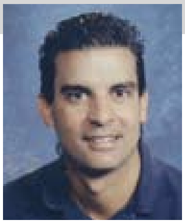
BY MIKE PRINCIPATO



Building your dream team

In my October 2006 column, I opined that the entrepreneur who starts a shop and grows it to, say, $2 million to $3 million in revenue is not likely to be the same person who leads that shop to $5 million or more. To get to that level, entrepreneurs need management skills that are wholly different than the talents they typically possess.

That column, "The $5 million man," apparently resonated with a lot of owners who were impressed with my monthly contribution to their water cooler conversations but were underwhelmed by the specifics of my insights. Readers' e-mail was along the lines of, "Thanks, genius. You convinced me that I need to hire more management talent than I have onboard. So how, exactly, do I find my '$5 million dollar man'?"

First, let's assume you've searched your soul, your ambitions and your income statement and decided that you are indeed ready to reach for the so-called "next level" of shop revenue and personal riches. The next step is easy: Determine where your shop's management weaknesses lie, because the person you want to hire needs to fill those voids.

When you boil it down, there are four areas of management expertise you'll need to achieve $5 million in sales: operations (production, process, purchasing and shipping), marketing and sales (no, they're not the same thing but are often managed by the same person in a small firm), finance (cash flow, commercial banking and payroll) and administration (the executive rank that holds it all together).

Take it from me, this little exercise requires a brutally honest evaluation that a typical entrepreneur will find painful. At the height of my shop's success, I thought I was the proverbial expert in every room. The reality, however, was quite different. My forte was and is marketing and sales. I was only passable at finances and marginally competent at operations, limitations that would emerge—as they often do in business—at the worst possible times.

Odds are you're strong at operations, a characteristic common among many owners due to years of on-the-shop-floor experience. If so, perhaps you're uncomfortable or weak in sales and marketing, which become ever more important for any growing company. And, if you "grew up in the business," you may also lack the strategic management skills a shop needs to transition from a business model totally dependent on people to one that's grounded in systems, and from reactive to proactive management.

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Now the real fun starts, because it's not enough to define your potential $5 Million Man simply by what he knows; you also need to carefully discern the type of executive to whom you're willing to delegate a significant share of your current responsibilities and—quite possibly—your shop's destiny. To do so, dig deeper into your own personality traits or, better still, ask close friends and key employees to describe their view of what makes you uniquely you. Also, don't settle for just the good traits, which they'll offer up easily and first.

Are you a hard-driving, energetic, ambitious, charismatic leader? If so, you're not likely to want to share the spotlight, much less the power, that being top dog brings. A $5 Million Man is quietly competent but unmistakably tough and committed when the situation calls for it.

On the other hand, if you're the kind of owner or executive who's all about results, loves being on the shop floor and couldn't care less whose name appears in the local newspaper, perhaps the right one for you is a garrulous, razor-sharp marketing guy with a strong project management background.

You've defined the skill set you need. You've decided on the personality type(s) you can live with, and you're prepared to let go of the reins to give your $5 Million Man a chance to succeed. So what are you waiting for? There's a whole world of sharp people eager for an opportunity to join your dream team and gain some props for vaulting a small business from the ranks of relative obscurity to "player" status. Hire a recruiter, place some print display and Internet ads or all of the above. Happy hunting.

About the Author

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Emergency service

BY BILL KENNEDY, CONTRIBUTING EDITOR

Komar Industries Inc. produces equipment to efficiently destroy just about anything. The company makes augurs, shredders, compactors, feeders and extruders that quickly and relentlessly reduce waste items like old televisions and telephone poles to small and manageable pieces.

During 3 decades of manufacturing its material processing systems, Komar has developed an ability to productively machine large parts to high accuracy. To take further advantage of those skills, the company offers contract machining services. According to programmer Rick Smith, contract jobs generally involve low-volume runs or one-offs of complex parts, often under the pressure of short lead times.

One rush job was for a replacement component in a plastic extrusion machine. The 2¾"-thick aluminum ring had a 21" OD and 10" ID and featured a delicate, 0.135"-thick contoured flange.

Because there was no electronic part file or drawing immediately available, Smith reverse engineered the ring from the damaged original by measuring it with micrometers, calipers and height gages. Some dimensions had to be extrapolated because the ring was "wrecked on one side," he said. Accurate reproduction was important because certain dimensions determined the ring's fit with a mating part. "We held about a 0.001" tolerance," Smith said. He used the measurement data to draw the part in his CAD system and then created toolpaths in his Mastercam CAM package.

Komar machined the part from a 24"-square × 4"-thick plate of T-6 6061 aluminum. Smith said the ring "was so thin that we ordered the piece of material thick enough so that we could grab hold of the extra thickness and hang on to that."

A bandsaw with a double-pitch HSS blade was applied to rough the ring out of the plate without using a fixture. For the ID, Komar drilled a hole, cut the bandsaw's blade, positioned the blade through the hole, welded the blade together and cut from inside out. The sawing left about ½" of excess material on both the ID and OD.

Then Komar chucked the ring in a Mazak Integrex 70 multitask machine and rough turned it with a Sandvik Coromant CNMG-432 insert held in a square-shank toolholder. Smith said the uncoated insert featured a chipbreaker and highly positive geometry, which prevented the generation of back pressure. The DOC was 0.25" per side, the feed rate was 0.020 ipr and the cutting speed was 700 sfm during roughing. The operation left about ⅛" of excess material on the ring overall. Cutting time was 22 minutes. However, after adding the time required for setup, including touching off tools, loading the chuck and mounting riser blocks to hold the part, the overall operation consumed about 5 hours. "If we ran two of them at one time, the second would take 22 minutes," Smith said. "Most of the work is setup."

Komar Industries

Komar Industries reverse engineered and machined this aluminum ring, featuring a delicate, 0.135"-thick contoured flange, on a rush basis so its customer could get a plastic extrusion machine back in operation.

Next, the ring was sent out for stress relief treatment, without which, Smith said, the part would "want to twist in every direction" from the stresses induced during roughing.

After it was returned to Komar, the ring was again clamped in the Mazak. "We indicated it in and then faced it," Smith said. "The facing gives you a Z zero (the Z-axis coordinate where its value is 0.000) and you can set all the tools from there."

For semiroughing, a Sandvik Coromant CNMG-431 insert was used because its sharper corner radius than the previously applied CNMG-432 insert generated less cutting pressure. Then a high-positive round insert with a 5⁄16" inscribed circle cut the final flange contour.

"I used it in a grooving cycle and just kept plunging and cleaning," Smith said. Multiple passes were necessary because "if I tried to get it all at once, it would want to chatter," he said. While cutting the contour, the DOC was approximately 75 percent of the button cutter's full-depth capacity. For a finishing pass, the DOC was 0.010" per side.

Another CNMG-431 insert, this one held in a boring bar, then roughed and finished the part's ID. Smith said the ID "comes down on an angle but underneath there is an actual groove." For the groove, he used another boring bar with a Top Notch-style grooving tool.

In an 18"-dia. bolt circle, the ring's lip required six equally spaced 0.220"-dia. through-holes, countersunk 82° to accept flathead screws. The multitask machine's milling head was used to drill and countersink the holes. The 0.220"-dia. drill cleared the edge of the ring's flared flange, but there wasn't room to run a countersink straight into the hole. So, Smith said, "I took a ½"-dia. drill with a 118° point to the grinder and put an 82° point on it." The altered tool provided the clearance needed for countersinking.

When machining was completed, a cutoff tool separated the ring from the extra material clamped in the lathe chuck. After touching the tool off on the front of the part, Smith moved the tool towards the machine chuck for a distance representing the length of the part plus the width of the cutoff tool. Then, "we turned the machine on and let it cut off real easy," he said. "I grabbed hold of the part as it came off the machine."

Cutting time for the second set of operations on the Mazak was 1 hour and 40 minutes, but with setup time, that part of the process consumed about 8 hours. Without including reverse engineering, total manufacturing time was about 13 hours. Smith said the job required "a little more time than what we thought it would, but it came out a good part. That is what we strive for. It was a one-time deal, and we got one good part."

For more information about Komar Industries Inc., Groveport, Ohio, call (614) 836-2366 or visit www.komarindustries.com. The Web site includes videos depicting the rapid demise of a range of waste items at www.komarindustries.com/video-library.htm.

Rotary table magic

BY JAMES A. HARVEY

To precisely locate a circular part or feature on a rotary table, a machinist must do two things. First, he must position the part over the rotary table's true axis by spinning the table and carefully "bumping in" the workpiece while watching the indicator readings. When the needle stops deflecting or reads zero, the workpiece's axis is directly over the rotary table's axis. The indicator does not have to be mounted in the machine spindle, but it can be.

Second, a machinist must position the milling machine's spindle directly over the axis of the workpiece. He does that by spinning the indicator around the workpiece and adjusting the X and Y tables of the machine until the indicator reading doesn't change or reads zero. To accomplish this task, the indicator must be mounted in the spindle.

Machinists often position/indicate the machine spindle directly over the hole in the rotary table's center and then position/indicate the workpiece in line with the hole. That method works but is almost never as precise as the previously described method. One reason is because the hole in the table's center is usually not exactly concentric with the table's true axis. Another reason is because error accumulates when indicating two features (the table's hole and the workpiece) to locate a part.

The following are some other helpful suggestions.

■ **Disengage the feed handle to rotate the table quickly.** Most rotary tables have a feature that allows the user to disengage the drive gears so he can freely rotate the table by hand. Turning the table by hand allows the user to indicate and position quickly.

■ **Disengage the feed handle to machine soft materials.** The gearing on a rotary table is set up so that by cranking the handle at a moderate pace, the table turns at a rate that is moderate but adequate for most jobs that fit on the table. Bear in mind that for any given handle rotation speed, the larger the part diameter, the faster the circumference will be moving. Because you can machine soft materials at high feed rates, sometimes it is easier to rotate the table by hand without the aid of the handle crank, or, in other words, with the crank disengaged.

■ **Machine close-tolerance diameters with care.** It is more difficult to hold tight tolerances on diameters cut with a rotary table than with a lathe. Any error made when moving the machine table is doubled on the part. In other words, for each 0.001" increment a machinist moves the milling machine table, 0.002" would theoretically come off a part's diameter turned in a rotary table. Another reason holding close tolerances on a rotary table can be difficult is because there's an inherent lack of rigidity when stacking tooling.

To hold a close tolerance, a machinist needs to engage the feed handle, apply a sharp cutter on the final passes, take light cuts at a slow feed and give the cut ample time to settle in against spring pressure.

■ **Machine a reference hole in the center of a square part for easier locating.** It is more difficult to line up a square feature on center on a rotary table than a round feature. When possible, a machinist should bore a hole or machine a round boss on or in the center of a square part to facilitate the lineup.

■ **Use a spring-loaded scribe to create layout lines.** Scribe layout lines to minimize bad cuts, especially for first articles and one-of-a-kind parts. It is relatively difficult to scribe lines on a round part's face with a height gage because there are no flat surfaces to reference.

One easy way to scribe lines on round parts is by using a spring-loaded scribe mounted in the machine spindle. After locating and clamping the part on the rotary table, a machinist can use the spring-loaded scribe to layout either circular or straight lines on the part by moving the part under the scribe. This is done by moving the machine's X and Y tables or by cranking the rotary table. The spring loading in the scribe allows light, yet constant layout pressure on the workpiece. When the layout is completed, it is easy to see what size endmills to use and what features to avoid.

■ **Use the rotary table to machine large counterbores.** A machinist can use a lathe to machine large counterbores. Another possibility is to apply a boring head with facing capability. A machinist could also perform the job in a CNC mill. But for my money, the easiest way is to machine the part on a rotary table.

About the Author

James A. Harvey is a machinist and plastic-injection-mold maker based in Garden Grove, Calif. He can be e-mailed at HarvDog42@aol.com. Machining Tips is adapted from information in his book, "Machine Shop Trade Secrets: A Guide to Manufacturing Machine Shop Practices," published by Industrial Press Inc., New York.

BY DR. JEFFREY BADGER

Achieving finish requirements

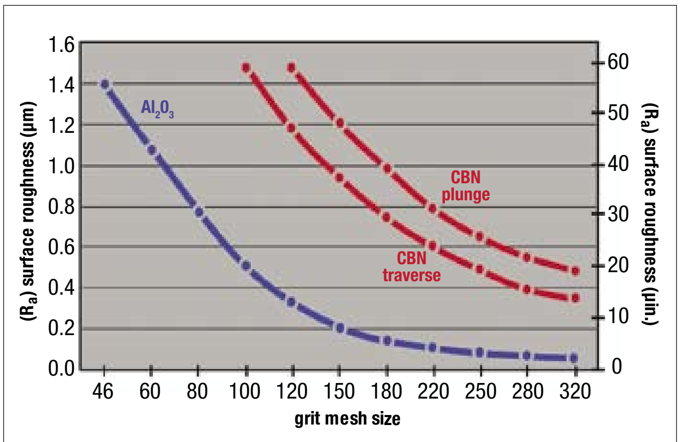
Dear Doc,

I surface grind a lot of ferrous material with aluminum-oxide and CBN wheels. I have a tough time determining how to impart the correct surface finish, especially after switching from an Al_20_3 wheel to a CBN wheel. I end up wasting time playing around with different grit sizes. Do you have any guidelines?

The Doc Replies:

The figure below provides the approximate grit size required to achieve a given surface finish. Of course, grinding conditions and, in particular, dressing conditions also play a role, but this information will put you in the ballpark of where you need to be.

For example, if you need a 30µin. surface finish, you'll need about an 80-grit Al_20_3 wheel or a 180-grit CBN wheel when "regrinding" the material using side traverse, or a 220-grit CBN wheel for a straight plunge-



J. Badger

Surface finish vs. grit size for grinding ferrous materials with Al_20_3 and CBN wheels.

grinding operation. If you dress the Al_20_3 wheel finely, a 60-grit wheel should be OK. If you dress the wheel coarsely, a 100-grit wheel will work but will experience more wheel wear and probably generate more heat.

Dear Doc,

I'm getting chatter marks on ground specimens. I've had two "experts" in. The first said the wheel was out of true. The second said the spindle isn't stiff enough. Who should I believe?

The Doc Replies:

There are two types of chatter: forced and unforced.

An out-of-true wheel is a source of forced chatter. When forced chatter occurs, the oval-shaped wheel contacts the workpiece only intermittently. Therefore, it usually occurs at the wheel frequency or double the wheel frequency. To calculate wheel frequency, divide the wheel rpm by 60.

Archives MNATP, Collection Meillassoux

Unforced chatter occurs when the workpiece vibrates at the combined natural frequency of the workpiece and fixture assembly. The culprit in unforced chatter is usually a lack of spindle and toolholder stiffness coupled with aggressive grinding conditions, which create large forces on the workpiece. The lack of stiffness means the workpiece bounces all over the place.

To determine if the chatter is caused by an out-of-true wheel, first count the number of chatter marks across a certain length in a ground sample. Then use the following formula:

Chatter frequency (Hz) = table speed (in./sec.) × number of chatter marks in sample ÷ sample length (inches).

If you prefer metric, use mm/sec. for table speed and millimeters for sample length.

An out-of-true wheel bangs against the workpiece at the wheel frequency or double the wheel frequency, i.e., at the two high points on the wheel. Occasionally, it bangs at four times the wheel frequency, i.e., at the four high points on the wheel.

Let's say the wheel is running at 1,800 rpm. The wheel frequency is, therefore, 30 Hz (1,800 rpm ÷ 60 seconds = 30 Hz). Next, let's say you count 21 chatter marks in a 2" sample length and the table speed is 360 ipm, or 6 in./sec. That calculates to a chatter frequency of 63 Hz (6 × 21 ÷ 2 = 63). That's slightly more than double the wheel frequency, indicating the wheel is probably out of true.

Chatter caused by poor stiffness occurs at the combined natural frequency of the wheel-and-workpiece assembly, which is usually much higher, say, 300 Hz.

How can you be sure? Take the suspected out-of-true wheel and grind about 0.002" of a workpiece at a small DOC of, say, 0.0002" each pass. Here, the forces acting on the wheel are not large and stiffness should not be a problem. If you still see chatter marks, it's probably because of an out-of-true wheel.

Another option is to halve the table speed and see if you get double the number of chatter marks in the same sample length. If so, the wheel is out of true. If the spacing is the same, the chatter is caused by something else. △

About the Author

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