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   331 ❑ Primary Metal Manufacturing
   332 ❑ Fabricated Metal Product Manufacturing
   333 ❑ Machinery Manufacturing
   334 ❑ Computer/Electronic Product Manufacturing
   335 ❑ Electrical Equip/Appliance & Component Manufacturing
   336 ❑ Transportation Equipment Manufacturing
   337 ❑ Furniture and Related Product Manufacturing
   339 ❑ Miscellaneous Manufacturing
   423 ❑ Wholesale/Trade/Durable Goods
   999 ❑ Other Manufacturing NEC

3b. If your company does NOT manufacture AT THIS LOCATION, specify company’s primary product or service performed. (please specify)

4. Number of employees at your company.
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   6. ❑ Medical
   7. ❑ Transportation (including automotive)
   8. ❑ Other (please specify)
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Replaceable heads represent the next step in the evolution of reaming. Cover image courtesy of Allied Machine & Engineering Corp.

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### Contributors

- **Cutting Tool Engineering**
- Cutting Tool Engineering regularly features writing by numerous industry experts and practitioners, such as Jeffrey Badger, Keith Jennings, Christopher Tate and Brandt Taylor.

### Advertising Sales

- Scott Beller, East
  - 847-714-0183
  - scottb@ctemedia.com
- Marc Condon, Central/West
  - 847-714-0170
  - mcondon@ctemedia.com
- Dave Jones, Central
  - 708-442-5633
  - dmj_jones@ctemedia.com

### Corporate Staff

- **Chief Executive Officer**
  - Dennis Spaeth
    - dspaeth@ctemedia.com
- **CFO/Director of Sales**
  - Kenneth Spaeth
    - 847-714-0173
    - kspaeth@ctemedia.com
- **Controller**
  - Julie Distenfield
    - julied@ctemedia.com
- **Circulation**
  - Stamats Data Management
    - cte@stamats.com
    - 800-553-8878

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Conventional cutting fluids cool and lubricate but have critics. One is Fusion Coolant Systems Inc., which offers supercritical CO₂.

In the first installment of a four-part series, Jay Ball, product manager of solid milling at Seco Tools LLC, defines optimized roughing in detail.

At EMO 2019, Stanley Kroll, sales manager at J.W. Done Corp., provided a guided demonstration of the company’s Orbitool deburring product line.

Thank you to TK Machining Specialties LLC, Hamilton, Ohio, for opening its doors to a Girl Scouts troop from neighboring Ross. Each girl worked on and took home a shop-made fidget spinner and earned an inventor badge. See this and more on CTE social media.
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Newly restored at ctemag.com are a multitude of feature articles and columns originally published in the magazine from 1996 to 2009. While updating the 800-plus articles, I noticed that a solid majority covered topics that are still relevant, such as the difference in skills required on the job and the actual skills possessed by job candidates.

Not surprisingly, Cutting Tool Engineering covered the skills gap in 1998 — and probably significantly earlier as well. According to a survey CTE conducted that year, 68% of respondents said it had been very difficult to find metalcutting workers during the past 12 months while 29% said it had been somewhat difficult. Only 3% reported no difficulty finding talent, and many of those companies might not have even needed additional workers.

As metalworking professionals are certainly aware, the skills gap scenario hasn’t changed much in 22 years. Nearly 500,000 jobs are open in manufacturing, according to the U.S. Bureau of Labor Statistics. And this is occurring while the industry is in a slump.

Scrambling to find skilled labor isn’t unique to North American manufacturers of precision-machined parts. The proportion of European manufacturers indicating that a lack of trained workers is limiting production is near a record high at about 17%, The Wall Street Journal reported in October.

However, some young people are realizing the advantages a manufacturing career provides and are reaping the rewards. One such person is Noah Cantara, product specialist at Hyperion Materials & Technologies Inc., Worthington, Ohio. CTE Publisher Dennis Spaeth met him while attending the fall meeting of the Cleveland-based United States Cutting Tool Institute in San Diego’s La Jolla neighborhood. Spaeth recorded a conversation between Cantara and Terry Iverson, president and CEO of Des Plaines, Illinois-based Iverson & Co., a machine tool distributor and rebuilder. The video is at cteplus.delivr.com/2t5df.

Cantara, whom Iverson singled out as “the millennial in the group” during his presentation, started at Hyperion Materials & Technologies as an intern and is in his third position there.

“The progression has been truly amazing,” Cantara said. “I never thought going into this industry where I’d be today.”

He seems to be on a promising career path like many people in a generation that sometimes isn’t viewed too favorably. Even in the 1998 survey, 29% of respondents said job applicants tended to exhibit bad attitudes and poor behavior.

On a separate note, I would like to welcome machine shop owner Brandt Taylor as the new Machinist’s Corner columnist, starting this issue on Page 22.

CTE

about the author
Alan Richter is editor of CTE. Contact him at 847-714-0175 or alan@ctemedia.com.
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COMMON LANGUAGE CONTROVERSY

By William Leventon

Significant progress has been made in creating a common language for machine tools. However, two organizations have been spearheading separate efforts to reach that goal, causing confusion in the industry.

First came version 1.0 of MTConnect in 2008. Backed by AMT – The Association For Manufacturing Technology, McLean, Virginia, MTConnect is a protocol for data exchange between shop floor equipment and software for monitoring and data analysis. The MTConnect standard offers a semantic vocabulary that machining equipment can use to provide structured data with no proprietary format, eliminating the need to translate data from different sources in a manufacturing system.

Nine years after the launch of MTConnect, the German Machine Tool Builders’ Association, also known as VDW, announced that it would lead an effort to develop a universal machine tool interface. Called by the acronym umati, its goal is to easily, securely and seamlessly integrate machine tools and related equipment into users’ IT systems to facilitate transmission of machine- and production-related data both within companies and to the cloud.

As “universal” implies, VDW and its partners want to make umati a standard for machine tool users worldwide. But why release umati when MTConnect already exists? According to its website, MTConnect was developed by over 300 machine builders, integrators and end users and has been used to connect over 50,000 devices in more than 50 countries.

When the umati project started, all the major machine tool builders that were VDW board members “were fully aware of MTConnect, and some even had implementations,” said Alexander Broos, VDW’s director of research and technology. “But they felt that MTConnect did not serve their needs or that of their customers. Furthermore, even though MTConnect was widely known, they perceived only a very small installation base, especially outside of the U.S., and basically no customer demand.”

He said one reason umati backers are dissatisfied with MTConnect is that it is a read-only standard — that

We ‘have found common ground to work going forward to ensure that there is harmonization’ of the two standards.
is, it defines only the reading of data from control devices, not the writing of data to those devices.

“In the long run, umati will also (cover) calling routines and writing data,” Broos said, “which is not foreseen in MTConnect.”

This criticism bothers Tim Shinbara, AMT’s vice president and chief technology officer.

“There are good reasons why we decided to start with read,” he said, chiefly involving concerns about the safety and security of MTConnect systems.

Shinbara said MTConnect developers now have published “interfaces” that allow data to flow back and forth between equipment.

He said MTConnect is an information model and a data dictionary filled with terms collected over more than a decade. In contrast, he primarily sees umati as a means of transporting manufacturing data to software applications.

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Marketing information, however, describes umati as a dictionary for machine tools that permits translation of data coming from proprietary equipment — exactly the purpose of MTConnect’s information model and semantic dictionary, he noted.

Broos countered by pointing out that MTConnect “now provides a huge list of parameters but no identical structure” for data.

As a result, he said, two different MTConnect installations may not be compatible.

“We put a lot of effort into making...

Alexander Broos (right), VDW’s director of research and technology, discusses umati at EMO Hannover 2019.
sure that the structure of the data in the (umati) information model is identical for every connected machine,” Broos said.

Backers of umati believe that the importance of this was shown at EMO Hannover 2019. The demonstration featured 110 machine tools and 28 software services connected by 70 umati partners from 10 countries. Thanks to umati’s precise information model, all connected machines produced the same data structure, he said. The software developers consequently were able to tap into the entire data pool without having to communicate with any of the machine builders.

Broos expects the first version of umati to be launched by midyear and to cover 10 use cases that help machine operators optimize processes and improve shop floor transparency. All major CNC manufacturers already have committed to supplying umati-ready products, he said.

As for the relationship between umati and MTConnect, people from the two camps “have found common ground to work going forward to ensure that there is harmonization” of the two standards, Shinbara said.

Eventually, he hopes MTConnect and umati will be able to work in a complementary fashion for the same production processes.

Broos thinks that a simple merging or integration of the two may not be feasible, but he believes that VDW and AMT need to “intensify” cooperation because both organizations want to clear up confusion caused by the separate MTConnect and umati initiatives.

Collaboration with AMT, he said, “starts by seeing how we can make use of what has already been defined and incorporate that into the umati model.”

about the author
William Leventon is a contributing writer for CTE. Contact him at 609-926-6447 or wleventon@gmail.com.
There are almost 200 countries, but only three — the U.S., Myanmar and Liberia — have not adopted the International System of Units, the official metric system of weights and measures. Ancient Babylonian and Egyptian records, as well as the Bible, indicate that length first was measured with the forearm, hand or finger. Time was measured by the periods of the sun, moon and other heavenly bodies. Volume was measured with stones and seeds, which served as standards, and “carat” still is used as a unit of weight for diamonds and other gems. Carat was derived from the seed of the carob tree. The uniqueness of these seeds is that their weight is practically the same from one seed to another. In the metric system of units, the weight of a carat equals 200 mg (0.007 oz.).

In the 1790s, the French Academy of Sciences deduced an invariable standard for all measures and weights and established a Commission of Weights and Measures. The commission assigned the name meter to the unit of length. This term was derived from the Greek word “metron,” meaning a measure. The physical standard to represent a meter was to equal one ten-millionth of the distance from the North Pole to the equator along Earth’s meridian running near Dunkirk, a city and port in France on the Strait of Dover, and

**Conversion of units of length from the metric system to the U.S. customary system and vice versa.**

<table>
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<td>0.9144 m</td>
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<td>25.4 mm</td>
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<td>1 mile</td>
<td>1.609344 km</td>
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The commission was asked to conduct accurate measurements of the length of the meridian and prepare physical standards for a meter and a unit of mass, the kilogram. France approved the two platinum prototypes Dec. 10, 1799, forming the basis of the metric system.

On Sept. 28, 1889, the first General Conference on Weights and Measures, in its resolution “Sanction of the international prototype of the meter,” determined that the international and national prototypes of a meter would be made of a platinum alloy with 10% iridium to within 0.0001 m (0.0003’).

On Oct. 20, 1960, the 11th General Conference on Weights and Measures adopted the name International System of Units. Many scientists, inventors and engineers who lived in the 17th through 20th centuries became immortal when their names were incarnated into the units of measurement. There are seven base units: meter, kilogram, second, ampere, kelvin, mole and candela. Two are named after renowned scientists: André-Marie Ampère (1775 to 1836) and Lord Kelvin (1824 to 1907).

Also at the 11th general conference, the resolution “Definition of the meter” considered whether the international prototype defined a meter with adequate accuracy for

---

**about the author**

Ancient Babylonian and Egyptian records, as well as the Bible, indicate that length first was measured with the forearm, hand or finger.

present needs of metrology. The adoption of a natural, indestructible standard was examined. The conference decided that a meter is the length equal to 1,650,763.73 wavelengths in a vacuum of the radiation of the krypton-86 atom. It also was determined that the international prototype of a meter sanctioned by the conference in 1889 would be kept at the International Bureau of Weights and Measures under the conditions specified in 1889.

On Oct. 21, 1983, the 17th General Conference on Weights and Measures, in its resolution “Definition of the meter,” considered whether the present definition allowed a sufficiently precise realization of a meter for all requirements. The conference decided that a meter is the length of the path traveled by light in a vacuum during a time interval of 1/299,792,458 of a second.
MILLING SETUP TRICKS

By Brandt Taylor

Workholding for milling parts with curved surfaces is challenging. This column will show how to use a milling vise to clamp a casting with a curved-surface datum (Figure 1). The datum surface is 76.2 mm × 157.2 mm (3"×6.189") with a radius of 106.4 mm (4.189").

The two ears on the right are machined on a parallel inside surface with a tolerance of 25.45 mm/25.4 mm (1.002"/1") between the two. The ear on the left is machined on an outside surface 12.7 mm/12.6 mm (0.5"/0.496") thick. The two cross-holes are reamed perpendicular to the machined surfaces. Parallelism and perpendicularity are 0.5°. This level of accuracy requires the part to be machined in one clamping. A computer graphics program was used to design the workholding and toolpaths and choose the tool.

The machine tool is a three-axis bed mill. A 152.4 mm (6") milling vise with custom jaws is used for workholding. This vise develops 3,175 kg (7,000 lbs.) of clamping force when the screw is tightened to 108.5 Nm (80 ft.-lbs.). The clamping setup uses three pieces of 12.7 mm × 22.2 mm (0.5"×0.874") 6061 T6 aluminum bar stock as struts that go against the back jaw and press against the workpiece. This arrangement distributes the 3,175 kg at three places along the workpiece. Two struts are 127 mm (5") long, and one is 133.5 mm (5.256") long.

Therefore, the three struts have an average compression of 0.0635 mm (0.0025") under the 3,175 kg load, which ensures that all three
clamping points are held securely. The 2,758-bar (40,001-psi) yield strength of the aluminum workpiece guarantees that it will withstand the 365-bar (5,294-psi) clamping stress.

To hold the part in the vise, a pair of soft jaws were made from 19 mm × 76.2 mm (0.748”×3”) cold-finished 1018 steel. The front jaw has grooves that accept 9.5 mm-thick (0.374”) aluminum inserts with a 106.4 mm radius. The width tolerance of the casting can be +2.54 mm (+0.1”), so the center of the radius is 39.624 mm (1.56”) above the vise bed. A work stop is attached to one corner of the front jaw with a ¼-20 screw. Figure 2 on Page 22 shows the front jaw with inserts and the work stop.

A 101.6 mm × 4.8 mm × 25.4 mm (4”×0.189”×1”) side milling cutter was applied to cut the flats. A special toolholder (Figure 3 on Page 22) was made to mount in a 25.4 mm endmill holder.

When using a vise setup with multiple clamping points, ensure that all clamping points are in compression. Workpieces vary in
dimensions, which is especially true with castings. Figure 4 on Page 22 shows the clamping setup. To assemble for machining, first put a casting against the front jaw and determine the correct vertical position. Then position the struts, which are held up by spacer blocks. Snug the vise, but don’t tighten it. If a strut is loose, fill the gap between it and the back jaw with a feeler gauge. Then tighten the vise. A bunch of loose feeler gauges work well here.

Once the setup is validated, document it with photos. Figure 5 on pages 22 and 23 shows the setup.

Figure 6
A different casting is machined.

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blaser.com/synergy735

Figure 6 on Page 24 shows another casting being machined. It uses the same 76.2 mm-tall jaws but without the inserts. Two struts are between the back jaw and the workpiece. Here the cutter passes over and under the strut on the right.

This setup uses a different work stop that is versatile, rigid and easy to make. A ½-13 hole in the side of the vise accepts the stop. The stop is made from a piece of 12.7 mm × 25.4 mm aluminum bar, some ½-13 threaded rod, nuts and washers. If a workpiece hangs out from the side of the vise, it’s no problem.

To summarize:
1. A milling vise can be used to make rigid, repeatable workholding setups for irregularly shaped workpieces.
2. A setup that allows all machining in one clamping saves time and reduces errors.
3. Using software to design workholding and program flow saves time and trouble.
4. Validate the entire machining operation.
5. Document the setup with a written description and photos.
6. Measure raw material before machining, and adjust parameters as needed.
7. Ensure that all clamping points are tight.

Definitely document the work. If the job repeats in five years, it would be cool to have photos from the first setup.

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**about the author**

Brandt Taylor is owner of Berlin, Massachusetts-based Taylor Engineering, a machine shop and manufacturer of lathe chuck jaws. He can be reached at 978-838-2979. For more information about the chuck jaws, visit www.stopjaws.com.
Dear Doc: We cylindrical OD-plunge steel shafts and divide the cycle into the standard rapid-feed, roughing, semifinishing, finishing and spark-out cycles. There’s disagreement about when we should shift from rapid feed to roughing. We don’t have an acoustic emission sensor for first-contact detection. Any thoughts?

The Doc replies: The only way to answer this question is to have some idea of the range of blank diameters going into your grinder. If your shop is like many — maybe most — shops, it doesn’t have a clue and is wasting weeks a year grinding nothing but air.

Let’s say the final diameter after grinding is 25 mm (0.984”) and you start roughing at 26 mm (1.024”). Where did that number come from? It’s likely that 26 is just a nice, round number where you’ll know you’ll be safe. Also, back in 1979, a machine operator tried decreasing that to 25.8 mm (1.016”) and noticed more...
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wheel wear before going back to 26 mm. And that’s where it’s been ever since.

The solution is to measure blank diameters — not just one part or even five parts but perhaps 100 or more. If your part is long, you’ll have to measure cylindricity in addition to diameter.

I once visited a company in Japan that measured 500 blank diameters for every part variation produced. The company then calculated means and standard deviations and thought long and hard about when to shift from rapid feed to roughing. The company was so obsessive because it knew that grinding air was a waste of time and wanted to keep that to a minimum while still ensuring that the wheel didn’t crash into the part.

So, find that engineering intern, give him a micrometer, and tell him to spend three days measuring and plugging the data into a Microsoft Excel spreadsheet. If some batches go into the grinding machine after hard turning and other batches are coming straight from...
heat treatment, which tends to distort parts, he’ll have to do measurements for both groups. If some parts are 10 mm (0.394") in diameter and some are 100 mm (3.937"), he’ll have to measure those separately. If some parts are long and some are short, he may have to position the parts between centers and measure not diameter but cylindricity to see how length affects distortion.

Once these measurements are completed, the choice of the starting diameter is usually easy. When you do this, you’ll be embarrassed. You’ll think, “Gosh, our largest blank was 25.6 mm (1.008”), and we start rough grinding at 26 mm? That’s absurd.” Don’t tell anybody — just quietly start reprogramming your start diameters.

Is this effort worthwhile? Let’s do some rough calculations. Let’s say your company produces 2 million parts a year and you start roughing from 26 mm in diameter at 2 mm/min. (0.079 ipm) for a respectable Q-prime of 2.6 mm²/sec. (0.24 in.²/min.). If by measuring the blank diameter you can reduce the start diameter from 26 mm to a modest 25.9 mm (1.02"), you’ll save 0.05 mm (0.002") off radius divided by 2 mm/min. = 1.5 seconds per part. That doesn’t seem like much. But at 2 million parts, that’s 3 million seconds, or 833 hours. At, say, $100 an hour, that’s $83,300 a year.

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**about the author**

Jeffrey Badger, Ph.D., is an independent grinding consultant. His three-day High Intensity Grinding Course will be held Feb. 18-20 in Columbia, South Carolina, and April 6-8 in Springfield, Massachusetts. For more information, visit www.TheGrindingDoc.com.

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Do you still use that old standby, the HSS chucking reamer, for hole-finishing operations? There are excellent reasons to do so. HSS chucking reamers are inexpensive, dependable, readily available and forgiving of misalignment and misuse. For example, one catalog house lists more than 5,000 HSS reamers on its website, most of them in stock. But if you decided a long time ago to ditch HSS hand-ground tool bits for carbide ones, it might be time to question why you haven’t taken the same route for reamers.

For many shops, the move to solid-carbide reamers is a no-brainer. Yes, the price may be several times that of their HSS equivalent, but the higher productivity and hole quality are enough to win over even the most frugal shop owners and purchasing managers — that is, until reaching hole sizes of 12.7 mm (0.5”) and larger, at which point a solid-carbide reamer becomes increasingly hard to justify. What then?

Brazed carbide reamers are one option, but a better alternative dates back a century. On Dec. 27, 1920, inventor Torsten A. Gyllsdorff of Detroit-based Standard Reamer & Tool Co. applied for a patent for a two-piece reamer,
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‘Because only the head of the tool is made of carbide, it’s a much more cost-effective solution for large-diameter reaming applications.’

**Moving to Modular**

one “wherein the cutting end can be replaced at low cost when worn.” His “new and improved reamer” unfortunately used an HSS head, which minimized improvements to productivity, but hats off to his forward thinking regardless.

**Old Dog, New Tricks**

A number of cutting tool manufacturers have resurrected Gylls-dorff’s idea and made it better. Peter Gennuso, sales engineering manager for OSG USA Inc., Irving, Texas, said the company’s PXM endmill platform can be equipped with a variety of heads, including special form tools, chamfer and radius cutters or exchangeable-head reamers.

“Because only the head of the tool is made of carbide, it’s a much more cost-effective solution for large-diameter reaming applications,” he said.

What defines large? Depending on the style of head, the PXM system covers diameters from 10 mm to 32 mm (0.39” to 1.26”), a range that Gennuso said complements OSG USA’s solid-carbide reamer line.

“The vast majority of machined holes are ¾” (14.29 mm) in diameter or smaller,” he said, “and for most of these, solid reamers are the best choice. For larger diameters, however, the PXM lineup provides the advantages of a solid cutting tool with the flexibility and cost benefit of an indexable platform.”

These reamers are also quite

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**about the author**

Kip Hanson is a contributing writer for CTE. Contact him at 520-548-7328 or kip@kahmco.net.
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accurate. In OSG USA’s case, the PXM offers 0.015 mm (0.0006”) or less of radial runout and axial repeatability within ±0.03 mm (0.0012”). This is accomplished via a buttress-style, screw-on carbide head whose face and taper mate with a cylindrical steel shank, similar to an HSK spindle or a comparable dual-contact mount.

Gennuso said a general rule is to leave 1% of a hole’s finished diameter for reaming. For a 12.7 mm hole, that would mean drilling to 12.57 mm (0.495”). Check any drill chart, however, and you’ll find that the nearest drill size is 12.3 mm (0.484”), roughly three times his recommendation. So what do you do?

“Reamers are designed to remove a relatively small amount of material,” he said. “But with the larger diameters like those discussed here, your drilling options are more limited. So it might be necessary to drill as close as you can, semifinish with a boring tool and then ream to size. Without that three-step process, it can be tough to guarantee the proper amount of finishing stock and avoid problems with chip evacuation.”

Hello, Alvan

What if you need to go even larger? Talk to Ben Morrett, senior product manager for the Alvan reamer line at Allied Machine & Engineering Corp., Dover, Ohio. Since the early 2000s, the company has partnered with S.C.A.M.I. snc, a family-owned reamer manufacturer in Italy that produces modular reamers up to nearly 203.2 mm (8”) in diameter.

The reamer line’s monoblock style covers hole diameters from 5.8 mm to 32.1 mm (0.228” to 1.264”) while the replaceable-head series is slightly larger at 11.8 mm to 60.6 mm (0.465” to 2.386”). Both kinds are available in fixed or expandable models. There’s also a ring-style reamer that ranges from 17.6 mm to 200.6 mm (0.693” to 7.898”).

“It’s a very versatile product line,” Morrett said. “We have different grades of cermet, carbide, PCD and CBN available, as well as various coatings and geometries, so there’s little we can’t handle materialwise. With that in mind, I would...
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say that most of our customers are using them for production work, such as hydraulic manifolds and fire-arm components.”

He said his statement about production work is not meant to scare off job shops and other high-mix, low-volume manufacturers that benefit from the product’s broad application range and ability to expand holes up to 1% of a reamer’s diameter. The sticking point is cost: Whereas a five-person shop might balk at spending an additional 30% or more for a modular reamer, high-volume manufacturers easily can justify it based on cost per hole.

“I worked with a shop recently that was getting around 1,000 parts out of a brazed carbide reamer,” Morrett said. “By switching to our Alvan solution, they increased that to 14,000 parts. So, yes, our tool costs roughly one-third more than a conventional reamer, but the delta is insignificant when you consider the productivity improvements.”

Down in the Bayo

Arlington, Texas-based Iscar Metals Inc. is another company targeting high-volume manufacturers.

“If you’re only doing a handful of parts, it’s probably most cost-effective to use a standard HSS or brazed carbide reamer,” said David Vetrecin, holemaking product manager for Iscar Tools Inc., Oakville, Ontario. “Modular reamers are more suitable for production work.
Moving to Modular

where cycle time is critical.”

Hole quality is also a critical factor when selecting a reamer, he said. Iscar’s Bayo T-Ream interchangeable-head reamer, which covers diameters from 11.5 mm to 32 mm (0.453” to 1.26”), guarantees diametral head accuracy of ±2.03 µm (0.00008”) and 3 µm (0.0001”) runout and indexing repeatability.

“In most applications, we can easily hold hole size within 5 µm (0.0002”) even while feeding 50% faster than a traditional carbide reamer,” Vetrecin said. “This makes our system a favorite in the aerospace, automotive and indeed any industry where hole quality is just as important as throughput.”

Throughput also depends on setup time, and modular reamers don’t disappoint. The Bayo T-Ream, for example, is equipped with a bayonet screw and special wrench for rapid changeovers. Perhaps more important than speed is simplicity, however. Considering the

For the most effective chip evacuation when reaming through-holes, always use a tool with left-hand flutes, and blind-holes should be reamed with a straight-flute tool.
shortage of qualified workers, modular reamers offer a set-it-once approach, after which anyone can replace heads with a screwdriver.

**Rules of the Reaming Road**

Vetrecin said the rules are no different when using modular or conventional reamers. For the best chip evacuation on through-holes, always use a tool with left-hand flutes, which push chips forward. Blind-holes should be reamed with a straight-flute tool or right-hand tool, if available. Since most modular reamers offer through-the-tool coolant, by all means use it, preferably with high-pressure coolant.

Monitor tool life, and replace tools sooner rather than later, especially if there’s the possibility of regrinding a tool, he said. Because penetration rates are often much higher with modular reamers — primarily due to the advanced edge geometries and coatings from most cutting tool providers — always follow a manufacturer’s recommendations for feeds and speeds.

Lastly, don’t forget to properly align a reamer. Some toolmakers offer adjustable sleeves or adapters for machines with out-of-whack turrets and spindles. Otherwise, a high-quality hydraulic holder is the best way to grip any reamer while avoiding floating holders whenever possible.

“Whether modular, HSS or solid carbide, hole quality and tool life both depend on minimizing runout when reaming,” Vetrecin said.

‘Our tool costs roughly one-third more than a conventional reamer, but the delta is insignificant when you consider the productivity improvements.’

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ctemag.com/cteguide.com 41
Electro-permanent magnetic workholders offer multiple advantages — even for nonmagnetic parts.

By Alan Richter

One goal all machine shops have is to improve overall shop efficiencies. Multiple paths are available to achieve that objective, including electro-permanent magnetic chucks when workholding is targeted. This type of magnetic workholding helps end users move more parts out the door, according to Mike Eneix, vice president of sales for Techniks Inc., Indianapolis. “It’s all about optimizing setup time and part changeover time, and that’s where a lot of productivity gains are occurring these days.”

Two other types of magnetic workholders are available: electromagnets and permanent with rare earth magnets. However, unlike an electromagnet, an electro-permanent magnet requires only a short blast of electricity to activate or deactivate a chuck and continues to provide the same holding force even if disconnected from the power supply, Eneix explained. “You don’t have constant electricity going to the magnet, generating heat and creating distortion or warping of the workpiece you are holding.”

From a safety standpoint, an electro-permanent magnetic workholder will not release a part if a facility loses power while the part is being machined, added Mitch Springer, president of Statesville, North Carolina-based Alpha Workholding Solutions LLC, which also
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specializes in electro-permanent magnetic workholding.

The company’s magnetic workholders incorporate round pole technology instead of square or straight magnetic poles, Springer noted, adding that the technology provides an even balance between the north and south poles to more uniformly clamp a part. In addition, the technology minimizes stray flux, so chips don’t adhere to the workpiece.

Permanent magnets using rare earth magnets are cost-effective for small workholding applications, Springer noted, but they must be activated manually, which requires internal mechanical parts that tend to eventually wear. Additionally, coolant can infiltrate a unit and deteriorate the internal components over time.

“On the electro-perm like ours, they are completely sealed,” he said. “We have chucks out there that are over 15 years old and still going right along with no problems.”

According to Michael Harris, national sales manager for the East Coast/Canada at Techniks, permanent with rare earth magnets are most commonly used for lifting magnets that don’t require electricity. That type is also suitable for holding large parts more economically than an electro-permanent magnetic chuck. “You just need to position magnets every so often,” he said. “You don’t need the entire part covered with magnets.”

Electromagnets are frequently found on grinding machines, Springer added. “There are still applications across the board for every type.”

John Powell, president of Raleigh, North Carolina-based Wen Technology Inc., which focuses on the electro-permanent design, concurred. “When you have powerful requirements, then those revert back to electromagnets. When you have a small, detailed requirement, they revert back to permanent magnets. But for the general application, electro-permanent seems to be good for holding.”

Hold Tight

Powell said a magnetic workholder can effectively grip almost any cast-iron or steel workpiece with the exception of some stainless grades, such as 300 series ones. In the case of tool steels, high hardness and high alloy content will reduce the holding power somewhat and their tendency to retain magnetism can make them difficult to remove from the magnetic workholder. Nonetheless, the possibility of machining five sides in one setup results in moldmaking being a major application for magnetic workholders. Also, magnetic workholders are available that effectively demagnetize a workpiece, and a major application for those is hard turning bearing rings.

When an end user isn’t certain whether a workpiece material is suitable for a magnetic workholder, Springer said Alpha can make a recommendation based on the
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company’s experience or conduct tests at its facility to determine if magnets are even feasible. An example is when the workpiece is an exotic metal or otherwise out of the ordinary. “We do a lot of testing for customers before they even go down the path of investing money.”

Another workpiece material that many people think would be ideal for magnetic workholding is armor plate, but it isn’t, Eneix said. He added that some stainless steel alloys seem to be magnetic but don’t have enough carbon.

However, magnetic workholding can be employed even when machining aluminum and other nonferrous materials. The most common way is to build a steel fixture plate that mounts to the magnets while holding the nonmagnetic workpieces, Harris said. “That would shorten the setup time.”

Most conventional workholding is made of steel, Springer said. “It is usually mild steel. Mild steels are the absolute best to use with any kind of magnetic workholding simply because they magnetize really well and then they let go of the magnetism as well. You don’t have residual magnetism.”

Springer added that some people use Alpha’s A-Pod magnetic modular system when switching between magnetic and nonmagnetic workpieces. Each module measures less than 101.6 mm (4”) in diameter and 76.2 mm (3”) in height, provides 635 kg (1,400 lbs.) of clamping force and can be placed and moved as needed.

Using a magnetic side rail integrated into the fixture, a magnetic workholder secures a welded steel rectangular tube. Once gripped, the workpiece is both the y- and z-axes.

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“They set up the A-Pods where they need to go and do their magnetic parts,” he said. “Then when they have to switch over to nonmagnetic parts, the A-Pods just clamp their magnetic fixtures that hold their nonmagnetic workpieces.”

Enhancements, Developments

Magnetic workholders have a fairly long history, with electro-permanent magnetic workholding introduced in the U.S. in the mid-1990s, according to Powell, but they nonetheless continue to evolve. For example, he said Wen Technology offers intelligent controls that are fail-safe and enable problems to be easily diagnosed.

When a customer calls with a control problem, a blinking light sequence provides a code to indicate what is wrong, Powell said. “In a matter of minutes, you can get the situation sorted out. You can also prevent the electricity from flowing uncontrolled and damaging the chuck itself.”

Using both the control and a specific wiring configuration for the magnets, Wen Technology is able to “fire” them sequentially, he said. This capability is shown in the photo below where a welded steel rectangular tube is held magnetically for machining. In this case, ensuring that the tube was straight was critical, so a magnetic side rail was integrated into the fixture. First, the side rail is magnetized to positively pull the tube straight in the y-axis against the rail, and then the base magnet is magnetized to pull the tube down in the z-axis and held straight automatically.

“You need to break the magnet up into separate firing zones and then sequence the part,” Powell said.

Eneix said Techniks develops custom controller solutions for multiple magnetic chuck installations, which are common. If there are 10 chucks, for instance, the customer can control them individually, as groups or by part name.

“If you have a specific part that is...
always the same length and width, you may only need to magnetize chucks one through five,” he said. “You could name it as such, and it will magnetize chucks one through five.”

In addition, the control for Techniks’ magnetic workholders enables the magnetic flux to be adjusted using eight flux height settings and prevent the flux line from coming through a part to avoid any chip buildup, Harris said.

Springer explained that the magnetic field protrudes from the top of Alpha’s workholders about 10.2 mm (0.4”), so any part that thick or thicker will be fully clamped without any magnetism bleed. Conversely, the clamping will be reduced for parts thinner than 10.2 mm because some magnetism bleeds through.

“That’s why we use that design, so you don’t have flux seeping out everywhere,” he said. “It’s all contained. The side of the chuck is not magnetized. You are not going to have anything coming out there or the bottom. It only exits the top.”

To more effectively hold thin workpieces, which tend to bow, Eneix said Techniks offers 35 mm (1.38”) pole magnets. The company also offers 50 mm (1.97”), 70 mm (2.76”) and 90 mm (3.54”) sizes for thicker workpieces.

“Once we came up with the technology for doing it in a 35 mm pole,” he said, “that keeps the flex line a lot closer to the base of the magnet and allows us to hold on to...
exceptionally thin parts.” Techniks also offers spring poles that can be placed on the face of a magnet to compensate for any warped stock and eliminate Shim-less when holding parts, such as large plates. “The huge advantage in a shop is gaining productivity so you don’t need to Shim parts, so they will keep flatness before you machine them,” Eneix said.

New to the Old
Even though the technology is well established, magnetic workholding is far from being universally understood and accepted when the application is appropriate.

Techniks says there is no decay of holding power over time with EEPM magnetic chucks.

“Every single week, it never fails that we talk to somebody who has never used magnets and doesn’t know how they are going to work,” Springer said. “Most of the market is just not that familiar with it yet or hasn’t really decided to break free from what they are used to doing and trying something new, which isn’t that new, but it just seems that way.”

The benefits, however, can be eye-opening when someone is exposed to the technology.

“People who have never used a magnet for milling are typically shocked that the part is dead quiet,” Powell said. “With any clamp-type system, you basically have point contacts, and the part is free to vibrate in between.”

With magnetic workholding, on the other hand, a magnet has a much lower holding force per unit area of contact compared with a steel clamp, he added, but that lower force is over the entire surface. Therefore, the entire surface is clamped, and the part cannot vibrate. There is no screeching or squealing — just silence, a fine surface finish and long tool life.

In addition to significantly reducing setup and changeover times by eliminating the need to tighten and then undo a series of clamps or vises, magnetic workholding can help generate business.

“One job shop used to decline a specific job, and then they found (out) about magnets and incorporated magnets and all of the sudden went after that work,” Eneix said. “They got the work and made great margins on that work as well.”

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CTE
Machine maintenance programs decrease downtime, boost bottom line.

By Larry Adams

Looking for ways to save thousands or even millions of dollars?

That question might sound like a scam, maybe the subject line of spam. But it isn’t a ruse. While not every company will see a seven-figure dividend, any part manufacturer can save money by reducing machine tool downtime, especially the unplanned variety, through the use of predictive or preventive maintenance programs offered by equipment suppliers and third-party firms.

Few breakdowns happen without warning. If warnings are noted through regularly scheduled maintenance procedures or real-time data analysis and action, costly breakdowns can be mitigated.

Spending a little today on machine maintenance often offsets future repair costs, said Jack Lugas, field service engineer for Absolute Machine Tools Inc., Lorain, Ohio. According to research company ARC Advisory Group Inc., unplanned breakdowns typically cost 10 times more than planned downtime. A study by Aberdeen found that unplanned downtime can cost a company as much as $260,000 an hour. Overall, unplanned downtime annually costs manufacturers $50 billion, according to a Wall Street Journal article, and equipment failure is the cause of 42% of this unplanned downtime.

In addition to not having access to out-of-order machines, manufacturers may not get as much from machines when they work. Some companies purchase equipment to increase capacity when they don’t need to, said Graham Immerman, executive director of...
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Over A Century in the Machine Tool Business
marketing for Northampton, Massachusetts-based MachineMetrics Inc., which provides out-of-the-box industrial internet of things connectivity. He said the average machine utilization rate for the machines that his company deals with is 27%.

“So the question becomes, when you are justifying capital equipment spending, are you getting everything you can out of the machinery that you currently have?” he said. “The answer almost certainly is no.”

Maintenance costs can be hard to justify, especially if nothing goes wrong. When chips are flying and spindles are turning, money is made, so the incentive to curtail production is low. While some companies religiously maintain machines, others do not, Lugus said.

Changing filters is a minor task that can be critical to optimal machine operation.

“I mostly because they are too busy,” he said. “Mostly because maintenance is a cost item, not a moneymaking endeavor.”

Predict or Prevent

Predictive and preventive maintenance are two programs that help manufacturers reduce the
frequency and duration of machine downtime, though in different ways.

Predictive analytics allows users to analyze real-time data for just-in-time maintenance by comparing information with known scenarios. For instance, what does it mean when cutting speed operates at a certain rpm during a particular machining operation? How does that situation compare with known failure modes? Preventive maintenance programs are based on predetermined factors, typically time and usage.

With predictive maintenance, real-time machine data is compared, and any necessary alerts are sent so decisions can be made. Operators can log in from anywhere with internet connectivity. Machines eventually might feature artificial intelligence and machine learning algorithms that automatically can order parts or schedule maintenance.

The intriguing possibility of self-maintaining equipment is partly why predictive maintenance is one of the hottest offerings in manufacturing. Equipment suppliers are integrating predictive maintenance into their offerings. Third-party companies, such as MachineMetrics, are aiding the data-driven machine maintenance process from the OEM to the machine and tool supplier. According to a November report from ReportLinker, the predictive maintenance market is expected to reach $12.7 billion by 2025.

Using big data and machine learning, a large quantity of data is systematically analyzed and incorporated into processes that can predict when equipment could fail. By monitoring machine performance during normal operation to set baselines, previously captured machine performance can be compared with real-time data to determine if there is a problem or if one is developing.

Mazak Corp., for instance, has expanded its data-driven decision-making capabilities. Joe Sanders, process development coordinator for the Florence, Kentucky-based machine tool builder, said monitoring spindle health can reveal impending failures based on specific types of performance measurement data. For example, analysis can look for vibration signatures that signal bearing failures, but unless the monitoring system can distinguish between

about the author

Larry Adams is a freelance writer who has written extensively about manufacturing. Contact him at AdamsEditorialServices@gmail.com.
signatures that spell damage and those that don’t, the system can report false positives.

“An AI-based monitoring solution can use a baseline assessment of a spindle to determine when performance is heading toward a critically impaired state,” he said. “This can reduce downtime and the production of out-of-tolerance parts.”

Parameters, such as critical speeds and changing spindle position, also can be tracked continuously. Vibration analysis gives insight about wear on bearings and shafts by comparing previous vibration patterns.

Temperature is an important parameter too. Rafael Linan, field service manager for United Grinding North America Inc., Miamisburg, Ohio, said thermistors can track the temperature of key components.

“Electrical components in cabinets should remain under 55° C (131° F),” he said. “If a $10 fan isn’t working, a capacitor can overheat, and the controller can burn out. And the CNC costs $15,000 to replace.”

Knowing the critical parameter or combination of parameters is paramount to utilizing predictive maintenance. New ways to continuously improve production might be developed if the right combination of information is conceived.

“The importance of proper maintenance cycles has always existed and is an area of continuous improvement for most companies,” said Alan Hallmann, North American sales manager for MC Machinery Systems Inc., Elk Grove Village, Illinois. “With an ever-growing amount of automation being used in industry to offset labor costs or labor availability, these machines can run more efficiently and around the clock.”

This requires more maintenance intervals.

With “the implementation of machine monitoring and software packages to organize the data for efficiency — i.e., Industry 4.0 or smart manufacturing — we can now obtain a more predictive approach to when maintenance is scheduled,” Hallmann said. “This increases the need for maintenance and further showcases its importance.”

At United Grinding North America, Linan said, “We are working on something that we call digital solutions in which we compare a machine’s hours to the amount of time each component should last, and then we have a system that tracks the productivity and life expectancy. Based on parameters, we are able to advise the customer to repair an item or look at certain components.”

Implementation Challenges

Many equipment types can capture data, and nearly all manufacturing facilities feature a mix of machinery — much of which “speaks” its own language. Other equipment utilizes communication protocols like MTConnect or
Daily CNC Machine Maintenance

These are the “apples a day” that keep CNC machine tools out of the machine emergency room. They sound simple because they are. Conducting a few minor checks at the end of each day or shift can help catch a problem before it snowballs into a major breakdown.

Check fluids. CNC machines require adequate fluid levels, such as lube and hydraulic fluid. Working daily with machines gives a good baseline for how quickly fluids need to be replenished. When machines start using fluid at a higher rate, have them checked. Excessive fluid use can be a sign of problems.

Give grease. It is the smooth operator that keeps all working parts moving and grooving. Not all machine shops check grease points each day, but shops should look at all moving parts for dry spots. A quick shot of grease goes a long way toward reducing unwanted wear.

Renew with a rag. Wipe down all surfaces to show a little shine by removing shop grime. Daily wiping of a machine also keeps small metal shavings from building up in damage-prone areas, such as way cover seals.

— Absolute Machine Tools
Open Platform Communications. “There are hundreds of different makes and models (of equipment), a range of legacies new to old, and they all speak different languages with different protocols,” Immerman said. “And the data on the different machines especially is written in different languages. So even if data is collected, how would you compare the load on one machine with the load on another machine? The answer is that data needs to be transformed. MachineMetrics can collect and automatically transform all of these different protocols into a standard language of our own, and that immediately makes data (from) all different machines comparable, actionable. You can start leveraging it to make decisions.”

He said most manufacturers lack visibility about the problems on shop floors. To be visible, each process must be known and considered.

To effectively utilize predictive maintenance, a company needs to predict with certainty the appropriate data and combinations of data for a machine. Implementation starts with a solid understanding of process variables and machines and a strong dataset. However, that might be easier said than done.

Boots on the Ground

Compared with the challenges of predictive maintenance, preventive maintenance — with its regularly scheduled, in-house visits — may be a better solution. It is definitely easier to implement and less costly. Maintenance schedules can be determined based on periods of time or triggered by reaching known usage factors.

Some maintenance work necessitates tearing down and rebuilding, and some requires regimented elbow grease.

Hallmann, for instance, said, “Any piece of mechanical equipment benefits from regular cleaning and maintenance. If these items were not cleaned and maintained on a regular basis, the life cycle of the items would be shortened. In many cases, safety would be compromised by the users.”

MC Machinery Systems, which distributes a variety of equipment, including from Germany-based machine tool builder OPS-Ingersoll Funkenerosion GmbH, also offers options to service myriad machines, such as OPS-Ingersoll Funkenerosion’s sinker EDMs and high-speed machining centers.

“In a general shop environment,” Hallmann said, “many components are exposed to contamination from the shop air, nearby machinery or metal chips generated by the milling machine.”

Cleaning, he said, is important for the following areas:

- The fans and air intakes on the controller and generator cabinets, ensuring that expensive electronics do not overheat due to fan failure or airflow restrictions.
- Linear ways and ball screws, ensuring that damage does not occur due to debris.
- Way covers, ensuring proper operation of the covers to protect expensive high-accuracy guides and ball screws.
- Work tank areas because if excessive dielectric sludge exists there, it can affect the overall quality of fluid supplied to cutting zones.

**contributors**

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United Grinding North America Inc.
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When a maintenance team always can view the latest conditions of machines, unplanned downtime is reduced.
addition, abundant sludge under a work table may collide with the bottom of the table. Linan said United Grinding North America is expanding service operations for digital solutions and in-person maintenance calls. The company already offers remote monitoring solutions. Customers utilizing in-house visits can gain broader views of production environments. Lugas said when he goes to a facility, he observes everything from foundations for machines to incoming power and water. Absolute Machine Tools offers three levels of preventive maintenance programs: bronze, silver and gold.

“Don’t cut corners,” he said. “Is the machine on the right foundation? Are there variations in the power that goes into the machine or moisture in the air? Do you have a high-speed spindle that uses an air-oil mixture to keep bearings cool at those high rpms? If not, it could cause some type of failure to the spindle.”

Machine Spring Cleaning

When performing a thorough spring cleaning of milling machines:
1. Remove chips from under way covers and the ballscrew area. Conduct a full-enclosure cleaning.
2. Check that all lubricants are at normal levels and functioning properly.
3. If necessary, make fine adjustments to an automatic toolchanger so it continues to change tools without hang-ups or jams.
4. Inspect a spindle and spindle drivetrain to ensure that there are no contaminants that would affect the life of the spindle.
5. Check spindle belts for tension, oil, chips and wear to avoid unnecessary or untimely downtime and prevent compromising a part during cutting operations.
6. Perform a ball bar test to check the circularity and alignment of machine planes.

When performing a thorough spring cleaning of lathes:
1. Indicate the turret, tailstock and headstock alignment to ensure optimal accuracies and tool life.
2. Check that all lubricants are at normal levels and functioning properly.
3. If necessary, make fine adjustments to a turret to avoid issues with hang-ups, jams and indexing.
4. Check a hydraulic system for dirt and contamination.
5. Check an actuator for chip buildup.
6. Check spindle belts for tension, wear and overall condition to avoid unnecessary or untimely downtime and prevent compromising a part during cutting operations.
7. Perform a ball bar test to check the circularity and alignment of XZ planes.

For both types of machines, it is highly recommended to often check or change filters to ensure overall integrity of systems.

– Absolute Machine Tools
Creating a lean manufacturing environment at a small shop starts with recognizing sources of waste.

By Christopher Tate

By now, almost everyone in manufacturing is probably familiar with the concepts of lean manufacturing or at least the term. Lean manufacturing can be so effective that many companies employ lean leaders, process improvement teams, kaizen teams or similar groups to help facilitate lean initiatives. Part manufacturers that do not have dedicated personnel or teams frequently hire consultants to aid with developing and implementing lean concepts.

Lean manufacturing has become an accepted practice at large and midsize companies, but small manufacturers, machine shops and fabrication shops have been slow to adopt the concepts. In my experience, owners and managers at smaller shops often believe that the concepts are applicable only to larger companies or that taking advantage of lean manufacturing concepts requires hiring people with special skills.

Focus on Waste
Those who are unknowledgeable about lean manufacturing easily can become intimidated by the concepts and tools, so implementation at places where these people work might be daunting. Very simply, lean manufacturing is the identification and elimination of waste in manufacturing processes and systems. Waste can be categorized in one of seven forms: movement, inventory, motion, waiting, overproduction, over-processing and defects.

The first step of the lean journey is learning to identify waste.

Movement. Traditional production at a machine shop moves batches of parts from workstation to workstation. A shaft, for example, may move from a lathe where turning is completed to a mill where keyways and cross-holes are drilled. A leaner method is using a work cell where all the necessary machines are close to each other so the shaft can go into
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Very simply, lean manufacturing is the identification and elimination of waste in manufacturing processes and systems.

What a Waste

the mill after turning, frequently using a robot. Another alternative could involve purchasing a lathe with milling capability to end the need for a separate mill.

Inventory. Most small shops fail because of inadequate cash flow. A shop must pay rent, buy materials and make payroll while waiting for funds to arrive from customer invoices, which can strain finances, and having cash tied up in inventory only exacerbates the problem. Identify and eliminate activities that create inventory. Resist the urge to make extra parts out of those last few inches of bar. Don’t buy a 208-liter (55-gallon) drum of coolant to save a few dollars per gallon when a 19-liter (5-gallon) pail will suffice. Try to remove the inventory of cutting tools by selecting ones that effectively machine a range of materials.

Motion. This form of waste is similar to movement but related to people, not parts, in a manufacturing system. Eliminating wasted motion often results in improved workstations. Consider the prior example involving a shaft. Eradicating unnecessary motion could be as simple as placing raw materials at an ergonomic height in a cell so machinists can retrieve them without bending, stooping or reaching. A shop could put machine tools in close proximity to each other or buy specially configured ones.

Waiting. This waste occurs when a machine or person cannot proceed because the previous step is incomplete. Waiting can be difficult to overcome in the low-volume, high-mix environment found at many small shops. Constructing a shaft cell to eliminate motion in the earlier example could cause waiting if turning operations take longer than milling operations.

Overproduction. A common statement at shops is
“I made a few extra in case we scrap some.” Making more parts than required is typical at small shops and sounds good until actual costs are calculated. Overproduction also occurs when managers feel pressure to keep people and machines working despite no demand for parts or when there is a diminished backlog of work and a shop starts producing parts before they are needed.

**Over-processing.** Simply doing more than required is over-processing. One of the most common forms of over-processing at a machine shop is the quest for a superfine surface finish. Machinists are taught to strive for a good surface finish, so imparting one on a part is a way to demonstrate skill. Unfortunately, a customer who requires a 3.18 µm $R_a$ (125 µin. $R_a$) finish usually won’t pay for the extra processing needed to produce a 1.62 µm $R_a$ (64 µin. $R_a$) finish. Remember that providing high quality and craftsmanship means meeting a customer’s expectations, so a part that conforms to requests is good enough. Don’t go beyond what is obligated. This is a difficult concept to sell to skilled machinists.

**Defects.** It is easy to see why defects are wasteful. Anytime that parts have to be remade or reworked because of a defect, the costs are unrecoverable. Eliminating variation and developing robust processes are the best ways for small shops to avoid part defects. Establish effective methods for performing work, and encourage everyone at the shop to use them.

Lean concepts are not difficult to understand. They have a commonsense feel once they become routine. But creating a lean shop does not happen in a short period of time. Significant cultural change often is required, and people must alter habits and opinions that may have existed for years. Recognizing waste in manufacturing processes and systems is the first act to becoming lean — no matter the size of the company.

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**about the author**

Christopher Tate is engineering manager of advanced manufacturing engineering and machining at the Savannah, Georgia, facility of Mitsubishi Hitachi Power Systems Americas Inc., Lake Mary, Florida. Contact him at chris23tate@gmail.com.
PAIN RELIEF WHEN TRACKING DATA

When a company is part of one of the largest tool manufacturers, merely employing good technology is not enough. That is why Fair Lawn, New Jersey-based Sandvik Coromant Co. needed to more efficiently track and manage tools and streamline production at its Mebane, North Carolina, plant.

Julio Vasconcelos, engineering manager at the facility, said Sandvik Coromant, which belongs to Stockholm-based industrial engineering group Sandvik AB, emphasizes the requirement to control costs and optimize processes.

“We value digital solutions, lean manufacturing and efficiency,” he said.

The site employs 130 people in design, management, programming, engineering and production. There are approximately 20 five-axis machines, 10 lathes and two multiple-axis grinders in nearly 8,083 sq. m (87,000 sq. ft.) of manufacturing.

With tool data management software, Denny Page, machine operator at Sandvik Coromant, knows that the tool he is about to use is correct.
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   7. ❑ Purchasing;
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   9. ❑ Other (please specify)

3a. What is the primary end product manufactured (or service performed) at this location?
   331 ❑ Primary Metal Manufacturing
   332 ❑ Fabricated Metal Product Manufacturing
   333 ❑ Machinery Manufacturing
   334 ❑ Computer/Electronic Product Manufacturing
   335 ❑ Electrical Equip/Appliance & Component Manufacturing
   336 ❑ Transportation Equipment Manufacturing
   337 ❑ Furniture and Related Product Manufacturing
   339 ❑ Miscellaneous Manufacturing
   423 ❑ Wholesale/Trade/Durable Goods
   999 ❑ Other Manufacturing NEC

3b. If your company does NOT manufacture AT THIS LOCATION, specify company’s primary product or service performed. (please specify)

4. Number of employees at your company.
   A ❑ 1-9  B ❑ 10-19  C ❑ 20-49  D ❑ 50-99  E ❑ 100-249  F ❑ 250-499  G ❑ 500+

5. Which of the following market segment(s) does your company serve? (check all that apply)
   1. ❑ Aerospace
   2. ❑ Communications, Computers, Electronics
   3. ❑ Defense
   4. ❑ Energy
   5. ❑ Heavy Equipment
   6. ❑ Medical
   7. ❑ Transportation (including automotive)
   8. ❑ Other (please specify)
space. The plant produces about 3,000 tools — mostly standard rotary ones — each month and maintains data on tools that already were made and shipped. Over 2,000 primary tool assemblies, including tools, collets and holders, are used. Vasconcelos said this translates to a tremendous amount of data, and keeping track of it was increasingly a headache.

“It became clear we needed a better way of managing that growing mountain of data and controlling the tools at the machine,” he said. “Historically, each engineer had their own way of controlling the tools and evaluating and presenting the info to the operators.”

Engineers frequently had to stop to check the tool assembly in the CAM system and at the machine tool, Vasconcelos said. The tool assembly often was different than expected because someone had failed to document a change or inform a manager that a change had occurred.

“Along with downtime, which of course translates into extra cost, at a certain point we realized just how much money we were spending on lost information,” he said. “There was some information stored in process documents for particular product lines, and there was information that resided in our CAM system, and there was also some information that resided only in Excel spreadsheets. Keeping track of that information was difficult. It just wasn’t efficient. It was challenging for our people to remember where to put everything, and everybody seemed to have a little bit different take on how particular tools were used. This too was a situation that was costing us time and money.”

Leandro Pereira, automation engineer at the site, remembers the situation well.

“Perhaps most detrimental was the fact that the information wasn’t necessarily being shared among different users,” he said. “For instance, information wasn’t always adequately communicated between NC programming and the shop floor. We didn’t have a database where the native information resided, so it would get changed or cloned or mutated. People were running off of secondhand information instead of the native information.”

Change obviously was needed,
ensures that tool data is available where it is needed, when it is needed,” said Robert Auer, director of business development for North America at TDM Systems. “It links CAM systems, presetting and crib systems, as well as machine controls, but it can also extend upstream to the planning and execution level, such as PPS, ERP and MES systems.”

He said TDM Systems’ software collects data from production and makes that data available to other systems.

“Sandvik Coromant Mebane is a very well-run facility, but they still had room for improvement,” Auer said. “The difference is that Mebane was determined to do something about it. The key driver for them was that they realized they needed to become more organized in terms of their tooling information.”

Becoming organized began with defining the tools. This was no easy task for the site with its thousands of tools and tool assemblies. But if NC programmers couldn’t search the database for information about the contents of the tool crib, then they would have to go look for the tool or tools in question. The result would be lost time and increased costs.

After implementing tool data
software, the facility found that those worries were gone.

“Using TDM tool graphics and equipment production modules takes the guesswork and uncertainty out of tool creation,” Vasconcelos said. “TDM allows managing the tool data from the CAM software to simulation through to the machine and operator. We needed a simulation system that sent info into CAM and ultimately to the machine tool operator. From TDM, we export files to our simulation program. Now the programmer can trust the tools he’s using and be confident that what is passed on to the operator from simulation is correct. In addition, TDM enables the operator to confirm that the tool assembly he plans to use is the correct one.”

Other issues arise during tool selection, such as determining which tools are best suited for different process steps. The tool data software helps engineers and designers quickly answer these questions by providing basic information about tools and potential applications. Besides aiding with tool selection for each NC operation, the software stores geometry and cutting data for each tool assembly, makes 3D tool graphics available for NC programs and simulation analyses and saves tool lists from the NC programs for future use.

“Keeping track of our thousands of tools and tool components used to be a headache and consume needless people hours,” Vasconcelos said. “Now we know what we need to stock in terms of cutting tools, tool assemblies, you name it, so that’s streamlined the purchasing function. TDM has become a vital part of our successful operation and an element in our vision of the future.”

— Article by TDM Systems Inc.
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machinists can realize ease of handling and energy efficiencies when producing components for e-mobility applications with Latrobe, Pennsylvania-based Kennametal Inc.’s 3D-printed, lightweight stator bore tool. It is for machining the stator bore of hybrid and electric engine housings.

“In the housing itself, all components of the engine, such as stator, rotor and bearings, are fitted in,” said Ingo Grillenberger, technical program manager of e-mobility for Fürth, Germany-based Kennametal GmbH’s Solutions Engineering Group. “For the final performance and efficiency of the electric engine, it is very important that all these components are aligned perfectly and they are concentric.”

E-mobility components typically are machined on small, low-horsepower CNC machine tools that require lightweight cutting tools. Kennametal’s 3D-printed stator bore tool weighs about half that of the conventionally manufactured version.

machinists to maneuver the tool, and the resulting lower moment of inertia reduces not only wear on machine components but energy consumption.

“It has advantages because it’s lighter,” Grillenberger said.

Although Kennametal developed the tool to machine stator bores, alternative applications are conceivable wherever there are big bores and large depths, such as the bores in transmission cases.

“The main bore that houses the stator of an electric motor measures approximately 250 mm (9.84”) in diameter and approximately 400 mm (15.74”) in length with a smaller bearing bore at the bottom,” explained Harald Brutetting, manager of program engineering at Kennametal. “When manufactured using conventional means, a reamer for this type of application would weigh more than 25 kg (55 lbs.), far too heavy for the existing machine tool or for an operator working with the tool.”

Brutetting and Kennametal’s Solutions Engineering Group turned to the company’s in-house additive manufacturing capabilities to print a strong yet lightweight indexable-insert tool equipped with Kennametal technologies, such as fine-adjustable RIQ reaming inserts for precise finishing and the KM4X adapter for enhanced rigidity. The tool also features 3D-printed coolant channels, which help boost productivity and extend tool life.

“By using metal powder bed 3D printing together with finite element analysis software, we were able to design and build a tool that brought the tilting moment very close to the spindle face, increasing its rigidity while meeting the customer’s weight restrictions,” said Werner Penkert, manager of Kennametal’s Future Solutions.

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