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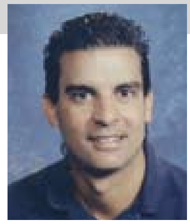
BY MIKE PRINCIPATO



Are you in?

As you may recall, I mentioned in my January column that I have some suggestions about how the U.S. can improve its manufacturing situation. The internal and external challenges facing U.S. manufacturing, in general, and your shop, in particular, are substantial but not insurmountable. This is as good a forum as any (better than most, frankly) to propose specific tactics to minimize our weaknesses, reinforce our strengths and move our respective industries forward.

Regular readers will not be surprised to hear that I have a plan; more like a modest proposal, really, but I'll still call it a plan. I spent more time than I should have ruminating about an appropriate title. I was thinking perhaps "Mike's Most Excellent Plan to Save U.S. Manufacturing," but that sounded a little presumptuous, not to mention unnecessarily dire.

In most of the quantitative and qualitative aspects of commerce that really matter, U.S. manufacturing rocks.

U.S. manufacturing doesn't need to be saved, except from its poor image. It needs a rebirth of the pride that once accompanied a career in manufacturing. It needs a renewal of the spirit that formerly inspired young people to become engineers, skilled tradesmen and manufacturing entrepreneurs. It needs (drum roll here, please) "The Great American Manufacturing Renaissance Plan."

The first step is to know thyself. If you're going to succeed in anything, you need to know who you are and, just as importantly, who you aren't. For too many years, we've allowed ourselves, politicians, the media and others to frame the debate. We aren't competitive enough. We aren't visionary enough. Our products aren't good enough. I don't know about you, but when it comes to naysayers who couldn't make a part or a payroll if their mother's life depended on it, I've heard more than enough.

So how should the debate be framed? You, my friend, are a participant in one of the most successful and productive economic juggernauts in the history of the world. Let's stop reminiscing wistfully about what used to be and start celebrating what is and what could be in the future. In most of the quantitative and qualitative aspects of commerce that really matter, U.S. manufacturing rocks.

In short, it ain't 1977 anymore, Sparky. Times have changed. For example, skilled labor is tougher to find. But so are leisure suits. Count your blessings.

Step two is to clean our own house. We're often our own worst enemies. A grimy, dark, badly managed job shop that's still in business reflects poorly on the contract machining industry. And when the management team of a major production plant has no positive presence in its community, it squanders a golden opportunity to promote the value and importance of manufacturing employment.

But that's just the superficial stuff. Sometimes we're even worse in management and strategic planning, which really matter. When we fail in those processes, our businesses suffer.

The trouble is many shops are owned not by trained managers but by entrepreneurial tradesmen who are rarely able to grow their businesses past a few million dollars in revenue. That's not a recipe for failure by any means, but it certainly doesn't create the level of high-impact employment that captures the nation's imagination.

As I mentioned in my October 2006 column, it's the rare entrepreneur who makes a successful transition to professional manager. I call such a professional manager the $5 Million Man and recommend that a shop looking to grow to that level hire one. Then give him the resources, space, authority and time he needs to achieve your goal.

Step three is to work the system to get in touch with our true inner industry selves.

But that's not enough. After that—even while we're doing those things—we have to change the old rules. In manufacturing's case, that means working the system in a way that an aggregation of shops of all sizes, all over the nation, never has.

It means a big, unified bloc of shops collaborating with a few effective trade associations to weed through the maze of government programs to focus on the ones that can actually make a difference. You and I are paying for programs that cover tax credits, low-interest financing programs, R&D grants and subsidized training. How about we start benefiting from them?

It means making a quantum leap in visibility on the national stage by breaking away from the same tired communication strategies that have failed for years. Currently, the fragmentation of manufacturing's many players precludes any unified presence. Imagine the impact of a highly publicized establishment of endowments at the nation's top 10 engineering colleges. Or a scholarship pool for students with potential at the top 50 vocational-technical schools. You get the idea.

Buckle up. Next month I start with step one. Want to provide input on The Great American Manufacturing Renaissance Plan? You know where to reach me.

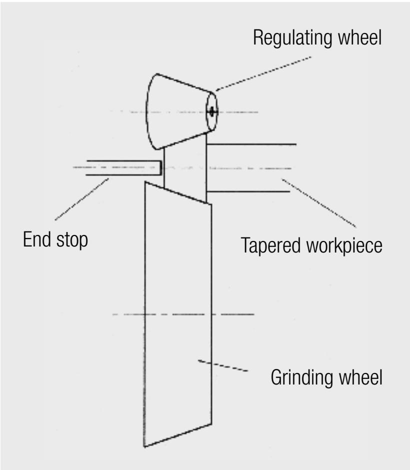
About the Author

Mike Principato is a metalworking industry consultant and former owner of a midsized CNC and EDM shop in Pennsylvania. He can be e-mailed at mprincipato@jwr.com.

Centerless grinding fundamentals

BY LAROUX K. GILLESPIE

Centerless grinding is a process many shops use for precisely rounding and sizing a bar stock's diameter so that the workpiece fits in a screw machine's collet. The bars provided by mills have subtle and not so subtle screw shapes and often need rounding. Any out of roundness of the bar stock remains on the finished parts unless it is ground away before part production.



Stuart C. Salmon, Modern Grinding Process Technology

Centerless grinding to an end stop allows precise grinding of tapers.

Centerless grinding equipment allows unfixtured bars to be fed through the grinder unattended in a relatively rapid operation. Removing any out of roundness is critical on parts that have tolerances tighter than ±0.0002". The process produces finishes as fine as 5µin. R_a.

In a continuous bar-feed operation, the bars or series of cylindrical parts are fed along the top of a workrest blade. The grinding wheel removes material and pushes the workpiece into the regulating wheel, which controls workpiece speed.

Typical grinding wheel speeds are 6,000 to 8,000 sfm, and regulating wheels rotate at 50 to 1,000 sfm. Workpieces can be fed up to 400 sfm, although a slower rate is typical.

Because the regulating wheel is oriented at a slight angle to the workrest blade, the frictional force from the regulating wheel pulls the workpiece along the blade and past the grinding wheel. Regulating wheels—typically rubber-bonded grinding wheels—are usually set at about a 3° angle, but the angle can vary from nearly 0° to 8°.

There are four different variations of centerless grinding: through-feed, infeed, end-feed and combined through-feed and infeed.

With through-feed, parts whose outer or only diameter is to be ground are continuously fed through the grinder. The infeed method allows shoulders, heads and multiple diameters to be produced similar to how they are generated on center-type grinders. In this instance, the blade helps position the part in relation to the wheels and a stop provides the desired axial dimension for shoulders.

End-feed grinding is used to produce tapers on the ends of parts. A taper is provided on the grinding wheel, the regulating wheel or both to produce the taper. A stop prevents a part from feeding too far.

Through-feed and infeed can be combined to straighten parts that are slightly warped.

Improper setup often produces lobing. Three- or 5-lobed cross-sectional shapes are common until the setup is corrected. Lobing can be detected by rotating the bar in a V-block under a dial indicator. Simple 2-point micrometer measurements will not show lobing. Multiple passes to provide 10 to 80 turns of the grinding wheel over the lobes removes lobing.

For precisely round parts, the operator must set the blade height so the centerline of the part lies above the centerline between the two wheels. Blades are ground with a large taper (typically from 30° to 60°). For maximum part roundness, a 45° blade angle is recommended because it speeds removal of both 5- and 3-lobed parts.

Some machinists note that for critical roundness when performing interrupted cutting, it is advisable to rough grind with a hard rubber-bonded regulating wheel, leaving only a minimum of stock, and finish grind with a vitrified wheel to avoid chatter. If the workpiece has lobes that are out of phase by half a lobe on opposite ends, the workpiece needs better blade support.

Totally seamless diamond grinding wheels, rather than ones with multiple molded sections glued together, reportedly improve performance when grinding carbide rods. "A more consistently manufactured centerless wheel substantially improves roundness of a centerless-ground carbide rod," said Glen Rosier, who handles business development of resin products at Abrasive Technology, Lewis Center, Ohio. "Consistent hardness throughout a diamond wheel creates reliable grinding performance, allows for higher stock-removal rates and an average 10 to 20 percent improvement in wheel life over wheels produced in sections."

About the Author

LaRoux K. Gillespie is a retired manufacturing engineer and quality-assurance manager with a 40-year history of manufacturing and deburring. He is the author of 11 books on deburring and almost 200 technical reports and articles on machining. He can be e-mailed at laroux1@myvine.com.

Six hundred-plus operations and counting

BY BILL KENNEDY, CONTRIBUTING EDITOR

In a linear, step-by-step way, some parts almost program themselves. More challenging jobs, however, may require repeated trials and adjustments to achieve an optimal blend of productivity and accuracy.

Challenging jobs are a specialty of The Manufacturing Facilitators. TMF designs, machines and fabricates a variety of medical, aerospace, military and consumer products.

According to owner Eric Potts, an aluminum superstructure component for prepress inspection equipment was among the shop's toughest challenges. The part—with finished dimensions of 4.061"×4.724"×13.767"—required more than 470 milling operations and 150 hole-related processes, including drilling, reaming and tapping. Hole-diameter tolerances were as tight as ±0.0002" and feature locations as precise as 0.0019".

TMF's customer provided a sample of the part and a SolidWorks 3-D model that Ryan Kleppe, CNC programmer and shop manager, called "enormous."

The sheer number of features was "incredible," Kleppe said. "Our biggest challenge was to add the features in the correct order," Potts added.

TMF machined the part from a 5"×5"×16" block of T6 6061 aluminum on a Haas VF-3 vertical machining center. The VMC was fitted with a 4th-axis rotary table to enable machining of multiple features without refixturing. Initially, Kleppe programmed machining of as many features as possible in the 4th axis. "By doing that, we found what our precision with the 4th axis actually was," he said.

When machined on the 4th axis, some critical features were produced inconsistently. As the problem features came to light, Kleppe removed them from the program to be machined separately. Potts said, "It would have been a huge time-saver to keep them in the 4th axis. We got a few good parts, but just couldn't keep it repeatable enough."

In its final form, the process' first set of operations on the 4th axis consumed 4 hours, involved 355 milling and 120 drilling steps, and required four 90° indexes of the part. In addition to using all 24 tools in the machine's toolchanger, TMF had to swap in eight more tools to complete the process. The shop recently added an another Haas VF-3 VMC with a 40-tool changer to eliminate tool swapping.

The Manufacturing Facilitators

Machining this approximately 4"×5"×14" aluminum component at The Manufacturing Facilitators required more than 600 operations, some of which tested the accuracy limits of the machine tool itself.

"For most of our roughing, we normally use inserted tooling," Kleppe said, "but the features [on this part] are too small for inserted tools." Therefore, TMF applied a variety of solid-carbide drills, reamers, endmills and ballnose cutters. The smallest endmill was 3⁄64" in diameter, and the largest cutter was ½" in diameter.

The hole-related operations included tapping five different types of thread. Kleppe employed cold-forming taps and rigid-tapping routines. He applied cold-forming taps to ensure bottom tapping, prevent chips from compacting in the bottom of the blind-holes and produce stronger threads.

Kleppe said the machining operations weren't particularly difficult. In the free-machining aluminum, the VMC basically ran at its maximum spindle speed of 10,000 rpm. "I did have to slow it down in some spots because the 4th axis was not as rigid as a vise on the machine table," he said. Initial concerns about part movement and warping during roughing proved unfounded. "The part has a pretty nice center cross section, so it stays fairly rigid the whole way through," Kleppe said.

A second set of operations on the 4th axis took 80 minutes. The part was refixtured and rotated 90° vertically to provide access to its ends and permit machining of angled features. "We had to build a riser to lift the 4th axis further off the machine table because when we rotated the part, it swung pretty tall," Potts said. The shop performed 117 milling and 27 hole-related operations, as well as 13 axis rotations. "Without the 4th axis, these operations would have required 13 separate machine operations," Potts said.

The part was approximately 98 percent complete after the two 4th-axis operations, Kleppe said. Remaining was machining of the critical features—all hole-related—removed from 4th-axis processes because of repeatability concerns. The shop designed three dedicated fixtures to hold the part for the remaining operations.

The critical features were located via what TMF called "Datum A," which was three pads machined on the part during the 4th-axis operations to establish a plane.

The first set of critical-feature operations took 10 minutes. The fixture for it was, according to Kleppe, "pretty basic. It was machined perfectly square from a solid block and used just one bolt that goes right through the center of the part. The three pads sat flat and pushed the part into the corner, just like you would in a vise to a stop."

The second fixture had pins that located the part by way of the precision holes drilled in the prior fixturing. Machining took 10 minutes. Finally, in the third fixture, TMF performed a 6-minute operation to machine an angled counterbore that couldn't be easily done using the rotary table. The part again was located via Datum A.

To assure repeatability of the critical features, Kleppe backed off the machining parameters about 25 percent. "We maintained chip load but brought down the speed and feed," he said.

Potts noted that the flatness callout for the datum pads was 0.00012". "There is no way that the machine can machine that flat; the tool marks are higher than the flatness callout," he said. Accordingly, the part was set on a piece of granite and TMF used 15-micron lapping film to polish all three datum points at the same time. Potts said: "Each is only about ½" square. We lap them until they clean up shiny. The amount of material removed during lapping is measured in microns. The process removes tool mark high spots left behind on an already very flat surface."

Potts said the customer is providing final engineering updates for the superstructure, after which production is to begin on a monthly basis.

Potts was positive regarding the long and tedious process development. New equipment—including the VMC, an automatic Brown & Sharpe coordinate measuring machine and a Tesa height gage—facilitates the production of the superstructure and bolsters the shop's overall capabilities. In all, getting the part right was "quite an effort for everyone," Potts said. He added that the shop's personnel and capabilities, "really matured quite a bit because of this part."

For more information about The Manufacturing Facilitators, Poulsbo, Wash., call (360) 598-1750 or visit its Web site: www.tmf-inc.com.

Transitioning to 3-D

BY BILL FANE

Many of you have read or heard about the importance of switching from 2-D to 3-D CAD drawings, especially in the mechanical and manufacturing worlds. You know you should convert, but it seems like a daunting challenge.

A common roadblock is that many end users perceive switching to be a difficult process. Admittedly, it can be, depending on how it's done. The big problem is all those legacy AutoCAD drawings. Inventor 2008 from Autodesk Inc., San Rafael, Calif., the developers of AutoCAD, goes a long way towards making this big problem a small issue.

Let's get the minor stuff out of the way first. The most obvious change to Inventor is the name. The new release is Inventor 2008 and not Inventor 12. This is to be consistent with standard Autodesk practice of using the year rather than the sequence number. I figure it is called 2008 and not 2007 because it's the "best before" date.

Like any new release, Inventor 2008 seems to have several hundred new and improved features. The ones of most interest to manufacturing job shops, however, revolve around the software's greatly expanded AutoCAD compatibility and interoperability functionality.

The big news is that Inventor 2008 has added a new file format option when creating 2-D working drawings. It's called DWG. This means Inventor 2008 allows the choice of creating 2-D working drawings in the previous IDW format or creating them directly in AutoCAD DWG files or "AutoCAD compatible" DWG files. The DWG files retain their associativity to the Inventor part or assembly file, so any changes to the model reflect through to the DWG file just as they do to the IDW file. You can even produce one or more 2-D drawings of each type from the same model.

In addition, Inventor opens DXF files, which is Autodesk's preferred file format for transferring data from other brands. Many, if not most, of the other CAD programs can save as or export their files in DXF format.

The ability to create an associative DWG file opens up another capability that eases the transition from 2-D to 3-D. Previously, the perception was that going from 2-D to 3-D was an all-or-nothing approach. Well, Inventor 2008's capability to produce an associative DWG file eliminates that problem.

For example, you might have an existing machine designed in 2-D using AutoCAD. You now want to redesign one portion of it in 3-D, but don't want to model the entire machine in 3-D just to be able to work on part of it.

No problem. Simply create the 3-D model of the area of interest and then produce an Inventor DWG drawing file from it. Now, open the AutoCAD drawing and erase the original of the region you redesigned and insert the appropriate view from the Inventor DWG file as a block insertion.

Bingo! The newly created hybrid DWG file is part legacy 2-D data and is partly derived from new 3-D data, which can be updated if the original model changes.

This same technique can be used for processes such as inserting 3-D equipment models into a 2-D factory floor layout plan.

You can also open an Inventor DWG file in AutoCAD. You can use all the normal AutoCAD commands to add to or edit the drawing, except you do not have access to those portions of the drawing views derived from the Inventor model. Your edited drawing file will survive the round trip back into Inventor.

Inventor 2008 opens an AutoCAD DWG file directly, without having to go through a translator. Previously, this translator was part of AutoCAD itself. The new process makes it faster to open DWG files in Inventor. You can also do a quick "open" rather than a translation of existing AutoCAD files to easily view, measure and plot them.

The new interoperability between AutoCAD and Inventor makes it much faster and easier to use existing AutoCAD geometry as Inventor sketch geometry in a new part model, which further simplifies the transition from 2-D to 3-D. You can also use existing AutoCAD data, such as standard notes and symbols, in your Inventor 2-D drawings.

Other program features of particular interest include the ability to retrieve model dimensions or apply annotation dimensions directly to axonometric views. Displayed dimension values will be properly adjusted for the viewing angle.

The new program also includes hatching enhancements. For example, different hatch patterns can be associated with different material specifications, so a section view of an assembly displays appropriate hatching on each part according to the material assigned to it.

Additions and improvements to the Design Accelerator could easily consume an entire review by themselves. For starters, Inventor 2008 has a completely redesigned shaft generator that is faster and easier to use, while the chains generator allows for an unlimited number of sprockets along with flat tensioning idlers.

The spring design interface has also been redesigned for easier use.

Moreover, Inventor 2008 includes a number of new or improved features in the professional version. For example, Tube and Pipe can automatically include gasket definitions in flanged connections, while the Dynamic Simulation module can automatically convert assembly constraints into simulation joints. Cable and Harness supports flat ribbon cables, and you can author your own custom connectors for use in the Content Center.

Because Inventor 2008 contains several hundred new or enhanced features, you'll need to try it yourself. The 2008 release is a worthwhile investment, either as an upgrade for existing users or for those looking to transition to the 3-D environment.

About the Author

Bill Fane is a former product engineering manager, a current instructor of mechanical design at the British Columbia Institute of Technology and an active member of the Vancouver AutoCAD Users Society. He can be e-mailed at Bill_Fane@bcit.ca.

BY MICHAEL DEREN

Taking your customers for granted?

It's easy for equipment vendors to fall into a false sense of security. If they provide good products, their customers purchase those products time and again. Customers can even become complacent when dealing with those vendors. I myself have been complacent from time to time in my dealings with vendors.

This false sense of security can lead some vendors to take their customers for granted. How so? Let's say a vendor you've dealt with for years calls and tells you he's going to be in the area tomorrow and asks if you have time to see him. "Sure," you reply. You keep the appointment time a little general, such as early morning, but you allocated time for him in your busy day. After all, you've done business with him for years. The general appointment time comes and goes and so does the entire day. Eventually, the whole week passes without hearing from him. That's bad business for several reasons.

The way I look at it, if I've allocated time to a vendor for a meeting, based on his request, the least he can do is show up. I can understand if he was tied up doing a demo or something else, but he should at least call to notify me. Nothing irritates me more than not calling. Does he really think the next time he calls for an appointment I'll be so quick to arrange a meeting?

What really gets me going are the cutting tool vendors who assume it's a given that because they have all or the bulk of my cutting tool business, I'll just take what they have to offer. Not! I had a cutting tool vendor (I'll call him Mr. Prime) who essentially had sewn up the solid-carbide business at a company where I worked. We landed a new fast-track project, and needed test cutters right away. Obviously, Mr. Prime was called immediately. He couldn't come right away, but asked us to send him the specifications for the cutters we wanted, and said he would follow up next week.

One of our engineers started to gather the information, while I called another vendor I had dealt with in the past. The vendor I called came the same day, determined what we needed and provided test cutters within 24 hours. Those cutters worked effectively.

Subsequently, when Mr. Prime found out we had placed a $10,000 to $15,000 initial order with another vendor, he was outraged. How dare we give "his" order to someone else! But we'd given him the opportunity to assist us.

Well, he lost that order. He followed arrogance with stupidity. He visited our company a few days later and tried to reverse engineer the other vendor's tool geometry in an attempt to replicate the tool and get the business back. If he'd succeeded in his attempt, he might have offered his tool at a lower price initially, then increased it until we paid the same price. Or he might have increased prices on other tools we purchased from him. Ultimately, his future opportunities were lost indefinitely when he told us he might not be able to provide the level of service in the future that we were accustomed to because of the lost sale. What service was he talking about?

The way I look at it, if I've allocated time to a vendor for a meeting, based on his request, the least he can do is show up.

Don't get me wrong. The second vendor had a lot to gain by providing the cutters quickly. This was his foot in the door, so to speak. But, because he understood our urgency, had a product that suited our needs, and showed us what he would and could do to become one of our vendors, he received the initial order. Subsequently, he was rewarded by becoming the vendor of choice for this type of project.

However, that didn't mean he was guaranteed those orders indefinitely. Just as a shop's customers judge the shop according to their most recent order, so too are equipment vendors judged. △

About the Author

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