DECEMBER 2006 / VOLUME 58 / NUMBER 12

BY MIKE PRINCIPATO

What's your company's expiration date?

I just read a bright young analyst's report on the outlook for one of America's most historically successful companies, and the news isn't great. Management had failed its shareholders, opined the analyst, by not adapting to a sea change in its core market. The report cautioned potential investors about the company's slow transformation from old-school manufacturer to digital player, warning that it was in danger of being swallowed by the crushing burden of debt resulting from that transformation. Although this one-time bluest of blue chip companies had dominated its industry for decades, employed hundreds of thousands of people and made a huge contribution to the evolution of domestic and international commerce, the analysis brimmed with disdain for the stodginess of its product line.

The company? Eastman Kodak Co.

All companies have an expiration date, including yours.

You remember Kodak, don't you? George Eastman, the company's founder, made photography as "convenient as a pencil," as he put it, in 1888 by inventing an affordable consumer camera, and the company later refined branding-by-packaging with a bazillion immediately recognizable yellow film boxes. Apparently, despite all that—or, perhaps, because of it—time's up for this multibillion-dollar dinosaur, thanks to the evolution of digital photography, according to the report.

The analyst's gloomy take on Kodak made me wax a little nostalgic, taking me to my 1981 graduation from the University of Scranton at the dawn of the Consultancy Era. Every classmate with a newly minted business degree lusted after a job with First Boston, McKinsey & Co. or Booz Allen Hamilton, the goliaths of the lucrative management consulting industry. On what aspect of business, I wondered, was a new college grad qualified to consult? As business history reflects, very little, but that didn't stop legions of business owners and executives from retaining these fresh-faced, would-be experts for their "invaluable" input on critical business issues.

It's hard to fault the corporations that hired the consultants; like many Internet startups that eventually failed, I'm sure it seemed like a good idea at the time. That said, I find it equally difficult to stomach the dissing of Kodak by those who are quick to write off one of the U.S.'s most enduring and profitable companies.

But the most valuable lessons to be learned from the overwrought pronouncements of some analysts and consultants aren't found in what they write or say, but rather in the way their veneerlike insights underscore a fundamental reality of business: All companies have an expiration date, including yours. Of course, some businesses last a century or more, while others—including many small, privately held firms—fail, sell or merge long before that.

What does that mean to your shop? It depends on your perspective. If you're an owner or top executive at a large manufacturer, it means an exit strategy should be at the top of your "to do" list, regardless of how far down the line that exit might be. The top tier of management at any company is usually in the best position to predict the rise or fall of its firm's fortunes and what those respective conditions portend for job security and income potential.

For example, in a shop tied heavily to the domestic auto industry, I'd submit that the shrinking market share of General Motors Corp., Ford Motor Co. and the Chrysler Group, combined with those automakers' relentless downward price pressure on parts suppliers, makes a painfully obvious case for planning an exit sooner rather than later. In contrast, the skyrocketing demand of aging baby boomers on the U.S. health care system is a predictor of future prosperity for shops serving the medical industry.

If, on the other hand, you're a machinist, programmer, operator or in a similar "line" position, you're going to need to work harder to discern whether or not it's time to embrace or seriously question your long-term prospects. You may, by virtue of plant floor scuttlebutt, have some vague impression of your employer's overall health. Or, perhaps, you're a reader of the metalworking trade journals scattered in the break room and have a more global perspective on the well being of your industry.

Neither source of information, though, supplies the kind of barometer to which I'm referring. What you really want to know is the outlook for the industries your shop serves. For that data, you'll need to broaden your reading horizon to include the print or online editions of general business publications. You'll eventually be rewarded with the macroview of your shop's current and possible future business environment.

Some companies age like fine wine while others grow old with as much grace as a wino. I can't predict when a business's time is up, but I can offer this bit of advice: Plan accordingly.

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 ctemag1@netzero.net.

Finding G code that reduces cycle time

BY LAROUX K. GILLESPIE

G codes are programming tools defined by ANSI/EIA RS-274-D-1980 (an international standard). The codes prepare a CNC machine for the work to be performed. Some controls, however, can use extra codes that are not standard for all machines. For example, mills perform several functions that lathes do not, so some codes for mills do not exist for lathes. Still the key functions from G00 to G99 are the same on all standard machines.

G codes define the following for the machine:

- The measurement system: G20 (English) or G21 (metric);
- The movement: G00 (rapid positioning), G01 (linear interpolation) and G02 and G03 (circular interpolation);
- Tool nose compensation: G40 (cancel), G41 (left) and G42 (right); and
- Preprogrammed sequences, or canned cycles: G70 to G89.

There are some simple rules for G codes. With newer machines, programmers can enter multiple G codes on the same line or block. Older machines only allow a single G code and will execute only the last code from the same group of codes in a block. For both older and newer machines, modal codes stay in effect until told otherwise. G01, for example, will stay in effect until turned off. Nonmodal codes, such as G04 (dwell), apply only to the immediate action; if needed again, nonmodal codes must be re-entered. Best practice dictates that a G00 function is called out at the beginning of a program to cancel all canned cycles and set all registers to the initial state. For example, G00 G80 sets canned cycles to zero.

Other G codes are for selecting machining parameters. G97 selects a constant surface velocity, while G96 selects constant spindle speed. G97 is particularly useful when facing on a lathe because surface velocity changes as the tool moves toward or away from the part's center. Using G97, the programmer sets the spindle speed to an initial rpm (i.e., G97S900 to run at 900 rpm), and the control automatically adjusts the rpm from that point on until the cut is finished. A G96 followed by a G95 provides a constant feed per revolution. If G96 is not used, the feed will continue to increase as the cutter moves to center on the lathe because the rpm is increasing as the tool moves to center.

Many controls only allow two-digit G codes, but codes beyond G99 exist for machines that allow three-digit values. Some examples provided by Haas Automation Inc. for its lathes are: G112 (Cartesian to polar transformation), G184 (reverse tapping canned cycle), G195 (radial tapping) and G200 (indexing on the fly).

The ANSI/EIA international standard has several unassigned codes that allow manufacturers or users to define their own functions, such as repeated steps (equipment manufacturers provide many canned cycles). Also some cutting tool companies supply routines for special needs. G05, G20, G45 to G49, G98 and G99, for example, are unassigned. Control suppliers can use them for functions unique to their controls or users can define their own functions.

For example, threading tool manufacturer Emuge Corp., Northborough, Mass., supplies a G-code sequence to optimize thread milling and software routines that specify feed, speed and detailed toolpaths. Mark Hatch, product manager, said the canned routines in most controls do not optimize thread milling. He added that while many users program to absolute dimensions, incremental programming saves programming time when thread milling several holes. The sequence uses G90 to define the X, Y and Z position for the holes, G91 to provide incremental positioning of the cutter during threading and another G code for creating optimized conditions.

The sequence returns to G90 at the end of the threading operation, moves the cutter to the center of the next hole, calls out G91 again and repeats the routine to produce another thread. The coding is shorter than a canned routine and prevents mistakes when threading multiple holes.

Many machinists use canned cycles, but developing custom cycles can pay big dividends. Unique G codes and routines can help shops reduce cycle time.

About the Author
LaRoux K. Gillespie is a retired manufacturing engineer and quality-assurance manager with a 40-year history in precision deburring. He is the author of 10 books on deburring and almost 200 technical reports and articles on precision machining. He can be e-mailed at laroux1@myvine.com.

Defensive line

BY BILL KENNEDY,
CONTRIBUTING EDITOR

Just a few years ago, it appeared U.S. defense products of the future would be based on "Star Wars"-style lasers and satellite technology for combating rogue nations. Today, however, the fight is against stateless enemies that wield relatively crude weapons, such as improvised explosive devices and truck bombs. P&S Machine Co. Inc., Graham, N.C., manufactures relatively simple but extremely precise and reliable defense systems that protect troops and facilities from such low-tech assaults.

For example, P&S produces "cat claw" systems that instantly puncture the tires of attacking vehicles. Each system's unit consists of an approximately 1'-square × 3"-deep stainless steel base from which razor-sharp curved-steel teeth rise when remotely commanded. The claws are linked in a chain of up to 60 units, placed in a trench across a road and activated by a high-torque electric motor. After a threat is resolved, the teeth are lowered to permit traffic to flow again.

P&S fabricates the base from 300-series stainless steel, beginning with a 1'×10½"×¼"-thick top plate that has four ½"-wide × 5"-long laser-cut slots. Perpendicular to the slots, P&S welds a ¼"-thick × 2¾"-wide × 10½"-long plate to each end of the top plate. Between the end plates, parallel to the slots, P&S welds three 3⁄16"-thick × 2¼"-wide cross plates. Before welding, P&S punches a 1"-dia. hole in the center of each cross plate with an OBI stamping press.

P&S Machine

Linked in chains of up to 60 units, 1'-square cat claw devices help defend military facilities and personnel from attacking vehicles.

To complete the base, two ¼"-thick × ¾"-wide × 10½"-long stainless steel bars are welded to its bottom, perpendicular to the slots. The bars act as feet for the unit.

P&S performs the welding with a CNC Omni Fusion robot from Capital Robotics. The robotic welding helps to assure that the base dimensions meet tolerances of ±0.005". Precision is crucial. "When 60 units are hooked together, the blades in the 60th have to come up at the same time as those in the first; the connecting tolerances between every part have to be very close," said Mike Scoggins, P&S president.

After welding, P&S clamps each base in a Mori Seiki SH-400 horizontal machining center and machines the bottom bars flat to assure the unit won't rock in operation.

On the outside of each of the two outer cross plates, P&S welds a ½"-thick × 2¼"-OD × 1½"-ID sleeve around the 1"-dia. punched hole. During assembly, the sleeve accepts a 1½"-dia. bearing held by a retaining ring.

In use, the bearing supports a 12"-long × ⅞"-dia. 300-series stainless steel shaft, which rotates to raise and lower the blades. After P&S mills a flat on one side of the shaft, it welds a 2"-long × 1"-wide lozenge-shaped stainless key on one end. The alignment of the key is critical for smooth operation of the units and must meet a tolerance of ±0.0001".

P&S then axially drills the other end of the shaft to accept two screws. The screws are used to attach a 2⅜"-dia. × 1"-thick coupler that P&S mills on a Mori Seiki MV40 vertical machining center from stainless steel bar stock. On one side, the coupler has a keyway to accept the shaft. On the other side, P&S mills a pocket to accept the lozenge-shaped key of the next unit in the chain. The shop also drills and taps two holes in the coupler for screws to attach a plate that secures the key in the pocket.

P&S makes holders for the blades from 5⁄16"-thick × 1½"-wide × 2⅝"-long stainless steel blanks. At one end, the blanks feature a laser-cut, D-shaped hole to match the shaft with its milled flat. P&S radially drills and taps a setscrew hole into that hole. Then, across the top of the blank where the blade will mount, P&S mills a flat and drills and taps two 3.5mm holes.

Next, P&S mills a set of shallow grooves, or serrations, across the flat. The holders are fixtured four at a time in the Mori Seiki VMC and a cutter with multiple carbide slitting blades creates the serrations.

The most challenging aspect of the project, Scoggins said, was choosing the blades' material and machining the blades. P&S helped its customer develop the manufacturing processes for the blades and determined that to produce a razor edge and perform as designed, the blades should be made of carbon steel, not stainless. So, from a ⅛"-thick sheet of carbon steel, P&S applies a specially made punch and die to stamp the 1½"-wide × 3"-long blades on an Amada Pega King turret punch press.

After the blades are annealed, P&S drills and taps two 3.5mm holes in each one. Then, in groups of eight on the Mori Seiki VMC, the shop mills the bases of the blades with serrations matching those in the holders. When assembled, the two sets of serrations mesh and help hold a blade in place.

Scoggins said putting the razor edge on a blade isn't easy because the blade's entire curved periphery has to be exposed for machining. The blades do not have a lot of clamping surface "and you've got to machine all the way around the thing," he said.

A fixture with two pins to match the blade's two tapped holes locks the blade in position, while a clamp grips the end of the blade that isn't sharpened. On a Mori Seiki TV 30 VMC, P&S applies a specially ground HSS cutter to mill the razor edge. Surprisingly, Scoggins said, the HSS tool lasts longer than a carbide one in this application. At 800 rpm and an 8-ipm feed rate, the cutter makes one pass across one side of the blade to sharpen it, consuming roughly a minute. Four blades are fixtured at a time and machined individually. After machining, the blades are heat-treated to increase hardness and electro-nickel plated for corrosion resistance.

P&S tests every unit after assembly. "We put 60 of them together across the plant floor and hook them up to a control unit to drive them. Believe it or not," Scoggins said, "with a wrench, you can move all 60 by hand."

For more information about P&S Machine Co. Inc., call (800) 334-6870 or visit www.psmachine.com.

Helping engineers: a machinist's perspective

BY JAMES A. HARVEY

I find it odd that management spends numerous hours discussing organizational and scheduling issues but manufacturing personnel spend little time discussing technical issues. As a result, engineers and manufacturing professionals make the same mistakes again and again.

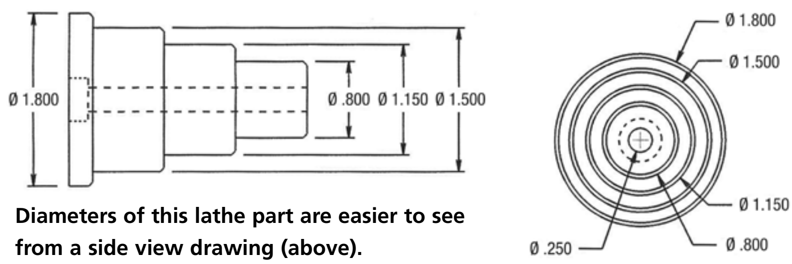
The following are suggestions for designers and engineers, who seldom receive feedback from shop personnel. The intention is to help designers and engineers improve the little things that, together, make manufacturing easier and more productive.

■ **Keep press-fit call outs simple.** The function of most press fits is to locate and retain two items together. I've bored and reamed countless holes for press-fit applications and have concluded that a light press is all that is needed for most applications.

To avoid complication, I suggest a 0.0005" interference for a light press fit and a 0.001" interference for a standard press fit.

Heavy press fits have four disadvantages. First, there is a tendency for parts to gall during assembly and disassembly. Second, a heavy press can significantly change the diameters of parts. In the case of a bearing, a heavy press can cause bearing damage.

Third, a heavy press may not locate items as accurately as a light press, because there is a tendency for material to distort and, possibly, flow unevenly under the high stress needed to make a heavy press fit. Finally, the stress caused by a heavy press may promote cracking of the parent material.



Diameters of this lathe part are easier to see from a side view drawing (above).

All images: J. Harvey

■ **Avoid providing too many dimensioning circular features with leader lines.** Multiple leader lines in one view can be difficult to sort out. It is often easier to see circular dimensions in a side view.

■ **Avoid leaving hidden lines out of a drawing for clarity.** While some designers and draftsmen think that leaving hidden lines out of a drawing helps to reduce "clutter," it actually makes the drawing more confusing for the machinist, who uses hidden lines to check what he thinks he sees in another view.

If a hidden line he's expecting to see is not there, the machinist can't be sure he's interpreting the drawing correctly. If you are going to leave hidden lines out of a drawing, state it clearly on the drawing.

■ **Design flex-type bar clamps that collapse easily.** While flex-type bar clamps work great when designed properly, some designers don't allow for enough weakness in the flexing area. Without enough weakness, mechanics are forced to apply a lot of torque to the clamping screw, which eventually strips the threads.

■ **Make an extra effort to design parts and assemblies that work with relatively loose tolerances.** This is not always possible, but it often can be done. In the shop where I work, plastic molded parts have tolerances within 0.001". It's a constant battle holding those tolerances, which guarantees a lot of downtime and creates stressed out inspectors, operators, molders and managers.

The fault is in the part design. One of the hallmarks of well-designed parts and assemblies is that they'll work with relatively loose tolerances.

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.

Flex-type bar clamps work well when there's enough weakness in the flexing area.

Core competencies

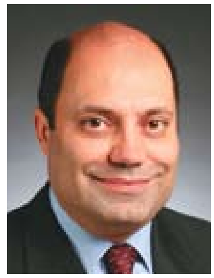
INTERVIEWED BY
ALAN RICHTER, EDITOR

Carlos M. Cardoso is president and CEO of Kennametal Inc., Latrobe, Pa. He joined the toolmaker in April 2003. Cardoso spoke about Kennametal's goals and strategies, the importance of manufacturing for the U.S. economy and industry consolidation.

CUTTING TOOL ENGINEERING: What are Kennametal's near-term strategies and goals?

Carlos M. Cardoso: We have two umbrella strategies as a company. Metalcutting is 65 percent of the business, and the other 35 percent is advanced materials. We want both, in the next 3 to 5 years, to be the same size. That doesn't mean we don't want to grow metalworking, but we want to grow advanced materials faster for a number of reasons. One is that the advanced materials market is as big as metalcutting. However, it's more fragmented, which we like because it allows us to make acquisitions. No. 2, it is very niche-oriented and high value. There are a lot of small companies that bring high value to their customers; therefore, it's very profitable. The other major strategy concerns our current geographic positioning. We have 50 percent of our sales coming from North America, 30 percent from Western Europe and 20 percent from the rest of the world, primarily developing economies. In the next 3 to 5 years, we want the rest of the world to be a third of our sales. The first reason is that the developing economies will grow at double digits for the next 3 to 5 years, while the Western companies will grow at 2 to 5 percent. Our vision is to grow at 7 to 10 percent for the next few years, and we can do that by taking advantage of the developing economies. Finally, it is unlikely all three regions are going to be in a depression or booming at the same time. That gives us a damper.

CTE: You spent more than 6 years at Honeywell/AlliedSignal. How would describe that company's culture compared to Kennametal's?



Carlos M. Cardoso

Cardoso: Culturewise, both Kennametal and Honeywell are very high-tech companies and from a high-technology point of view, there are a lot of similarities. Of course, Honeywell is a much bigger company than Kennametal. I also describe the culture here as high-performance. I'm from the AlliedSignal side of the Honeywell business. I came from a very focused, high-performance culture, and Kennametal has that culture. Regardless of the industry or product, three things make a company successful: a clear vision and strategy, the right products to drive that vision and strategy and the right people to create those products.

CTE: Did you use Kennametal cutting tools when you worked for Colt Manufacturing?

Cardoso: Yep. I've been a Kennametal fan for many years. I used to have my own machine shop, and I always knew that when I had a tough job, I would call Kennametal. That's one of the reasons why I came to Kennametal. It's a legacy.

CTE: How important is manufacturing's role in the U.S. economy?

Cardoso: Manufacturing brings wealth into the economy. We need to have manufacturing because people want to live better every year than the previous year. The driver is manufacturing. If an economy doesn't have manufacturing, it eventually loses its edge. Manufacturing in this country has been resilient and has been able to overcome a lot of different obstacles. I feel that will continue. However, we need to be focused on productivity. At the end of the day, we need to find ways of competing with countries around the world that have a lower labor rate. We're not going to reduce our wage cost here, so the only way to compete with Asia and other developing regions is with productivity, and we can do it. It's all a mind-set.

CTE: What is one of the biggest trends in metalworking?

Cardoso: Workpiece materials continue to get tougher because people want more durability and reliability. Composites and metal matrix composites are becoming kind of the norm. A perfect example of that is the new Boeing 787. One of the positive things for U.S. manufacturing is that a better standard of living is created when making a 787 or machining a composite than manufacturing a low-end part.

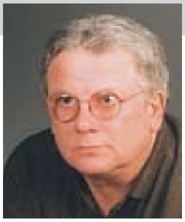
CTE: What are your predictions about industry consolidation?

Cardoso: The industry will continue to get consolidated, but I'm not sure if it's going to be at the big-player level. As this economy becomes more and more global, more players are going to have more and more difficulty competing. We've acquired companies with about $180 million worth of sales in the last 3 years. We've divested a lot because one of our strategies is to focus on our core competencies, which are in manufacturing.

CTE: Any thoughts on Berkshire Hathaway's recent purchase of Iscar?

Cardoso: The acquisition of Iscar, in my view, was a pure financial move. Warren [Buffett] wanted to have more of a foreign investment. He wanted to have currency diversity, so he made the acquisition. Relative to what impact in the marketplace it's going to have, it doesn't really have an impact. Large players in the industry will continue to acquire the smaller players, and the industry will continue to evolve accordingly.

BY MICHAEL DEREN



Price vs. performance

It's that time again. You went to IMTS 2006 and were probably impressed by the new manufacturing technologies. While there, you watched machine demos and gathered literature. Back at the shop, you pored over and sorted the information and invited select machine tool salespeople to give their spiels. Now it's time to make a decision. Before cutting that purchase order and making the down payment, determine if you really did enough research on the company's product. Sure, everything looks great in the brochure, and the machine builder did a great job demonstrating its equipment, but more effort is needed.

I should know because I have done my share of specifying and purchasing capital equipment and have also worked for OEMs that sell and support machine tools.

No doubt, many good machine tool builders exist. They have solid reputations for providing products that perform unfailingly day in and day out from the time they are set up. This equipment usually costs more, but some are willing to pay for better performance.

When I was an applications engineer for a European machine tool builder, I knew our turning centers were top of the line. At the time, a Pacific Rim-made turning center sold for half the price. However, you could run ours 24-7 without a hiccup.

Then there are OEMs that rush untested products to market. While working for one such company, we developed a programmable turntable for automated applications that could index, rotate and tilt. A few customers bought some sight unseen. After I integrated these first few with robots, the turntable rotated and tilted without fault. However, after indexing to a position, the turntable would quiver uncontrollably. I completed 10 different customer installations over several months before the problem was corrected, producing additional costs, downtime and angry customers. Predictably, few additional turntables were sold.

Being on the customer end for several years now, I have seen too many equipment purchases made primarily on price. One was a horizontal boring mill. The company I worked for bought the Eastern European-made machine at a great price from a U.S. distributor with a fine reputation. During the first year, the machine was down more than it was up. Only after 3 years and many service calls did the machine run adequately. The problem was that the turntable was not designed for the type of work our company was doing.

Another company I worked for had purchased three identical drilling machines from a start-up builder. The product looked great, but worked only sometimes. The service technicians were there more often than not. When the company received a large rush order that it needed to run on these machines, which required 24-7 production for 2 months to complete the job, the machines broke down repeatedly. To correct the problem, the company bought a newer machine from the same builder! Somehow, the company completed the job.

Before cutting that purchase order and making the down payment, determine if you really did enough research on the company's product.

When buying a machine tool, don't focus only on price. Like anything else, you get what you pay for. When talking with the OEM, let them demo the machine with the part(s) you plan on running. When buying a general-purpose machine tool, select a complex part made of a difficult-to-machine material to put the machine through its paces. But if you're running aluminum or plastics, you don't need the same machine that the shop down the street is using to run nickel-base superalloys. Buy the right machine for the job, and the payback will follow. △

About the Author

Mike Deren is a manufacturing engineer/project manager and a regular CTE contributor. He can be e-mailed at mderen1@adelphia.net.