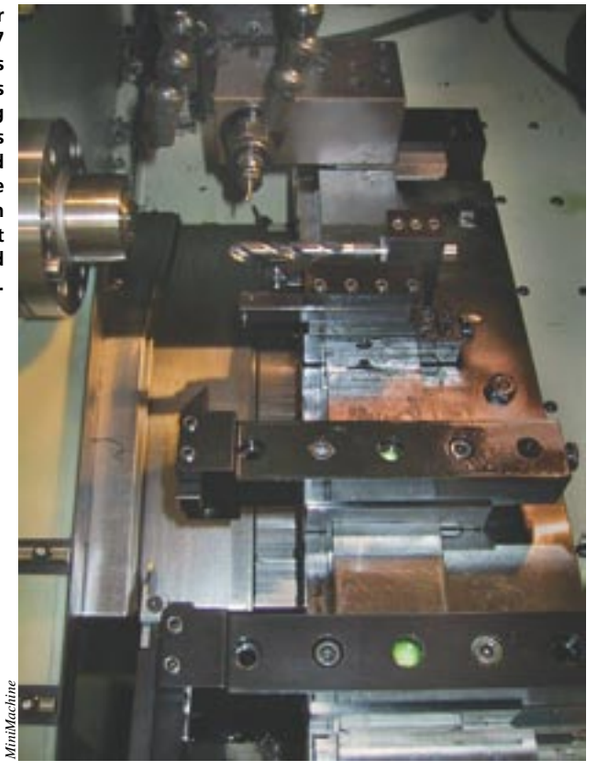
Pacific Tool Inc.
(425) 882-1970
www.pacifictool.com

Vista Manufacturing Inc.
(724) 495-6860



MiniMachine

The tooling for three Hardinge SP27 gang-tool CNC lathes at MiniMachine is carried on gang plates. Spare plates can be tooled while the machine is running, then bolted in during part changeover to speed setup time.

Do the Documentation

When machining repeat runs of familiar parts, full documentation of how each job was previously handled can greatly aid setup time reduction. That means faithfully recording information on paper, in computer files—and even on digital cameras.

MiniMachine's Rosenboom said setup records help to efficiently handle repeat runs. "We are using a digital camera to catalog some of our setups. We save the pictures electronically with the work order files, because when repeat business comes back around we say, 'What did we do last time? What tools did we use?' It's a pretty good way to go, especially on our gang tool machines."

MiniMachine has three Hardinge SP27 gang tool CNC lathes, which can handle parts up to 1" in diameter and provide runout accuracy of 0.000008" and 0.000010" positional accuracy. The tooling is carried on a gang plate, which can be removed from the machine as a unit. To speed changeover between parts, the shop has extra plates and sets them up while the machine is running. "The plate changeover takes about 8 minutes," he said. On familiar jobs, the offsets for a new plate can be loaded into the part program already in the machine, and "the offsets now match the plate that is in the machine. We are literally going again in 10 minutes," said Rosenboom.

Pacific Tool's Garbarino agrees that good documentation is the key to reducing setup times. "Multitasking technology has helped us reduce lead times with low-volume repeat products because we don't have to put the products through as many setups," he said. "If it's a repeat item, we go down to single-digit days [for lead times] on occasion." The key to such responsiveness, he said, is keeping track of every variable for each setup. "You have to approach it with a cellular manufacturing mentality, not just 'here's a machine tool and I can make these parts on it,'" said Garbarino.

The latter approach means creating a new process every time the part is run. The more efficient mindset, Garbarino said, is "I've gotten this part before, the program and setups are proven and if I follow this set of procedures for setting it up properly, I can replicate what I have done in the past. It's the same idea as the scientific approach to experiments."

A good example, he said, involves the method for compensating for tool deflection. "If the tool doesn't cut as you expected because of tool deflection, don't change the tool offset to take up for the slack. Change the program." Even though changing the tool offset will produce a correct part, the same compensation will have to be entered the next time the part is run. Changing the program will make the compensation part of the permanent part documentation, so that the next time that particular job is run, even though the program is officially "wrong," it will run the part correctly, according to Garbarino.

When it's sitting idle during setup, the most high-tech multitasking machine is as unproductive as a stone. The procedures and innovations devised by these shops show that there may be a nearly unlimited number of ways to cut setup time and thereby boost the time that these sophisticated chipmakers are actually making chips. △