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SEPTEMBER 2019

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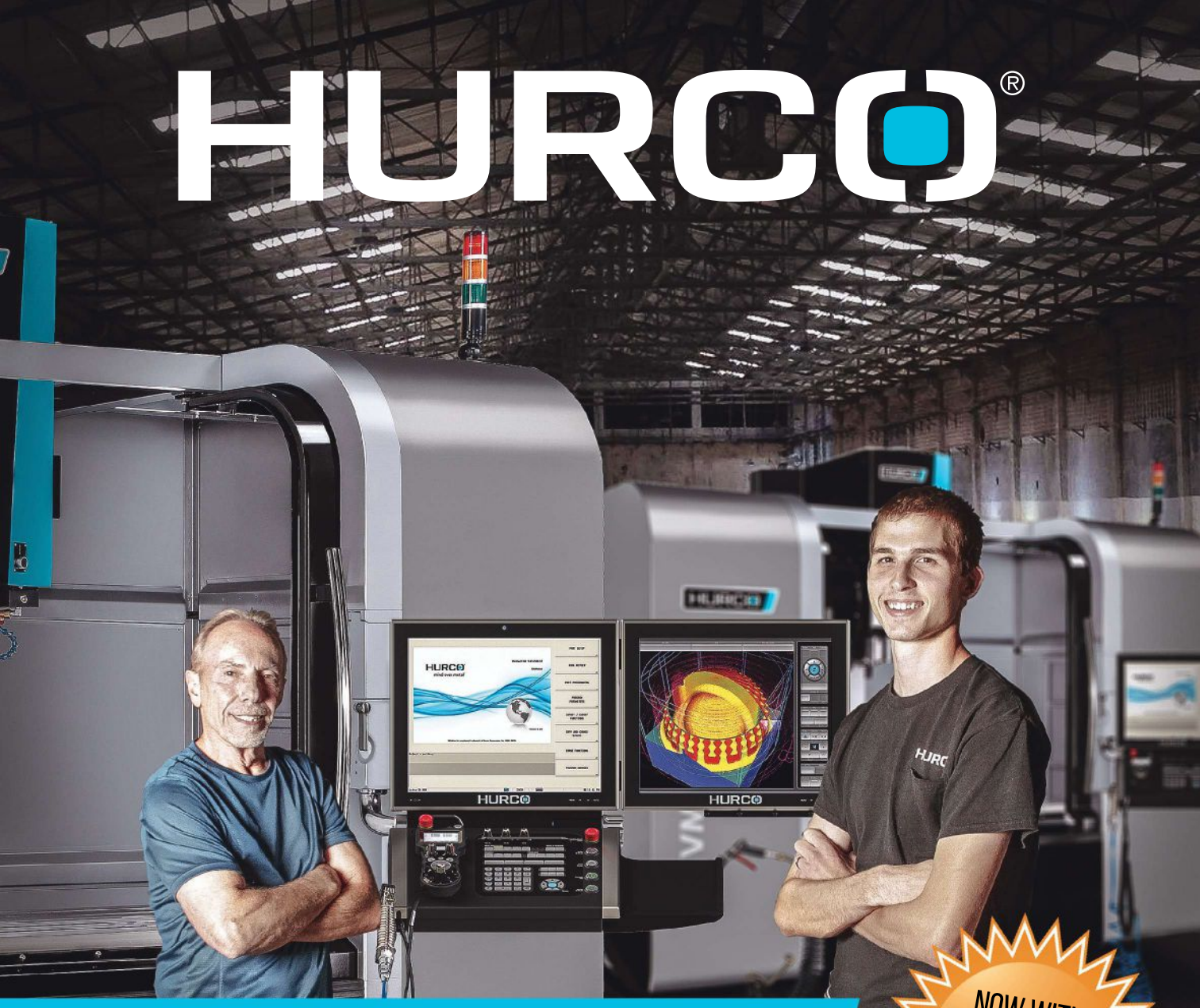


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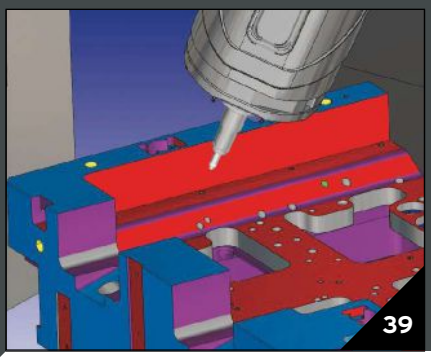



## Features



## Departments



**ON THE COVER**

Cover photo courtesy of Scholle IPN. This month's cover shows Scholle IPN's first product category test mold that was manufactured to incorporate Industry 4.0 technology. With that Industry 4.0 objective in mind, the team at Scholle IPN set out on its journey to take its tooling to the next level: Tooling 4.0. In the future state, OEMs will require their molds to be "engineered" with outputs that can communicate with the molding machine and robotic systems, via data, to assure a quality product, right out of the mold. See related feature on **page 14**.

Images courtesy of (left to right) GF Machining Solutions, Bohler and Open Mind Technologies USA.

VIDEO ACCESS

5 TRICKS OF THE TRADE

## Great Tips from This Issue

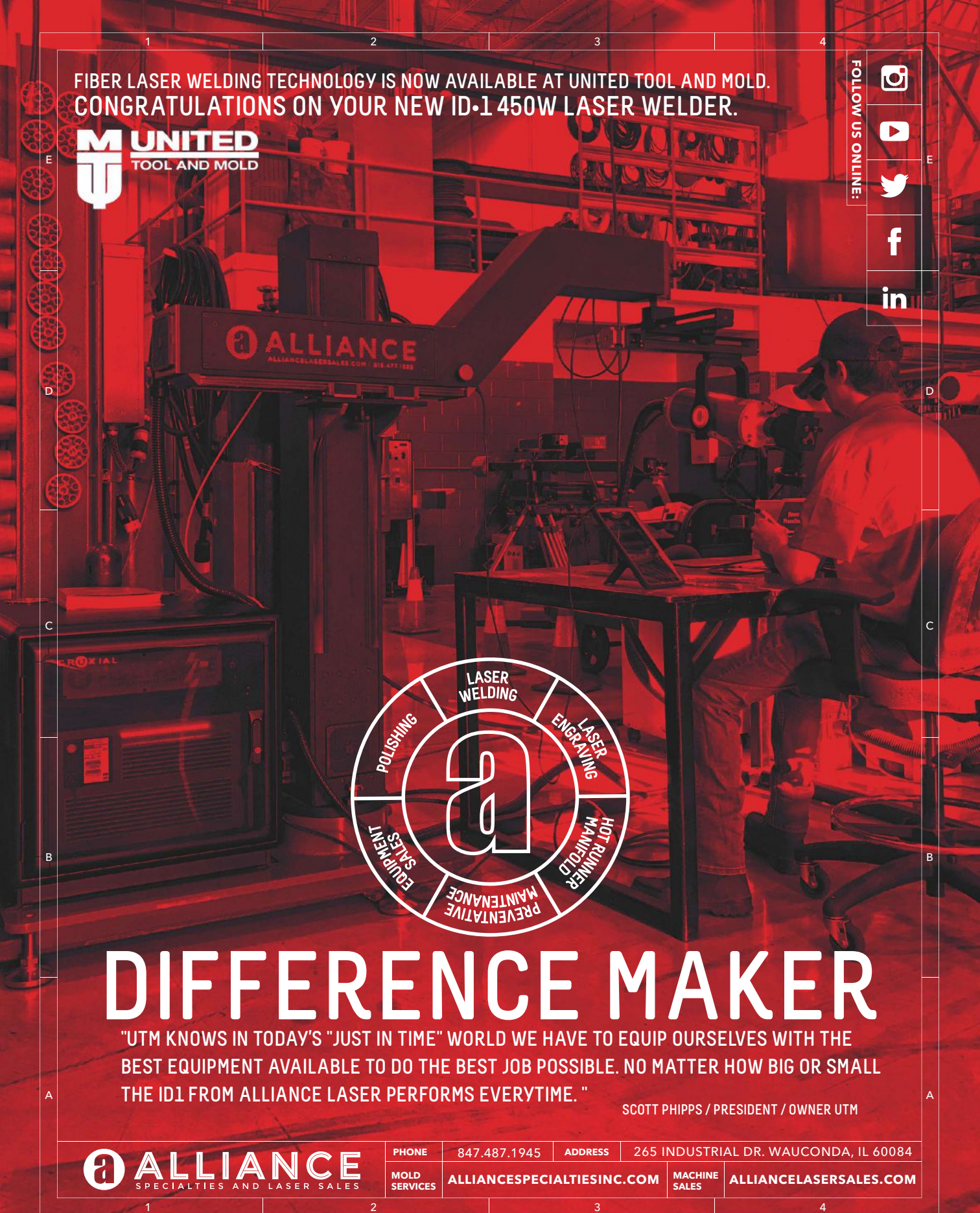
**1. Get to the Next Level**
In the Industry 4.0 era, engineered molds with digital outputs will be the norm and the mold supplier committed to "engineered" molds is the mold builder of the future.
**PG. 14.**

**2. Slug it Out**
Automatic slug management is a slower process than its manual counterpart, but it requires no human intervention.
**PG. 26.**

**3. Cracking Up**
To avoid material cracks, consider heat treatment and potential risks by providing large radii for critical areas, design the part "heat-treatment-appropriate" and machine the final contour after heat treatment.
**PG. 31.**

**4. Get Automatic**
Automatic indexing controls the movements of the axes to make a more efficient toolpath. It lets the cutter do its work without moving the machine all around.
**PG. 39.**

**5. High Stakes**
High-feed milling (HFM) tools work at elevated feed rates with modest speed or RPM, which reduces cycle time while extending tool life.
**PG. 56.**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# Back to School Tools

No matter how old I get, the month of September still reminds me of school days. And although I can still feel the dread of those last few days of summer freedom before heading back into the classroom years ago, I experience more of an optimistic feeling today, as my son gets ready for school and kids walk past my house on their way to the bus stop.

I feel hopeful and a little excited about the year of learning ahead for these kids, which reminds me that our job, as individuals working within the manufacturing community, is to help with that learning.

What I mean by that, is offering our time to help educate the next generation of workers about the career opportunities available in manufacturing. So many kids today *still* don't know what manufacturing is, so getting their attention as early as possible is critical.

If you haven't already, volunteer to organize or participate in a career day at your local elementary, middle or high school throughout the school year. If you are worried about what to do or say, *MoldMaking Technology* has a couple of tools to help you get your point across while promoting mold manufacturing. A few years ago, we partnered with the American Mold Builders Association, Society of Plastics Engineers Mold Technologies Division, the PLASTICS Association, Creative Technology, and NyproMold to produce video recruitment tools that quickly take the viewer through the various jobs and process steps involved in building a mold, and subsequently, the end product. These videos still stand today.

You can help spread the word by sharing these video resources with your local community, high school parents, educators and industry to grow and train the next-generation workforce while driving interest and awareness in manufacturing.

Go to youtube.com/c/moldmakingtechnology and click on the *Manufacturing Education Series* video playlist, particularly *MoldMaking Matters: Your Career Can Make a Difference* and *MoldMaking: Your Road to Success*.

On top of all this, next month on Friday, October 4th, the nation celebrates Manufacturing Day. Industry dedicates this day to showing the reality of modern manufacturing careers by encouraging companies and educational institutions around the nation to open their doors to students, parents, teachers and community leaders via a shop tour, school event about manufacturing, manufacturing-related job fair or career day event. Visit mfgday.com for more tools and ways to get involved.

Both of these suggestions are perfect opportunities to energize your local community about manufacturing. Get vocal and act local! MMT

Christina Fuges

Christina M. Fuges
Editorial Director

Follow MMT on: Follow @MMT_ChristinaF

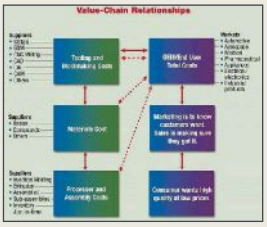
## THIS MONTH ON moldmakingtechnology.com

**VIDEO: A 'Quality Without Compromise' Mindset and A Diverse Customer Base Give Delta Mold More Peaks Than Valleys in Business**
Quality-driven processes and focus on diversity in the markets served are key to Delta Mold's continued success.
short.moldmakingtechnology.com/dmprofile

**PODCAST: *MMT* Editorial Team Wraps Up Amerimold 2019**


On this episode of The Manufacturing Alliance Podcast, the editors of *MoldMaking Technology* re-cap Amerimold 2019 and give a sneak peek at next year's event.
short.moldmakingtechnology.com/ame19recap

**BLOG: Keeping Up With ISO**




Everyone speaks the language of money, so it makes sense that the success of an ISO 9001 implementation would require a financial measurement of quality.
short.moldmakingtechnology.com/ISOkeepup

**WEBINAR: Networked production—Hype or Necessity?**



Michael Thiessen of Tebis America talks about the importance of optimization, being digitally connected and controlling the process of your manufacturing chain.
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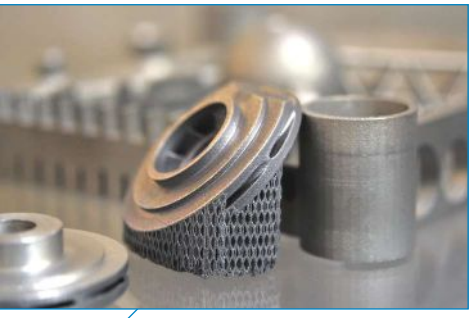
# **Additive Manufacturing** Has Found A Home in Moldmaking

By Andrew Garstkiewicz

Additive manufacturing (AM), or 3D printing, in moldmaking and molding will continue to progress as more players in the industry see results from the early adopters and gain more confidence to add it to their business strategy. Early adopters have already done groundbreaking work, driving additive material vendors to develop more and different additive material to expand uses, as well as driving the additive machine makers to listen to feedback on what has worked, what has not and what is needed to progress further. On the molding shop floor, early adopters have deduced what is required to maintain and keep additive inserts working as they were designed to do.

Conformal cooling arises quickly in conversation with molders and moldmakers when additive manufacturing is mentioned. Companies that specialize in additive-created conformal cooled inserts work with OEMs and moldmakers and can run simulation to show the before and after effects of using a conformal insert. Accuracy is paramount in these analyses and has a direct bearing on ensuring heat removal to properly address pressure drops and Reynolds numbers. It is possible to design an insert that would not be useful due to a large pressure drop that minimizes turbulent flow to remove the heat.



Andrew Garstkiewicz, senior AME for GE Appliances, a Haier company, and *MMT* Editorial Advisory Board member, believes moldmakers and molders will continue to benefit from 3D printing, especially for conformal cooling applications, thanks to the strides made by early adopters of the technology.

Hybrid designs are now being seen where the base of the cooling insert is manufactured with traditional subtractive methods, and then the complex conformal areas are added on top of the base piece. This approach can allow for more acceptable pressure drops, while still providing the benefits of very localized heat removal. It can also lower costs and lead times for producing the entire insert.

In conclusion, AM in molding and moldmaking has found a home, but not all the rooms are occupied. There are many companies that have already been successful at implementing this strategy to help with productivity and costs, and there will be many more that jump on the bandwagon. It will take more time, with more case studies and some pitfall analyses to further prove out its value, but this technology is here to stay, at least until the next great advantage comes to the industry. MMT

**FOR MORE INFORMATION**

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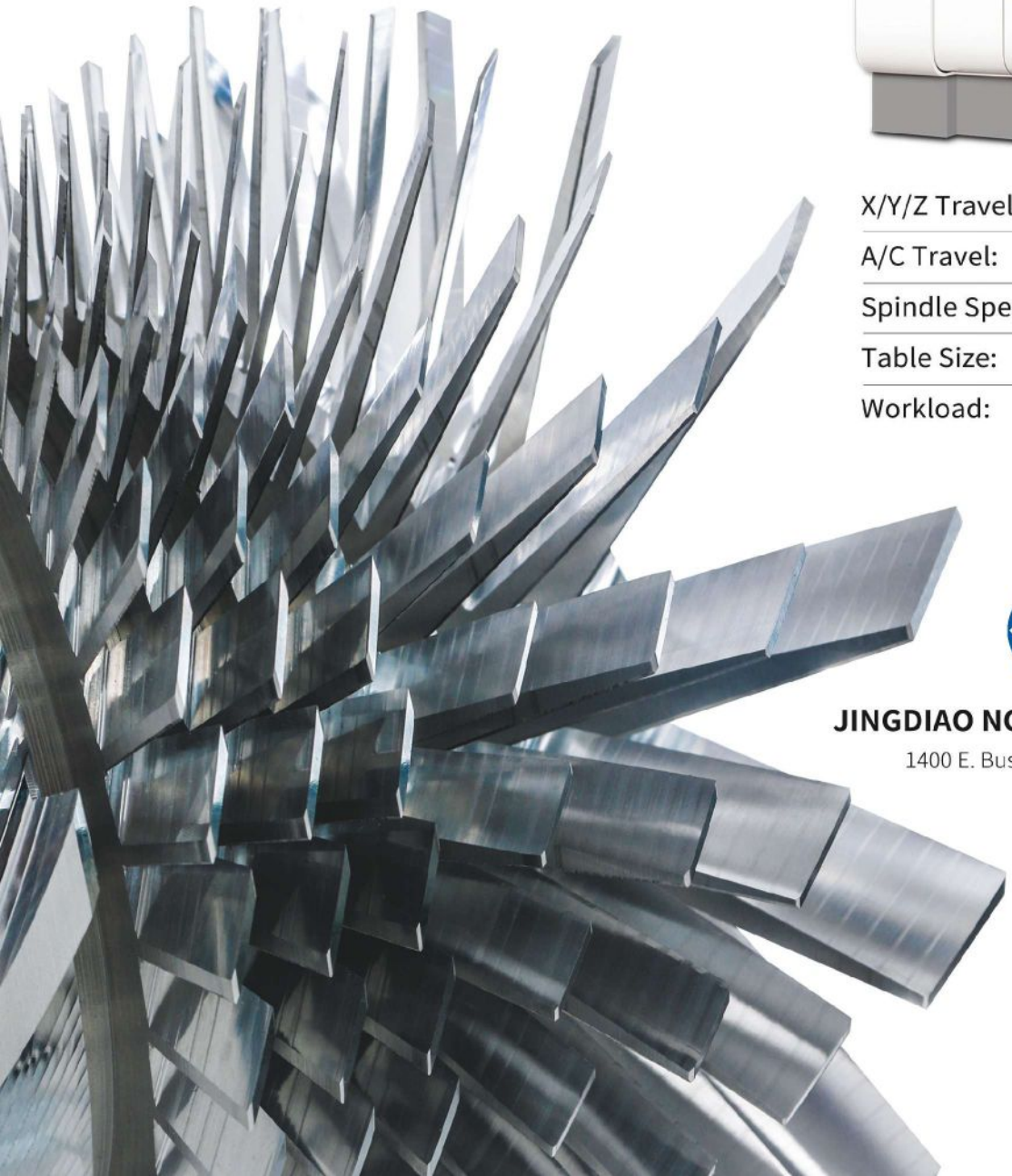

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VIDEO Access the related video under the Videos tab at *MMT* online.

## A Conversation with ...

# Del-Tool Co. Inc.

**What is your company's chief competitive advantage?**

**Doug Brinker, president:** Our company's five-axis capabilities and use of automation. Also, we are a very custom shop, and most of our employees in each department are moldmakers, which is an advantage for the customer because our people know all the aspects of moldmaking. They know what they are doing and why they are doing it. For example, our EDM operator and our electrode designer/machinist are both moldmakers, and they understand shutoffs. They know how to adjust the burns they are making so when it's a shutoff, it has steel there for properly shutting off. Those are the kinds of little things that are hard to teach if you haven't actually built a mold. Their experienced eyes see problems before it is too late, often as early as the design stage, but also as they are working on the mold in the shop, which is so much better than finding out after the mold has been assembled and shipped. Some customers ask us what needs to be done in order to make a part more manufacturable. While we do not offer full product design, our team can assist with refining their part models to ensure good shut-offs and properly positioned draft angles and so on. This kind of contribution to a project is what ultimately affects our ability to perform the five-axis machining, not to mention other processes like carbon cutting, and using automation effectively.

**How is your company using automation to advance your operations?**

**Brinker:** We are using automation very successfully within our sinker EDM and CNC carbon cutting departments. We currently have four Mitsubishi sinker EDM machines, two of which are integrated with a System 3R WorkPartner robot,


Images courtesy of Del-Tool Co. Inc.

Del-Tool uses automation to run its EDM operations 24/7. Here, a System 3R robot is networked with one of two Mitsubishi sinker EDMs. The complete cell features an 80-position electrode carousel and 10-position pallet system.

**Del-Tool Co. Inc.**
**640 Commerce Ave.**
**Baraboo, Wisconsin**
**608-356-7726**
**del-tool.com**

- Founded in 1967 by Joseph Ward in Wisconsin Dells, Wisconsin. Doug Brinker joined the Del-Tool team in 1985, and in 1987, Doug's father, Dale, became a partner. Later in 1993, Dale's son Kirk joined the company. After Ward retired in 1996, followed by Dale Brinker in 2003, Doug and Kirk Brinker have taken the reins.
- Specialize in engineering and building from one cavity up to 16-cavity custom thermoplastic injection molds and thermoset molds ranging from small unit dies to larger tooling.
- On average, the company builds about 75 molds per year.
- Currently employs 25 team members, including one apprentice.
- Industries served include medical, automotive interior and components, automotive lighting (for motorcycles, DOT and other recreational vehicles), consumer products, food, plumbing and electronics.

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This DMG MORI DMU 100P five-Axis universal machining center is one of two that gives Del-Tool its added efficiencies and precision when the job can benefit by five-sided, complex machining in one setup. The company says its goal is to ensure that jobs are designed to be machined as much as possible, reducing the need for EDM.



an 80-position electrode carousel and 10-position pallet storage system. We can run workpieces large and small in this cell and we operate it 24/7.

In our carbon cutting area, we have three high-speed machining centers: a Röders RFM 600, Röders RXP 500 (each with a 42,000-rpm spindle) and a Makino S56, which has a 20,000-rpm spindle. These three machines are set up with a centrally located System 3R WorkMaster robot that changes out electrodes, work pallets and cutting tools. This work cell also runs 24/7 and, combined with the EDM automated work cell, reduces our lead times and costs, which also benefits our customers.

**Let's talk five-axis machining. In what way has that been an advantage for your company?**

**Brinker:** In addition to several high-speed, three-axis vertical and horizontal machining centers, Del-Tool has two DMG DMU 100P five-axis universal machining centers equipped with X, Y, Z footprints of 40 by 40 by 40 inches and 18,000 rpm spindles. Five-axis capability gives us the advantage to machine on five sides of a component in one setup, which saves time and increases accuracy. Our goal for every job, for example when performing such operations as machining tall coring, deep cavities and parting lines, is to ensure that we can design it to be machined as much as possible and reduce the need for EDM.

Scheduling is a critical part of the scenario as well. We use Shoptech-E2, a web-based enterprise resource planning (ERP) system that helps us manage quoting, scheduling, purchasing, shipping and invoicing. But it is the scheduling that's key, not only to see where you are at with jobs but to be able to manage workflow more efficiently by knowing which jobs need to be done during working hours and which can be set up for running unat-

tended. We've been focusing on scheduling and automation so that we can get more work done with fewer people. We are also cross training our team so that as workflow moves through different areas of the shop, our employees can help manage any bottlenecks.

### In what other ways does Del-Tool ensure the satisfaction of its customers?

**Brinker:** I think it's the service after the sale, so to speak, and doing whatever we can to work on the molds as efficiently as possible. We have trucks here that are out on the roads every day to try to save days on different types of deliveries. Whether it's a repair or revision, or a new tool, all those days add up. If you're just shipping U.P.S. or common carrier, you lose at least a day on each end of that shipment for services on the outside, so we do what we can to save time and deliver the completed mold on schedule, ready for production.

> But it is the scheduling that's key, not only to see where you are at with jobs but to be able to manage workflow more efficiently.

We have one shift, but it starts at three or four in the morning and goes until five or six at night because some employees like to start early. I like having our employees' hours staggered throughout the morning and into the evening. It's like having two overlapping shifts, plus we run our machines unattended every night. It enables us to get more work completed faster this way.

### How does your shop deal with the ups and downs of the automotive market?

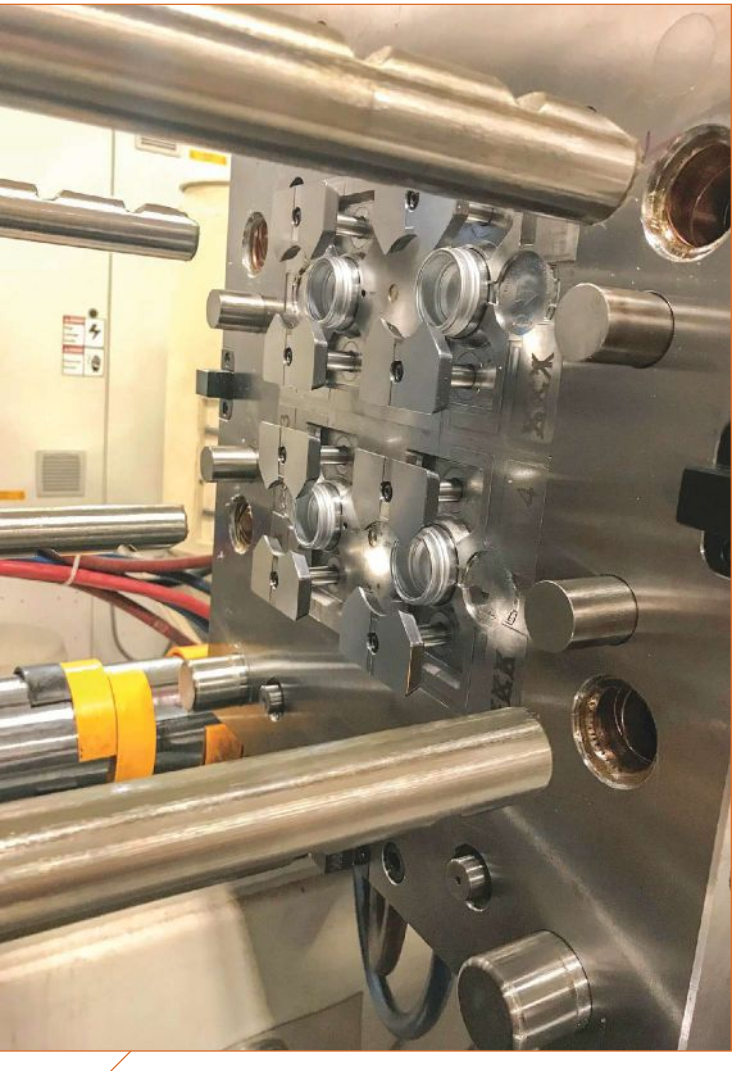
**Brinker:** The automotive market is not a majority of our customer base, but when there is a slowdown in that particular industry, we will take on some custom machining projects and job shop type work to fill in the work schedules. Also, we can give our customers an advantage by reducing costs and/or lead times when we have less of a backlog of work. The flow of mold repair and revision work is generally pretty steady, so we are able to react to customers' needs in this area a little more quickly than when operating at a higher, new-tooling capacity. MMT

By Don Smith

VIDEO Access the related video under the Videos tab at *MMT* online.

# Tooling 4.0: Don't Just Design a Mold, Engineer It

A packaging supplier applies Industry 4.0 technology to its injection molds so that components talk to each another to understand the dynamics of what is happening inside the mold.



Images courtesy of Scholle IPN.

This test mold was designed and built to capture outputs to help improve production mold design. This is called mold engineering.

In the words of Henry Ford: "If you always do what you always did, you'll always get what you always got." A statement to consider as we move forward into the future of manufacturing.

Manufacturing has become increasingly more organized, custom-made, cellular and automated over the years, but as digitization becomes the new standard, competitive pressure among manufacturers will intensify, and only the innovative will advance. Digitization requires new technology ready for Industry 4.0. Every shop has heard this buzzword, but does every shop truly understand its impact? To unravel the mystery of Industry 4.0, mold builders need to understand how industry reached 4.0 and what Industry 4.0 means to the OEM, injection molder and toolmaker.

For many plastic processors and moldmakers, robotics and automation are only the first things that come to mind when thinking Industry 4.0 integration. It is when you start thinking of machine-to-machine connectivity, data gathering, measurable outputs and artificial intelligence that you are looking at connecting 4.0 (IoT) technology into your tooling and molding process.

The first step to applying Industry 4.0 is ensuring that every employee understands that it will help resources better comprehend and measure the dynamics that are taking place between the press, mold, and resin. Industry 4.0 is not intended to replace people, but rather, to assist people in making educated decisions by using the data that is generated. Having people understand this principle is key to a successful implementation of Industry 4.0.

## Next-Level Tooling

So, what does this mean to today's mold builder? Well, a mold builder's primary goal is to provide the customer with the utmost quality, which demands the use of the latest technology, such as Industry 4.0. One such OEM looking toward the future by using Industry 4.0 is the mold manufacturing team at Scholle IPN.


**The first step to applying Industry 4.0 is to ensure that every employee understands that it will help resources better comprehend and measure the dynamics that are taking place between the press, mold, and resin. For example, this output is for production overall equipment effectiveness (OEE).**

Scholle IPN is a global packaging company that manufactures flexible packaging materials for a variety of industries. You may not have heard of us, but we guarantee you've interacted with our products that are used around the world in dispensing everything from soda, smoothies and coffee to motor oil and insecticides used in industrial farming. We engineer flexible packaging solutions that are safe, natural, economic and sustainable for 22 different markets. Our products are made around the globe—not so we can produce cheaper elsewhere but to effectively serve and produce right in the markets where we operate. Our molds use a variety of hot runner systems that are generally gated directly to the part, in high cavitation molds (16 cavities or higher). So, as we move towards the future and create new products or re-tool our core products, we need to look at the most technically advanced tooling available. With that objective in mind, the team at Scholle IPN set out on its Industry 4.0 journey to take its tooling to the next level: Tooling 4.0.

### Scientific Method Defined

- Make an Observation. (You can't study what you don't know is there.)
- Ask a Question. (How can we reduce Cycle Time?)
- Do Background Research. (Virtual Molding Simulation)
- Form a Hypothesis. (Describe what needs to be done in the Mold or to the Process?)
- Conduct an Experiment. (DOE)
- Analyze Results and Draw a Conclusion. (DOE Mini-Tab conclusion)
- Report Your Results.

**The Plan to Tooling 4.0**

The Scholle IPN North American Tooling Team started the process by creating a tooling assessment form to measure where the company was at this specific moment in time.

The team created the form to analyze the condition of all molds, mold preventive maintenance, mold engineering data, spare part inventory, mold conversions, mold AMs (or daily shift preventive maintenance), toolroom skills and tool room

Scholle IPN Senior Tooling Engineer Don Smith explains what happens during a design review to *MoldMaking Technology*'s Editorial Director Christina Fuges and Senior Editor Cyndi Kustush.

equipment. The team then drilled down deeper into each area to find measurable data. Within these categories, we compiled data from the production floor.

For example, in the mold condition category, we measured data that would help assess the overall status of each plant's fleet of molds. The data we captured included the cause of mold stoppages, any molding heldware (nonconforming product) and targeted cycle times, to name a few. Once each plant completed this step, in each category they established a series of prioritized goals. These goals would then drive the plant's continuous improvement tooling projects, such as collecting data to ensure that the Standard Operating Conditions (SOC) were updated to reflect the current molding conditions that produced in-tolerance parts. Each plant will work on its prioritized issues for six months to a year and then re-assesses the current state.

It was then time to develop the plan to take tooling to the next level by using scientific molding and data gathering, which demanded the right tool, process and measurable outputs. The purpose of this next step is to learn what is going on inside of the mold during each cycle by taking measurements of the physical dynamics. Items to measure include pressure, temperature, and time, for example. So, instead of flying by the seat of our pants, we can now fly by instruments and actually understand what is happening inside of the mold and then make any necessary adjustments.

Some steps the Scholle IPN team included in the plan were:

- Meet cycle time requirements with new mold components

by using additive manufacturing, better venting or monitoring with pressure sensors to provide feedback through the mold, into the press, then onto the production environment.

- Test mold designs virtually with software to get feedback and to set baselines for cycle time.
- Test a mold with software and sensors to see where the team needs to optimize for cooling, pressure, pack, balance, etc.
- Qualify a mold using a scientific method (**see sidebar on pg. 15**) to create a Design of Experiments (DOE; **see sidebar**) to generate the process window and to set sensors minimum/maximum levels.
- Use high-speed electric molding machines that feedback information via pressure and temperature sensors and relay information back to the system, keeping the mold in control and achieving lights-out manufacturing.

Next, the team reviewed the fleet of molds in its Northlake plant location and chose a project based on historical downtime issues: two identical molds experiencing short shots and imbalance issues. The primary objective was to learn about the pressure dynamics that were occurring between the molding machine and the mold.

The team designed this project to run in two phases. During Phase One, the team ensures that the hot runner system is not losing any heat due to long drops required by the mold design (moving or floating components in the "A" half are triggering the long drop lengths). The team determined that full heat containment is required on these molds before moving to Phase Two.

During Phase Two, the team installs RJG pressure sensors into the molds and molding machines, runs a DOE to set the high and low limits for the system to measure and re-programs the robotic removal system to determine whether to accept individual parts or to send an individual part to the scrap bin.

## DOE Concepts Defined

Using scientific molding's Design of Experiments (DOE) approach allows the molder to find the ideal process window and to see the result of having and maintaining that process window. The mathematical accuracy with which DOE displays the relationships between values and ideal outcomes is fundamental to scientific molding and to the OEM and end user's goals for injection molding projects.

**Performance**—The DOE process reveals product and process design sensitivities and potential changes. As a result, the team can make adjustments to input values or other standards. From a process standpoint, DOE evaluates areas like materials and injection molding settings (injection speed, melt temperature, cooling time) and raises questions about their influence on design and fulfillment of project specs.

**Production Efficiency**—DOE ultimately ensures that poor design is averted before manufacture by verifying the process outcome. It also provides a solution for faulty designs that reached the injection molding manufacturing stage, as testing can reveal which changes can be made in manufacturing to accurately and confidently correct missteps. This allows manufacturers to optimize their time and resources at every production step.

**Reliability**—DOE is versatile and can be applied to gather data about an injection-molded product's ability to withstand any number of environmental conditions like temperature, aging, wear, noise and voltage. Data knowledge at this granular level reveals design flaws and potential failure risks, providing ample time for modifications that translate to better, more reliable products that meet or exceed end-user expectations.

DOE is an imperative for scientific molding and a mathematically precise way to ensure best outcomes of complex injection molding projects for OEMs, manufacturers and end users.

The team installs RJG pressure sensors into the molds and molding machines, which will provide the data that determines if the parts are acceptable, based upon the DOE (design of experiments).

Now that these 4.0 components are "talking" to one another, a non-filled part will then be placed *directly* into the reject bin. This is Scholle IPN's first continuous improvement project on injection molds using Industry 4.0 technology: Tooling 4.0.

### Mold Builder of the Future

To apply Tooling 4.0 to future projects, Scholle IPN made its team and several quality tool builders' as strategic partners. Scholle IPN looked, and continues to look for, forward-thinking mold manufacturers possessing all tools in the toolbox but will not exclude shops without all the tools, as long as they are interested and willing to take the next steps with them.

A top skill set Scholle IPN was looking to implement with its mold-building strategic partner was **engineering** injection molds instead of **designing** injection molds. Engineering, by definition, is the application of mathematics, as well as scientific, economic, social and practical knowledge to invent, innovate, design, build, maintain, research and improve structures, machines, tools, systems, components, materials, processes, solutions and organizations. Design is the intentional

### Injection Mold Testing Capabilities Defined

FOT (First Off Tool): Mold functionality test.
- The mold must meet general expectations, and a molding process is established.
- Steel adjustments are made after the FOT test is completed.
- Control plans are established.

FAT (Factory Acceptance Test): The established process is used to optimize the baseline process.
- Both dimensional and functional tests are performed.
- Once approved dimensionally, the mold can be sent to the molding site.

SAT (Site Acceptance Test): The established process from the FAT is then repeated at the molding site.
- The DOE process takes place at the site.
- Both dimensional and functional tests are repeated.
- Any other part or assembly tests are in final testing.
- Final control plans are established.
- Upon approval, this moves to commercialization.

creation of a plan or specification for the construction of an object or system for the implementation of an activity or process.

Engineering a product (in this case, the injection mold) means to achieve measurable outputs via mathematics and science. Outputs include balancing runner systems (Beaumont theory), mold temperature control (calculate GPM; temperature sensors), conformal cooling (estimated cycle time and part quality targets) and calculations for optimized venting (pressure sensors). In the Industry 4.0 era, engineered molds with digital outputs will be the norm and the mold supplier committed to "engineered" molds is the mold builder of the future.

Here are some expectations that OEM/suppliers might place upon the mold builder of the future to take full advantage of advancing technology.

In the Industry 4.0 era, engineered molds with digital outputs will be the norm, and the mold supplier committed to "engineered" molds is the mold builder of the future.

- **Reverse engineering.** Ability to take older molds and mold components and accurately measure and create, as built, 3D models and prints.
- **Virtual mold analysis.** Ability to digitally create a molding process with measurable targets before engineering the injection mold, establish measurable cycle times (fill, pack, cooling, pressures), determine warp, venting, part sizes and steel safe areas, and use pressure and temperature sensors, as well as other scientific molding information, and possess end of arm tooling and robotic part removal knowledge.
- **Mold engineering capabilities.** Ability to output 3D mold models for virtual analysis, as well as fully detailed/toleranced drawings (.dwg output) and possess a detailed mold assembly manual with PM recommendations.
- **Hot runner system knowledge.** Understanding of fixed tip, valve gate, hot edge gates and system balancing.
- **Manufacturing/measurement of interchangeable mold components**. Ability to manufacture and guarantee interchangeable mold components,


This phase one production mold was a result of Scholle IPN's first continuous improvement project on an injection mold using Industry 4.0 technology or Tooling 4.0.

confirm/certify critical steel measurements, coordinate measuring machine and laser scanning capabilities.

- **Experience building high cavitation, injection molds.** Injection mold experience with 16-cavities and higher; pilot mold capabilities for data gathering (using mold analysis) and scientific molding experience (pressure, temperature sensors).
- **Injection mold testing capabilities.** FOT, FAT, SAT (**see sidebar**) and DOE experience, process development and turnkey capabilities.

As the prevalence of IoT increases, experts advise that the adoption of Industry 4.0 is necessary for business survival. However, moving an organization toward smart manufacturing is a multi-faceted project, regardless of company size. Simply put, Industry 4.0 and Tooling 4.0 are all about using technology to turn "dumb" products into "smart" ones. MMT

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By Scott Paul

# A SMART REVOLUTION

As the Internet of Things and 5G enable the creation of smart factories, manufacturers must prepare for the benefits and inherent risks.


Smart manufacturing is not science fiction; there are plenty of steps along the production process manufacturers can streamline, and it only follows that the manufacturing sector is an obvious place for such technology to take hold.

Smart technology is all around us today, including smartphones, smart thermostats, smart stereo speakers and smart parking meters. From our appliances to our shared infrastructure, the systems and materials we interact with daily are only getting smarter.

But "smart" isn't just a buzz word; it's a legitimately big deal. Labeling something smart, in the broadest definition, means a product or system adapts to its user to make the experience of its use *easier*. A smart parking lot can broadcast how much capacity it has available and guide a motorist to an open space. A smart thermometer can cool your house by turning on the air conditioning on a hot night, 30 minutes before you arrive.

These examples are made possible by the burgeoning Internet of things (IoT), which is the extension of internet connectivity to everyday devices, and the advent of fifth-generation cellular network technology (better known as 5G) that makes data transfer almost instantaneous.

That hyperconnectivity and blazing speed are now leading to the rise of the smart factory.

## Smart Manufacturing

Smart manufacturing is not science fiction; there are plenty of steps along the production process manufacturers can streamline, and it only follows that the manufacturing sector is an obvious place for such technology to take hold. Nor is smart manufacturing simply automation by another name; not that that kind of improved productivity is a true threat to manufacturing employment anyway. Instead, it's potentially the next big thing.

Think about it—by weaving together the chains of production instead of simply linking them, manufacturers will be able to create more responsive and *specific* products. What's more, they'll be able to do so reliably.

For example, consider the ability to integrate decisions made on a shop floor into product design in real time or being able to reroute inventory directly to customers to match changes in demand. This kind of flexibility will prove extraordinarily helpful to businesses, and it will make the manufacturing process exponentially more efficient.

In a nutshell, that explosion of *interaction* (IoT) and *efficiency* (5G) is a smart factory. It is in our near future, and American manufacturers are preparing for it, but this also includes preparing for the inherent risks.

## Smart Risks

Some risks are obvious. For example, how do we make a wholly integrated IoT secure?

Cybersecurity has become a daily part of our increasingly online lives, and it's no different for manufacturers. Businesses must constantly protect themselves against attempts at intellectual property theft, sabotage and even data corruption because of the exposure that our shared online space brings.

Other risks double as challenges, like how best to ensure this technology advent we're witnessing can still be used by

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small- and mid-size manufacturing companies that *don't* have internal R&D, or access to large amounts of capital. Their participation is important to maintain. Apple was famously founded in a garage, after all. So how should we guarantee this potential industrial revolution has a low barrier to entry requirement for a strong culture of ground-up innovation?

The answer to both of these problems is the same. You lay the ground rules for the rollout and implementation of this technology, and you set the parameters for its use. Some market forecasts predict $1 trillion in added value generated from smart manufacturing processes by 2025. If that's the case, our government should establish the norms of behavior, so smart manufacturers can focus on meeting that economic potential.

The United States should create a manufacturing policy so American manufacturers can thrive in its framework. And luckily, we've got a framework upon which to build. The Manufacturing USA program, a nationwide network of centers each focused on an emerging trend in production, has better connected domestic manufacturers with the fruits of government-funded R&D, and it should be drastically expanded.

However, there are equally useful legal moves that the government could make, for example championing rules on data governance in future trade deals and treating them as non-tariff barriers should other nations abuse them to create an artificial advantage. We should leverage the size of the American marketplace so that America's smart manufacturing policy benefits American smart manufacturers.

Lastly, the U.S. should create such a policy because policy abhors a vacuum, and other manufacturing powerhouses (such as China or Germany at the lead of the European Union) have no intention of waiting for us to establish rules first. They realize a competitive edge is at stake, and we should take the hint and retain some of that edge for our own.

Smart factories are coming, and they're quietly, incredibly important. We should be preparing the way for them by thinking about the guardrails in which we want them to operate. MMT

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By Eric Ostini

# EDM Slugs It Out for True Automation

**Automatic EDM slug management systems yield unmanned, lights-out operations, shorten cycle times and allow roughing and finishing operations with zero operator intervention.**

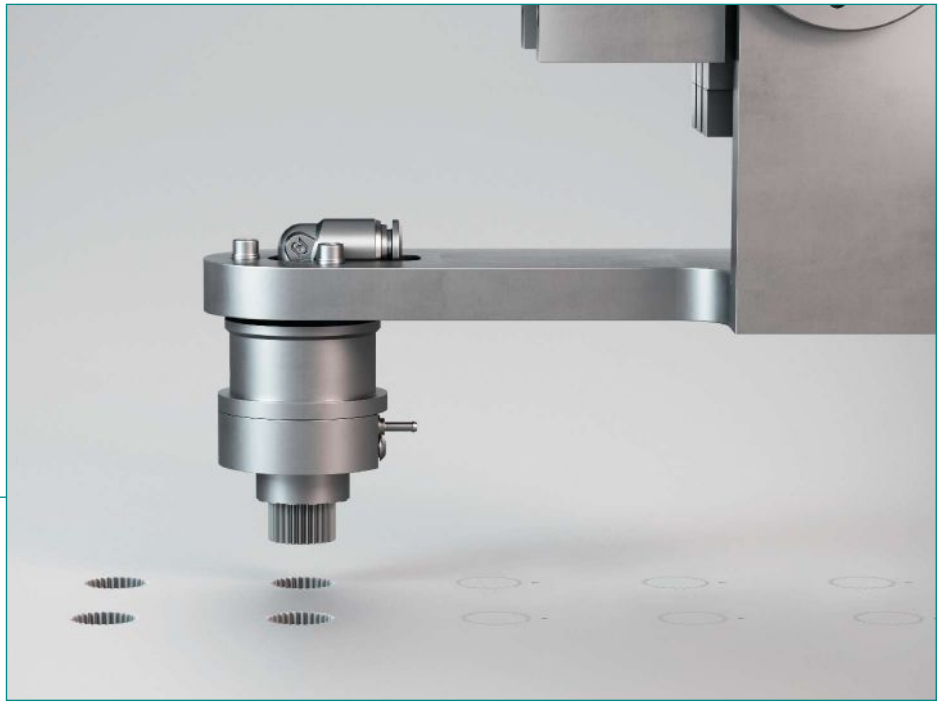
A major hurdle mold builders face when it comes to configuring wire EDMs for completely unmanned continuous operations is slug removal. Even as machine tool manufacturers transform metal-cutting applications with state-of-the-art automation solutions, operators of wire EDMs must deal with slugs the old-fashioned way. Despite decades of effort, stopping the machine and manually removing slugs has remained the overriding norm.

Slugs will fall onto the lower head of a wire EDM and can cause a fatal crash or trigger work-stopping crash protection routines when left to their own devices. CAM programs can prevent this by including tabs (only 0.100-inch thick) that keep the slug connected to the workpiece during cutting. Once the software completes that step, the operator then cuts these tabs off and removes the slug by hand. On average, this task adds an extra five to six minutes per tab to every EDM cycle and prevents unmanned operation. At best, shops will program EDMs to rough cut parts unmanned and overnight. The next day, operators remove the slugs and run the finishing passes.

### Small and Light Automated Slug Removal

However, shops that use a new automatic slug management system that incorporates Bernoulli's principle (the same property of fluid dynamics that allows planes to fly) can reduce all this manual labor. The system helps to ensure that shops can run their EDMs in a true unmanned, lights out operation, shorten cycle times and complete both roughing and finishing with zero operator intervention. Also, it is especially well-suited for small-cavity EDM operations and die-stamping applications.

The automated process begins with a complete roughing pass, leaving no welds or tabs behind. Instead, the machine's



The wire EDM process can now be completely autonomous. Conventional slug extraction can represent up to 20% of the total processing time and requires manual intervention. By automating this step, you reduce manual intervention and gain processing time.

Images courtesy of GF Machining Solutions.

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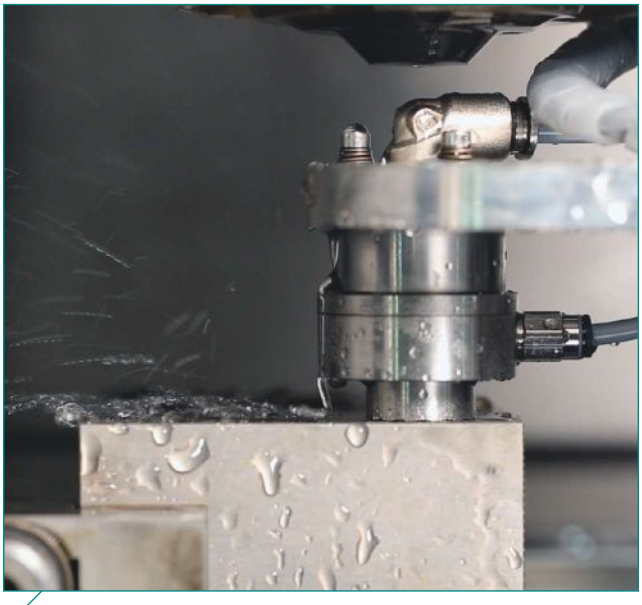


A new automatic slug management system incorporates the same principle of fluid dynamics that allows planes to fly to reduce the manual labor and run EDMs unmanned.

design enables the lower head to catch the slug before it falls into the tank. A device retrofitted to the upper head then lowers and blows high-pressure air over the slug, which creates suction that pulls the slug from the part. The machine's upper head then moves along the U and V axes to deposit the slug in a receptacle before returning to perform further operations on the part.

While automatic slug management is a somewhat slower process than its manual counterpart, the fact remains that it requires no human intervention. Manufacturers can load raw material into the machine in the evening and take fully finished parts out in the morning. Shops can run continuous machining operations and reduce total processing times by an average of 20%.

Because it uses suction, the system does require enough surface away from wire EDM start holes that can impede its operation. Naturally, slug weight and size are also limiting factors (10 by 10 mm and larger, and less than 0.6 pounds). In those situations, shops can remove small slugs with a pocketing strategy that uses the EDM wire like a milling cutter to machine off the slug.

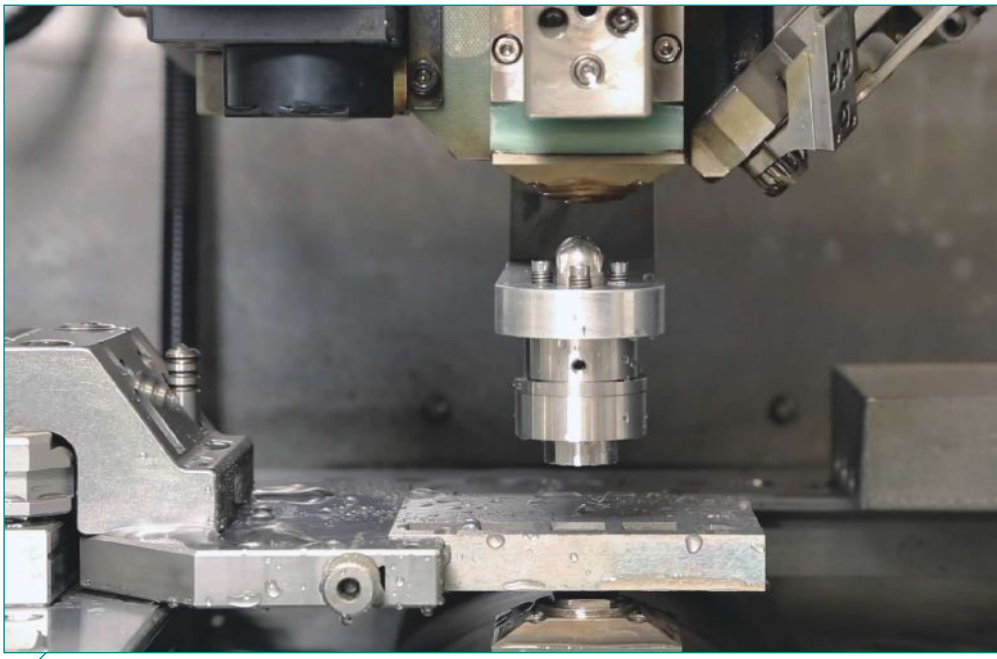
### Large and Heavy Automated Slug Welding

However, applications involving heavy (0.6 pounds) slugs and large cavities will continue to use automatic slug welding. During normal operation, brass EDM wire slowly melts away and leaves behind minuscule amounts of brass buildup, but excess energy, slow wire movement or insufficient coolant can significantly increase that buildup. This buildup, in

turn, reattaches the slug to the workpiece with brass.

Despite dramatically shortening cycle times, automatic slug welding does fall short of true uninterrupted automation because the process still requires an operator to remove the slug manually. The operator must knock the slug out using a brass hammer and manually remove the slug from the cavity to continue finishing the cavity.

However, a slug welding method in a system that uses clever G-code commands to precisely manipulate the brass accumulation prevents top-to-bottom welds and generates 0.100-inch-thick welds at the top of the part that joins only the surface of the workpiece and slug. The result is a slug that operators can easily knock out of the workpiece with a brass hammer, leaving behind brass



A new automatic slug management system incorporates the same principle of fluid dynamics that allows planes to fly to reduce the manual labor and run EDMs unmanned.

that won't interfere with a skinning pass or other finishing operation.

Automatic slug welding does eliminate the time needed to cut slug tabs and shortens the processing time to about two minutes. However, if the wire breaks mid-cut, a machine without the ability to rethread inside the gap will have to restart the entire program from the beginning due to new welds in the way. Thin sheets of material or small slugs are other challenges that require careful selection of weld points.

Automatic slug welding surpasses previous slug management systems such as pin-based and ejection-based systems. The pin of the *pin-based system* inserts itself through the wire start hole and expands outward to grip the slug and pull it through the gap following the cutting program. Unfortunately, given the size of the device, it was often unable to fit through most narrow wire start holes and could only securely grip relatively light slugs, preventing use on large or heavy slugs.

Automatic slug management and automatic slug welding solve these slug removal problems and fully automate many EDM processes.

The *ejection-based* system ejected the slug into the machine's tank. It retains tabs in the form of tiny triangular connections that hold a slug until a piston knocks it through the cavity and into a waiting receptacle. This allowed for full automation in theory, but in practice, operators had to fine-tune the device so the slug would fall cleanly through the cavity rather than jam the machine.

Automatic slug management and automatic slug welding solve these slug removal problems and fully automate many EDM processes. Despite the focus on the cutting area, machine tool manufacturers know that the next step in automation involves consumable usage. For example, automatic threading and rethreading are possible with current technology, but the future will deliver machines that can automatically alert operators when a machine has an insufficient wire supply on its spool to complete a part. This alert will help avoid production interruptions and ensure truly unmanned automated EDM part processing. MMT

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By Barbara Schulz

# How to Avoid Premature Mold Failure

## A look at the most common types of mold damage, practical examples, causes and recommended solutions.

An injection-molded part is only as good as the mold that produces it. If a mold prematurely fails during production, it's not only bad news for the molder who loses valuable production time—and possibly even a customer—but especially for the moldmaker, who promises his customers a long service life, fast injection cycles and clean surfaces.

If damage to the injection mold occurs before it reaches the required service, the material is usually suspected. "Customers only contact us when a tool fails and unfortunately, less often when it comes to initial material selection, optimum heat treatment or tool design," Dr. Alf Schürmann from Voestalpine High Performance Metals Germany GmbH, member of the Böhler Technology Team around Dr. Ingrid Jung says. "If it comes to tool failure due to inappropriate steel grades, typically the moldmaker has either chosen the wrong steel or accidentally grabbed the wrong blank from the shelf."

The first step to determining the reason for mold failure should be a damage analysis of the mold's condition. "You have to know the history," Schürmann says. "Selected material, heat treatment, mold design, location of highest loads on the mold during production, etc. These factors must be considered to determine the cause of damage."

Image courtesy of Barbara Schulz.

Due to an increasing use of conformal cooling channels, which—as the name suggests—are much closer to the mold contour than conventional channels, cracks reach the mold surface much quicker.

Images courtesy of Bohler.

When a customer's mold insert showed severe corrosion after a very short service period, the chemical analysis of the corroded part showed that a non-corrosion resistant tool steel (1.2343, H11) was used instead of a high-performance plastic mold steel with excellent corrosion resistance properties.

Here are some of the most common types of mold damage, practical examples, causes and possible solutions.

### Severe Corrosion After Short Service Life

When a customer's mold insert showed severe corrosion after a very short service period, he wanted to get to the bottom of the cause. The material used was a Böhler M340 ISOPLAST, a high-performance plastic mold steel with excellent corrosion resistance properties, high wear resistance and good machinability.

The chemical analysis of the corroded part showed that a non-corrosion resistant tool steel (1.2343, H11) was used instead of the given material. "The cause in such cases is very simple and not so rare," Schürmann explains. "Especially with smaller shops without electronic warehouse management in place, material mix-ups are more common than one might assume. Sometimes the material is not clearly identified or stored in the wrong place."



### Corrosion in Cooling Channels

If cracks occur in the cooling channels of mold inserts, one of the causes may be crevice corrosion between the brass plug and the steel surface in the cooling channel (see photo), even if the builder selected corrosion-resistant steel. Here, the crack passes from the thread of the stopper into the mold contour.

According to Schürmann, the first assumption is a ductility or toughness problem in the material. However, the real issue is elsewhere. Due to an increasing use of conformal cooling channels, which—as the name suggests—are much closer to the mold contour than conventional channels, cracks reach the mold surface much quicker.

During mold design, a designer should consider heat treatment and potential risks by providing large radii for critical areas, designing the part "heat-treatment-appropriate" and machining the final contour after heat treatment, if necessary.

"What happened, in this case, is contact corrosion between brass and steel, which are connected conductively and exhibit different potential for corrosion. The mold acts as a sacrificial anode that is attacked by corrosion and low-quality coolant," Schürmann explains. "So the builder must minimize the extent of contact corrosion, preferably with plugs made of high-strength plastics or separating the two electrodes (galvanic, PTFE, silicone, etc.). Optimum cooling water quality also contributes to corrosion protection."

### Material Cracks

Material cracks can occur during heat treatment, but the mold design can also be the cause. Common areas of cracking include sharp edges and sharp cross-sectional transitions. "These design features result in a high notch effect (uneven stress distribution) that causes a latent risk of cracking dur-

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A major concern for moldmakers are microcracks present in the mold. One of Schürmann's customers was looking for the cause of material cracks around the gate area in a mold insert made from corrosion-resistant PM steel.


Components at risk of fracture are those subjected to high stress and possess a critical geometry, such as the case of a breakage of a hot runner valve gate nozzle in mold core.

ing quenching. But obviously, the heat treater can only draw attention to this problem with externally visible notches (stress peaks)," Schürmann says. So, during mold design, a designer should consider heat treatment and potential risks by providing large radii for critical areas, designing the part "heat-treatment-appropriate" and machining the final contour after heat treatment, if necessary.

**Microcracking**

A major concern for moldmakers is microcracks present in the mold. One of Schürmann's customers was looking for the cause of material cracks around the gate area in a mold insert made from corrosion-resistant PM steel. Crack analysis showed an altered metal zone affected by the EDM process in the recast layer, or white layer. This layer has been heated to the point of a molten state, but not quite hot enough to be ejected into the gap and be flushed away. The EDM process altered the metallurgical structure and characteristics in this layer as it is formed by the unexpelled (material not forced out) molten metal being rapidly

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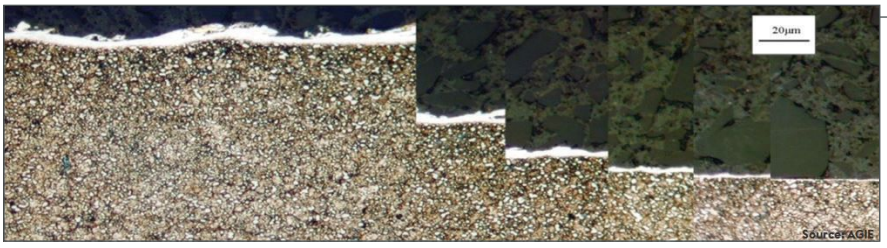


Microcracking is extremely prominent in the white layer. If this layer is too thick or is not removed by finer EDM finishes, polishing or additional annealing, the effects of this microcracking can cause premature failure of the part.



cooled by the dielectric fluid during the flushing process and resolidification in the cavity.

"Microcracking is extremely prominent in the white layer. If this layer is too thick or the builder does not remove it with finer EDM finishes, polishing or additional annealing, the effects of this microcracking can cause premature failure of the part, where in this example, a very hard, brittle microstructure with 61 HRC added to the problem," Schürmann explains.

To increase mold life, Schürmann advises to remove the white layer by eroding with the lowest possible power (finishing), grinding, polishing or microblasting, as well as tempering at approximately 30 to 50°C to below the last tempering temperature. A high quenching speed (between 800 and 500°C) should help avoid the grain boundary occupation with carbides.


If cracks occur in the cooling channels of mold inserts, one of the causes may be crevice corrosion between the brass plug and the steel surface in the cooling channel, even if a corrosion-resistant steel has been selected. Here, the crack passes from the thread of the stopper into the mold contour.

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Understanding all the possible causes of mold failure is necessary to take appropriate countermeasures.

**Part Fractures**

Components at risk of fracture are those subjected to high stress and possess a critical geometry, such as the case of a breakage of a hot runner valve gate nozzle in mold core. According to Schürmann, the component was made from PM23 high-speed tool steel and should have had a hardness of 60 ±2 HRC. The heat-treatment instructions said to "harden for toughness," temper two times and one quenching cycle.

To test the heat treatment, the team analyzed the breakpoint at the tip of the nozzle and found that the material quality met requirements, the structure was martensitic but high-temperature tempered, the edge microstructure had no abnormalities and the hardness was 65 HRC. The high hardness proves that, contrary to the specifications, the part was tempered three times with hardening temperatures of 1150 to 1180°C; a high hardening temperature results in higher wear resistance but lower toughness.

"In this case, the heat treater knew the customer's toughness requirement, so the problem was heat treatment. Very often, however, the heat treater does not get the right instructions, and they perform the wrong heat treatment, such as over-nitriding," Schürmann says. "Smaller parts are especially at risk because if the customer does not give the heat-treater specifications (wear-resistance and toughness requirements), they load the parts into the oven with larger parts as gap fillers, which then exposes the small parts to the hardening temperature for too long."

Understanding all the possible causes of mold failure is necessary to take appropriate countermeasures. MMT



CONTRIBUTOR

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**FOR MORE INFORMATION**

Voestalpine High Performance Metals Deutschland GmbH
www.bohler.de

By Cynthia Kustush

VIDEO Access the related video under the Videos tab at *MMT* online.

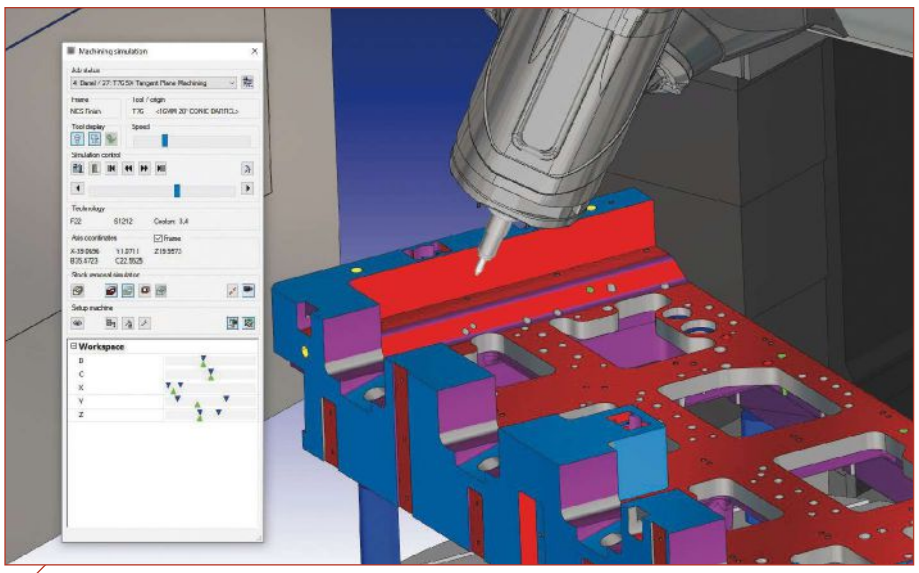
# CAM Software Speeds Programming and Optimizes Production

## Precision Mold and Machining Services gains more control, accuracy and capacity, and better surface finish, with high-performance CAM software.

Precision Mold and Machining Services Inc. (Warren, Michigan) offers a variety of services to the mold industry, including gun drilling, EDM machining, engineering changes, mold repair and maintenance, and three- and five-axis CNC machining and boring. For more than 30 years, the company has accepted overflow work from mold manufacturing customers and strives to deliver superior quality work and fast turnaround times because they know lead times are critical.

The company is also ISO 9001:2015 certified (soon to be AS9100d certified, Q3 2019), underscoring its focus on high quality in every process it performs. For five-axis machining, Precision Mold currently runs two DMG MORI DMU 85 monoBLOCK series CNC machines, which feature a 33.5-inch table diameter and X, Y, Z travels of 36.8 by 33.5 by 25.6 inches. The company also has two DMG MORI 210 P duoBLOCK series CNC machines, featuring a table diameter of 66.9 inches and X, Y, Z travels of 82.7 by 82.7 by 49.2 inches. "We have always invested in high-end machine tools so that we can complete work quickly and with extreme accuracy," Brandon Loehr, machining manager, explains. Both Loehr and his brother Taylor, business development engineer, work with their father, David, whom owns Precision Mold.

If a process is not producing results at an acceptable level or rate, Precision Mold finds a better way. For example, in 2013 the company changed its CAM software to *hyper*MILL from OPEN MIND Technologies USA (Needham, Massachusetts) and in so doing, significantly changed the face of its five-axis CNC milling operations and its overall business, for the better.

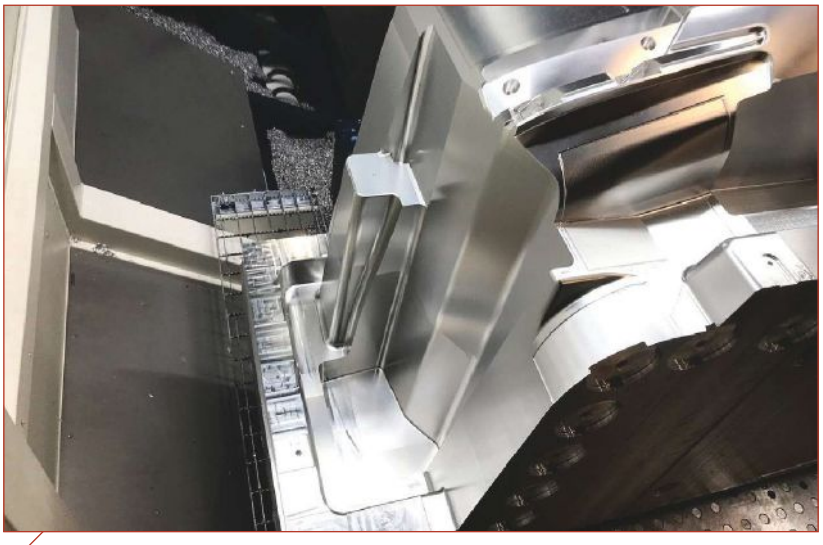



Images courtesy of Precision Mold & Machining Services Inc.

Precision Mold & Machining Services Inc. uses *hyper*MILL CAM software for programming 2.5D, 3D, five-axis milling and mill/turn tasks. *hyper*MILL's automatic indexing feature controls the movement of the axes, automatically finding the best tilted solution and only using simultaneous movements where necessary. Additionally, if a potential collision is detected, the automatic pitch adjustment function will change the contact point of the cutting tool to finish the job. These features alone cut the company's programming time in half.

### Optimized Tool Paths Boost Cutting Speeds

"When we purchased our first five-axis machine in 2013, we quickly realized the limitations of the software we were using at the time," Brandon explains. "While we were able to create five-axis simultaneous tool paths, the tool paths produced resulted in excessive and jerky movements of the B and C axes." For example, the old software, when performing automatic, five-axis simultaneous tool paths, would send the rotary C-axis spinning all over the place, according to Loehr. "Then the cutting tools basically followed it all around, too. It looked fast and cool, but it was inefficient. It was fast on the calculation side, but it was not creating a smooth tool path. You might have programmed for 150



*hyper*MILL MAXX Machining, a corresponding CAM package with modules for high-speed milling, drilling, roughing and finishing, combined with the switch to conical barrel-style cutters, enables Precision Mold to machine pockets and achieve a better surface finish and a more accurate surface geometry faster than ever before. Shown here is a deep pocket finished in an automotive fascia mold core.

inches a minute, but it only moved 30 inches a minute if it was moving all the axes around simultaneously."

As a result of the previous CAM software's performance, Taylor Loehr says he had to spend a lot more time creating multiple 3+2 tool paths to more quickly achieve the results that customers required. "This led us to search for a more efficient CAM solution," he says. A few years after purchasing the first five-axis machine, they turned to their machine tool supplier representative for recommendations on the best software options and that is how they learned about *hyper*MILL CAM software for seamless and precise programming of 2.5D, 3D, five-axis milling and mill/turn tasks, and the *hyper*MILL MAXX Machining performance package for maximizing machine performance.

### Automatic Indexing

*hyper*MILL has an automatic indexing feature, which controls the movements of the axes to make a more efficient tool path. "It lets the cutter do its work without moving the machine all around and gives us a more accurate cut," Brandon says. The auto indexing function automatically finds the best tilted solution and only uses simultaneous movements where necessary. "It is a more controlled process. It

### PRECISION MOLD AND MACHINING SERVICES INC.

**PROBLEM:** Previous CAM software tool paths were inefficient and uncontrolled. Less accurate surface finishes required more hand work and costly time.

**SOLUTION:** *hyper*MILL CAM software from OPEN MIND Technologies USA, Inc.

**RESULTS:** Faster creation of tool paths and more controlled axes, more accuracy and optimized surface finishes, saving significant time and enabling company growth

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won't retract the cutter. Instead, it will make circular movements to go directly to the next spot and continue the cutting as quickly as possible, which reduces a lot of the excess movement we were getting with our other software, especially when machining corners," he says. "As a result, it is faster and can keep up with the feed rate that is programmed. There are fewer moving parts, too, so it is easier to get up to speed."

### Collision Avoidance

*hyper*MILL MAXX Machining is a corresponding CAM package with modules for high-speed milling, drilling, roughing and finishing, the tool paths of which are extremely easy to program, according to the Loehrs. It is as simple as selecting the surface or surfaces to be machined and entering the desired contact position of the cutting tool. "If a potential collision is detected, the automatic pitch adjustment function will change the contact point of the cutting tool to finish the desired machining area entirely. It does this seamlessly and without excess movement of the machine axes," Taylor explains. As a result, programming time is reduced (less tool paths to calculate) and the surface finish quality is not affected negatively. "Additionally, this allows us to finish more areas with a single, short tool because we are confident that the five-axis movements will produce a finish that is up to our standards. Previously, we would have to either extend our tools or spend extra time programming to produce the same result. Our programming time was cut in half due to not having to create dozens of similar tool paths with different tilt angles," Taylor says.

### Perfect Pocketing Technology

*hyper*MILL's MAXX Machining has enabled Precision Mold to also drastically reduce the time it takes to machine pockets. "We used to machine these features with a ball or bullnose endmill using a 0.010-inch step-down," Taylor says. By using conical barrel cutters (specifically the Emuge Circle Segment, which they learned about at the same time they discovered *hyper*MILL) combined with *hyper*MILL Perfect Pocketing Technology, they can now take a step-down of 0.150 inch and achieve a better surface finish and a more accurate surface geometry. Perfect Pocketing Technology stands for efficient roughing with adapted pockets. This means the software uses an intelligent algorithm that ensures linear and contour-parallel tool paths are optimally linked to maximize feed rates and fit the largest possible pocket into the area that will be rough machined. This advantage applies to both standard and high-feed cutters. Regarding the style cutter the Loehrs are now using, Alan Levine, managing director of Open Mind Technologies, says the radius of a barrel-style cutter is much greater than that of a standard ball nose cutter whose radius is defined by the cutter's diameter, and this simple change in cutter style has made a notable difference in the overall pocketing process.

"We machine some very large blocks with a lot of details, so using the Emuge barrel-style cutters and Perfect Pocketing Technology is a strategy that saves us an average of 10-15 machining hours per mold versus the time it takes using the current industry standard Z-level strategy with ball-nose cutters," Taylor says.

### Control and Accuracy Brings Finer Finishes

"With *hyper*MILL, we can achieve excellent surface finishes due to the smooth and limited movement of the rotary axes," Taylor says. "When using our old software, gouged or bumpy surfaces in the tool paths would have to be benched out and re-machined. Our goal is to have zero need for spotting, and we are pretty close to achieving that when we machine both cavities and cores because of *hyper*MILL."

He says the company uses *hyper*MILL's automated probing function to quickly and easily inspect workpieces before they come off the CNC. If any deviations are detected after finish machining, probing cycles, which are integrated in the machining process, will enable the machine to adapt its program to address the issue. "We use the probing tool for everything we cut to ensure it matches the specifications of the customer, which saves us a lot of time and expense."

"The key point is to do a quick inspection prior to removing the part from the machine," Levine says. "For example, if a missed region, due to a broken cutter or a large deflection, is detected first on a coordinate measuring machine, then the part is already moved away from the CNC machine, and likely the next part is already being cut. Identifying possible problems while still on the milling machine reduces risk and simplifies the workflow." He notes that the on-machine probing is not generally a substitute for final inspection, but it gives the shop assurance before taking a large block off a milling machine. "Also, if they take it off the mill and later remount, alignment will be problematic no matter how good the setup routine," Levine says.

### More Speed and Control Boosts Output

"It's very easy to keep up with the machine and keep operations running, whereas before, it was frustrating because we would run out of time during the day trying to get the programming done," Taylor says. "With the old software, we might have to calculate a single tool path two or three times until we achieved a decent one to run. Some longer tool paths might take half an hour to calculate, but if you have to redo it three times, you just wasted over an hour."

"We can take on more jobs and complete them faster than before," Brandon adds. "I'd say we have taken on at least 25 percent more jobs, and that's being conservative. *hyper*MILL has allowed us to increase our capacity and give our customers a better product faster." MMT

### FOR MORE INFORMATION

Precision Mold and Machine Inc. / 586-774-2330 / bloehr@precisionmold.com / tloehr@precisionmold.com / precisionmold.com

Open Mind Technologies USA Inc. / 339-225-4557 alan.levine@openmind-tech.com / openmind-tech.com

# News and Reviews from **Industry Organizations**

### American Mold Builders Association (AMBA)

On Thursday, October 24, AMBA will host a dual Plant Tour Workshop at JMMS, Inc. (Easley, South Carolina) and MSI Mold Builders SE (Greenville, South Carolina). With a specialization in die and mold program management for OEMs and tier vendors, JMMS uses its "Plan. Do. Check. Act." strategy to help clients improve part quality, use less material and lower cycle times for better manufacturability, while MSI Mold Builders SE dedicates itself to lean manufacturing processes, resulting in the design of accurate and durable steel and aluminum molds. The Tour Workshop includes tours of both facilities, lunch, and cross-talk and networking reception the evening of October 23.

One of AMBA's primary membership benefits is the opportunity for professionals in different functional areas to connect with peers. This event, facilitated by an AMBA staff member, provides opportunities for mold manufacturers to share challenges with industry peers, ask questions and solve common problems. By joining such an expansive and energized group of professionals, members can access the AMBA community for virtual networking, without leaving the office!

Upcoming peer networking opportunities are available for Senior Leaders and HR professionals on September 11, 2019. For more information and to register, visit the AMBA website.

### Canadian Association of Mold Makers (CAMM)

CAMM, in association with the Windsor-Essex Economic Development Corp., continues to foster its partnership with Chhattisgarh, India. The Canadian organizations recently hosted an India Delegation Roundtable and Dinner at St. Clair College's Centre for the Arts, where it signed a Memorandum of Understanding (MoU) that will allow the two geographical regions to form business relationships, share information and, in the long-term, improve economic conditions. CAMM's Jonathan Azzopardi told AM 800 News, "We've signed an MoU with Chhattisgarh to be able to create clusters to help them grow their initiatives and they have reciprocally agreed to help us grow ours."

Important events include CAMM Golf Day, which will be held on September 8 in Windsor Ontario, CAMM/Automate Canada AGM dinner, which will be held September 9 at Caesars Windsor, followed by the Windsor-Essex Economic Development Corporation-sponsored Emerging Technologies in Automation Conference and Trade Show on September 10. For more information, visit the CAMM website.

**FOR MORE INFORMATION**

American Mold Builders Association / 317-436-3102 / amba.org
Canadian Association of Mold Makers / 800-567-2266 / camm.ca
Society of Plastics Engineers / 203-775-0471 / 4spe.org


During Amerimold, the SPE Mold Technologies Division awarded Francine Petrucci of B A Die Mold Inc. (center) and Brenda Clark of Hasco America (left). Renee Nehls of Sussex IM stepped down as Chair of the SPE Division, and Wayne Hertlein (right) enjoyed the "girl power" celebration!

### The Mold Technologies Division of the Society of Plastics Engineers (SPE)

The SPE Mold Technologies Division made a little history at Amerimold in Rosemont, Illinois, when it announced it was honoring the first female Moldmaker of the Year alongside another female who was named Mold Designer of the Year. Francine Petrucci, president of B A Die Mold Inc. in Aurora, Illinois, is this year's Moldmaker of the Year while Brenda Clark, engineering manager of Hasco America Inc. in Fletcher, North Carolina, won Mold Designer of the Year (she is only the fourth woman to receive this honor). It was also the first time the SPE Division recognized two women in the same year. It also honored Renee Nehls of Sussex IM, who is a 2017 recipient of Mold Designer of the Year and also just stepped down as Chair of the SPE Division. To learn more about the SPE Mold Technologies Division, its awards, scholarship programs and technical events, and to inquire about membership, visit the website. MMT

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# X-Cell Tool and Mold On Automation

**Automating machining processes has been a critical component to X-Cell Tool's ability to reduce lead times. When did you first begin using it and why?**

**Jim Cummings, general manager:** It was back in 2011 that we started looking at robots for our EDM cells in an effort to reduce cost by increasing unattended time. The next benefit was the longer continuous run times; we were also increasing machine utilization.

**How are you currently using automation in your shop?**

**Cummings:** The current thought process is similar, but the motivation is now leaning more toward machine utilization as opposed to unattended time. I think the mindset has shifted more toward the idea that, if the machine is going to run, it will run unattended (that is a given), so let's run it continuously for as long as possible. Then let's have the next job ready to set up and minimize the downtime. We want to productionize the machining process, running jobs in batches, order-by-order, rather than running like a job shop where it is workpiece by workpiece. Our machines that have integrated robots are production centers, and we need to get as many hours out of them as possible. Of course, you always have those ones, twos and "fews" that can be disruptive, but they need to be done as well. The best time to get those completed is during the day when your moldmaker is there to set them up. But at the end of the day, the moldmaker must be ready to turn that robot back on and run production through the night.


The 2019 Leatime Leader shop X-Cell Tool and Mold uses automation to productionize the machining process, running jobs in batches, order-by-order, rather than running like a job shop where it is workpiece by workpiece. This has reduced costs and lead times while increasing machine utilization.

So we have established another mantra at X-Cell. When you punch that time clock in the morning, you should already be asking yourself, *"What am I going have ready to run tonight?"* At that point, you spend the time to set up that next long-running job. Maybe it takes until lunchtime to have it ready, and that's okay because now you have the rest of the day to get those two parts for that other job done, too. At the end of the day, you can turn your robot on and start running the production job you set up earlier in the day.

Another possible scenario is you have a production job set up using your robot, and it is running when you arrive in the morning. That is great! In that case, when the robot comes to a good stopping point, you can pause the program, put the production pallets back in the carousel, bring an empty magnet, vise or pallet into the machine and set up those two parts to get them done during the day. When those two parts are done, flip that robot back on, and you are running in auto through the night. It is all about the UP TIME.

Bottom line, you need to have the mindset of "What am I running tonight?" and plan for that to happen.

**Does X-Cell Tool have a plan for expanding its automation capabilities in the short-term? If yes, please share that plan and the motivation for it. If not, what is your next operational focus?**

**Cummings:** Currently, we are creating a five-Axis Yasda Hard Mill Work Cell that will include our current YMC 430, a new YMC 650 and upgrading an existing System 3R WorkPartner robot. By upgrading the robot capacity with another bookshelf configured for taller components and positioning the robot between these two five-axis machines, it will serve both machines.

This type of cell requires more attention to dialing it in because cutter wear can affect quality when holding the 0.0001-inch tolerance. Therefore, our goal is to set up a hard mill operation to rough at night and finish during the day when we have the operator there to monitor the quality.

We are also looking into adding automation to our lathes for soft turning. Again, this is with the primary goal of increasing our utilization of those machines. MMT

### EDITOR'S NOTES

For more information on how to enter our Leadtime Leader Awards program, or if you have a question for any of the Leadtime Leaders, please email Christina Fuges at cfuges@gardnerweb.com, or visit short.moldmakingtechnology.com/leader

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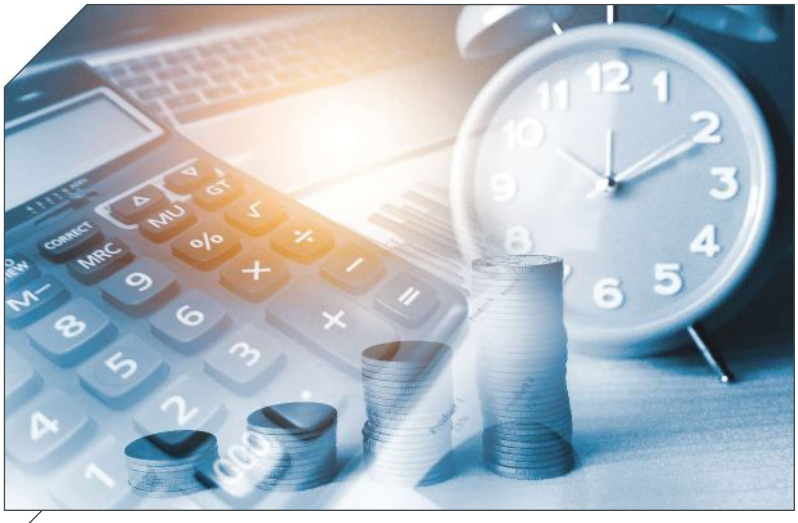
# How to Start Planning Your Exit



What is your mold shop worth? The value you perceive may not be the same as a potential buyer or next-generation owner, so understanding the value of the company and the drivers of value are key to maximizing your benefit upon exit.

By Michael J. Devereux II, CPA, CMP

The exiting planning process is a challenge for many mold shop owners because they love what they do, and it is very hard to imagine not coming into the shop every day. Developing your succession plan will force this very uncomfortable thought process, which may change how, why and when you plan to exit the company. Here are some factors to consider when developing or refining your succession plan.

## Determining and Maximizing Value

What is your mold shop worth? The value you perceive may not be the same as a potential buyer or next-generation owner, so understanding the value of the company and the drivers of value are key to maximizing your benefit upon exit.

First, *benchmark* your shop against others in the industry. The benchmarks should look at financial and operational metrics. These operational metrics are what drive the financial results and many times, are the leading indicators to determine your shop's value. Second, work with a business valuator to determine the *value drivers* of your shop, as the current or historic value is not sufficient. This exercise will help you understand *why* your shop is worth a certain amount. The *why* will help you determine where you should focus your efforts to increase that value.

## Blocking and Tackling

Ensuring that your books and accounting records are clean is important. What type of internal controls do you have in place concerning cash or accounts payable? How quickly do you "close the books" each month? Is your ERP capable of providing information you need to run and improve your business? Do you have proper oversight concerning your shop's assets?

Having internal controls in place (and well documented) will help you run the day-to-day operations of your shop and lend to credibility and confidence to your reporting, which you'll need to make decisions impacting the growth and profitability of your business.

## External or Internal Succession

Evaluate the type of transfer that may take place when you exit your shop. The transfer could be internal, such as family members or key employees set to take the reins of your shop once your exit begins. Or, you may sell the company to an unrelated third party. Both types of transfers come with their challenges, and you will likely position your company differently once you determine which route is best for you.

If the goal is to transfer your business to *family members*, you will need to evaluate several considerations. Is the family member capable of running the shop at the same level that you have? Does the family member have the wherewithal to purchase the company, or will there be a gifting aspect to the transaction? Will the estate tax have an impact on the transfer of your business to the next generation if not transferred at fair market value? Can you use trusts (such as an intentionally defect grantor trust) or other planning techniques to transfer current or future value of your shop tax efficiently?

You may encounter some of the same issues if transferring the business to *key employees*. Do they have the means of purchasing the company? Are they capable of running the business? Do they want to take on the risk of being a business owner? While you may think of these key employees as family, the thought process is different in transferring the company to a key employee vs. transferring to a son or daughter.

Sometimes it makes sense to re-capitalize your business into voting and non-voting shares. This allows you to begin transferring some of the company to family members or key employees without you giving up control.

If the goal is to transfer your shop to a *third party*, you may want to consider preparing formal documentation that will assist in conveying the value of your shop. This may include preparing a confidential information memorandum, quality of earnings analysis in advance of due diligence and documentation of your intangibles (customer relationships, workforce, proprietary techniques or processes, etc.).

### External Transfers

Unlike internal transfers, external transfers have their own set of factors to evaluate. Is the buyer strategic, geographic or financial? This will impact what you could receive for your shop. Does the buyer want all or only some of your business? You may want to change the structure of your company if you plan to keep some of the operations.

Does the buyer want to buy stock or the assets of the business? Sellers, typically, would prefer to sell their stock, as the gain would be taxed at capital gains tax rates. However, buyers would prefer to purchase assets so that they may depreciate and amortize the value of the company over time for income tax purposes.

The changes to bonus depreciation brought about by tax reform further encourage asset deals since used equipment may now qualify for bonus depreciation, as long as the shop purchases the asset from an unrelated party.

Also, external buyers may require that you have your financial statements audited. However, if you don't know whether a future buyer will require an audit and your bank only requires that you have reviewed financial statements, ask your CPA to observe your inventory count at year-end so that they may go back and audit the financial statements should a future buyer require this step.

You may also want to have your income tax returns reviewed for areas of opportunity or exposure. For example, missed tax incentives, such as the R&D tax credit or missed tax deductions. You want to be sure you've exhausted all appropriate areas of the tax code to ensure you haven't paid too much in income taxes. Looking for areas of exposure may also make the deal flow smother. For example, you don't want to get into due diligence with a buyer only to find out that you should have filed tax returns in six other states in which your shop was doing business.

Begin now before you lose your passion. Understand and document your goals. These may range from establishing a legacy to being charitable, providing security for you or your heirs. Once you've outlined your goals, start to build your succession plan and be relentless at keeping it up to date. MMT


CONTRIBUTOR

Michael J. Devereux II, CPA, CMP, is a partner and director of manufacturing, distribution and plastics industry services.

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# Index Expands on Supplier Deliveries

## July 2019 – 50.6

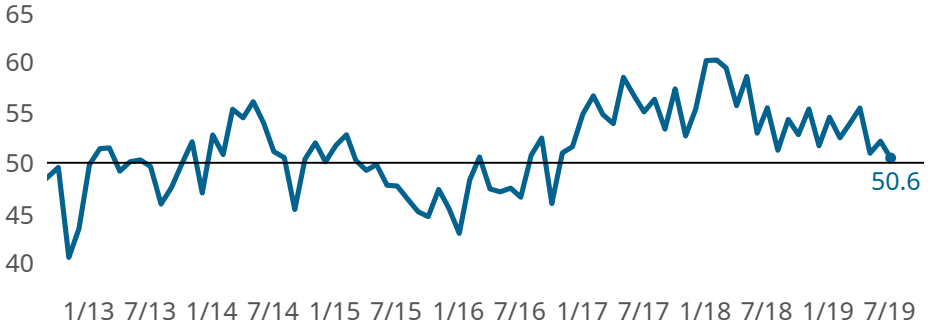
The Gardner Business Index (GBI): Moldmaking expanded during July, registering 50.6 thanks to an uptick in supplier deliveries. Index readings above 50 indicate expanding activity while values below 50 indicate contracting activity. The further away a reading is from 50, the greater the change in business activity. Compared to July 2018, the Index is 9.4% lower. Gardner Intelligence's review of the month's underlying data found that supplier deliveries, which increased in activity in July, was the leading Index component. The Index was also supported by production and new orders. A no-change reading in employment activity combined with contracting backlog and export activity all pulled the Index lower.

For a second month in a row, new orders activity fell below that of production. This delta between orders and production may have contributed to July's contractionary backlog reading. In the year-to-date period, backlogs have reported four months of contracting activity, two months of expanding activity and one month of no change. Only exports have reported more months of contracting activity during 2019, suppressing total new orders activity. MMT

ABOUT THE AUTHOR

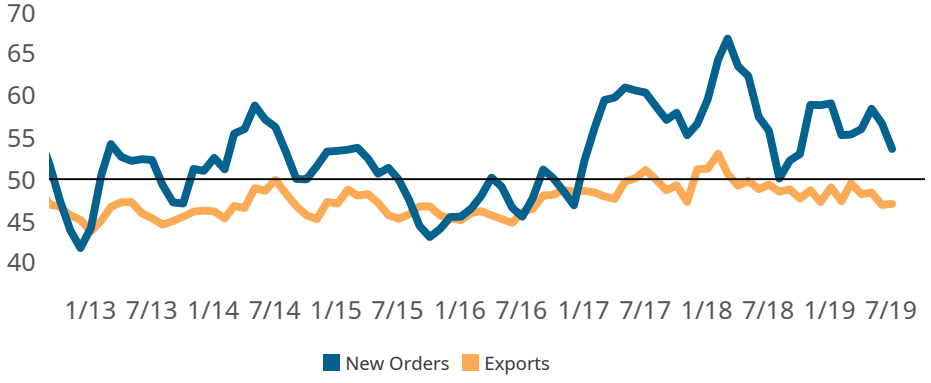
Michael Guckes is the chief economist for Gardner Intelligence, a division of Gardner Business Media (Cincinnati, Ohio, United States). He has performed economic analysis, modeling and forecasting work for nearly 20 years among a range of industries. He is available at mguckes@gardnerweb.com

**Gardner Business Index (GBI): Moldmaking**




The Moldmaking Index reported a record-breaking 33-month continuously expanding activity driven by supplier deliveries. Since its most recent apogee in early 2018, the Index has experienced slowing growth.

**New Orders and Exports (3-Month Moving Average)**




Export orders have weakened in five of the first seven months of 2019, undermining total new order activity.

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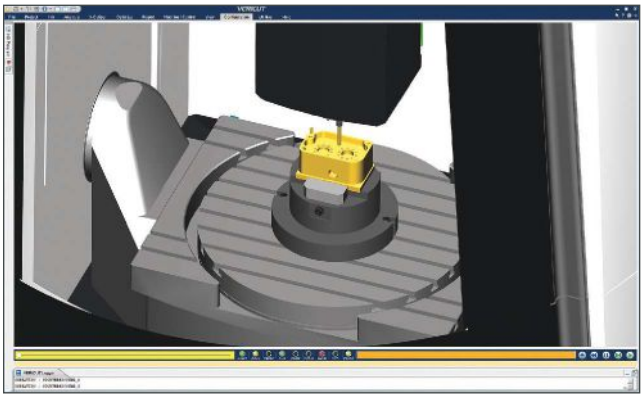
## Software Enhancements Increase Power and Improve Efficiency

**CGTech**'s Vericut 9.0 simulates real NC data on digital twin machines to prevent crashes, identify conflicts between setups and tooling, and ensure machined parts match engineering designs. According to the company, the software's graphics display provides crisp views, which can be rotated or zoomed while cutting, and it features several enhancements designed to increase power and improve efficiency. Instant access to viewing the workpiece, CNC machine or both saves time, and improved connectivity to tooling websites and cloud repositories auto-configures Vericut for optimization. Major functions can be used in any view and can easily switch between workpiece and machine views, layouts and docking arrangements.

The software provides more ways to section the part, streamlines setup for toolpath optimization and significant enhancements for lathe and mill-turn tooling. Vericut's force optimization reduces machining times up to 70%, even for superalloy metals. It enforces manufacturer's recommended cutting conditions to greatly extend tool life. The software also detects collisions and near-misses between all machine tool components. It simulates all types of CNC machining, including drilling and trimming of composite parts, water jet, riveting, robots, mill/turn and parallel kinematics. The software operates independently but can also be integrated with leading CAM systems.

**CGTech / 949-753-1050 / cgtech.com / Booth 1337 at WESTEC**



## Digital Tooling Products Provide High Accuracy and Reliable Results

**Big Kaiser** will display digital tooling innovations, as well as cutting-edge products and accessories, at WESTEC and EMO Hannover.

At WESTEC, the company will display Ewe fine boring heads range; the Torque Fit tool assembly accessory that tightens fixtures for collet chucks with an integrated torque measuring system; the Level Master Wireless, which enables leveling information to be read from a separate display device and ensures correctly achieved precision levels; the Speroni Essentia tool presetting and measuring system that efficiently measures tools offline, permitting the operator to achieve full machine productivity; and hydraulic tool holders with peripheral jet coolant holes that are ideal for high-precision five-axis machining, including straight shank types made exclusively for Swiss-type lathes for cutting tool changes with high accuracy and reliable results.

At EMO Hannover, the company will display the EWA system, which eliminates the need to stop the machine tool to take measurements and manually adjust the boring tool; the Mega Micro Coolant Nut, which enables more efficient coolant supply for the micro cutting tool; an updated hydraulic chuck with switchable coolant supply; smaller sizes of the C4 Turning Tools; the ChipFan, which provides a safer chip removal method; and C-Center Cutter Inserts, which include two new coated inserts, ACM250F for stainless steel and DS20 for aluminum, for expanded precision and versatility.

**BIG KAISER Precision Tooling Inc. / 888-866-5776 / bigkaiser.com / Booth 1745 at WESTEC / Hall 3, Stand B14 at EMO Hannover**

## Updated Control Panel Keeps Operators in Mind

**Eldorado** gundrilling machines now feature an updated operator control panel. While still using a PC-based system featuring Beckhoff controls, both the hardware and software have been improved with job shop operators in mind. The display screen has been enlarged to seven inches, which offers larger graphics and easier-to-read menus. Touchscreen capability has also been added to improve menu navigation. Large pushbuttons have replaced the keypad, which makes the control panel more durable and easier to use in a shop floor setting. For shops with older Eldorado machines, the control is available as a retrofit package.

The control also features CNC G-Code programming capability, which enables users to write their own gundrilling programs. This improves machine flexibility with options like variable feeds and speeds, drilling peck cycles, dwell times and many other basic G-Code capabilities. A USB connection for an external keyboard makes it easy to quickly type new G-Code programs while standing at the machine.

**Drill Masters-Eldorado Tool / 800-658-8855 / dmetool.com / Booth 824 at WESTEC**

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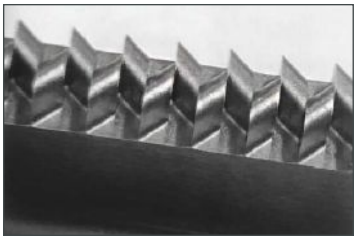
## Advanced Technology Solutions Take Processes to Next Productivity Level

**GF Machining Solutions** will highlight its range of Industry 4.0-enabling technologies at EMO Hannover 2019. The company will spotlight live application demonstrations illustrating cutting-edge technologies, as well as an Industry 4.0 corner dedicated to growing industrial segments and customers' shops both today and in the future.

The company's booth will include digital products, including the open platform communications unified architecture protocol, which collects and makes a wide range of data accessible for manufacturers to analyze and fine-tune processes. It will also include the AgieCharmilles Cut AM 500, a horizontal wire EDM solution; the Mikron Mill S 400 U with the Heidenhain TNC 640 contouring control represents the Mikron Mill S range of high-speed milling solutions with automated machine calibration; original manufacturing calibration; the AgieCharmilles Cut P 550 Pro with a human-machine interface to be launched in 2020; and the DMP Flex 350, a flexible metal 3D-printing solution from GF Machining Solutions and 3D Systems. Additionally, visitors will be able to see the new, updated design of GF Machining Solutions products.



**GF Machining Solutions / 847-913-5300 / gfms.com/us / Hall 27, Stand B26 at EMO Hannover**


## Vertical Machining Center Designed for Fast and Easy Five-Sided Parts

**Milltronics** Europe B.V. will unveil its VM250IL-5x five-axis VMC at EMO 2019. Utilizing the Milltronics Series 9000 control, the VM250IL-5x is designed for fast and easy five-sided parts. The company will also demonstrate its ChipBoss milling software, along with its bi-directional turning software.

ChipBoss milling software uses proprietary algorithms to calculate tool paths and control maximum cutter engagement, enabling the machinist to cut profiles at full depth. The software works by automatically controlling the tool's chip load, keeping it constant and resulting in faster cycle times, better tool life and more accurate parts. Cycles times (depending on geometry) can be reduced by as much as 50% percent with up to 3-5 times better tool life. The software also improves part accuracy through reduction in tool deflection.

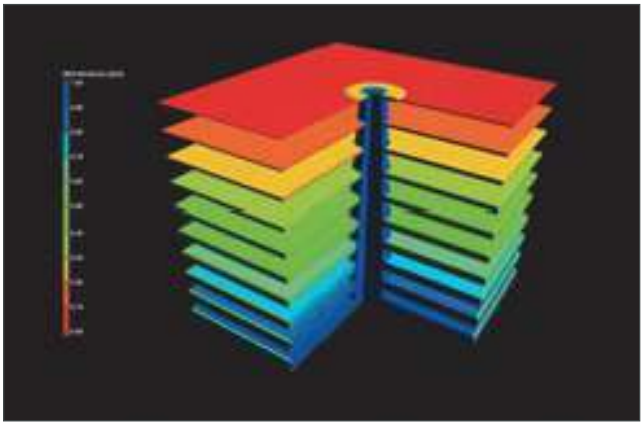
The bi-directional turning software, which will be demonstrated on a SL8II CNC lathe, effectively reduces the time it takes to turn parts by 50%. The bi-directional cycle allows for "zig-zag" (or bi-directional) turning, which results in significantly shorter cycle times.

**Milltronics USA / 888-999-1440 / milltronics.com / Hall 27, Stand F75 at EMO Hannover**

## Software Update Suited for Industrial Computed Tomography

**Volume Graphics** announces the latest generation of its software solutions for non-destructive quality assurance with industrial computed tomography (CT): Version 3.3 of VGStudio Max, VGStudio, VGMetrology and VGinLine. Updates in 3.3 include multi-material dimensioning, native Q-DAS support, OCR-based automation and high-quality volume meshing.

VGStudio Max software is used for analysis and visualization of industrial CT data and covers all requirements related to metrology, defect detection and assessment, material properties and simulation. Using the latest version, users can determine the surfaces of multi-material components, export measurement and analysis results to store them centrally in quality-management software, automate inspection processes more flexibly based on text recognition and translate real CT data into volume meshes for simulation. The latest updates facilitate segmentation of multi-material objects and includes native support for data export in Q-DAS format for both VGStudio Max and the VGMetrology metrology solution, as well as the VGinLine solution for automated CT inspection. Optical character recognition enables users to read out text in CT scans and store it in meta information. With the volume meshing module, users can create accurate and high-quality tetrahedral volume meshes from CT scans for use in mechanical, fluid, thermal, electrical and other FEM simulations in third party software. This is based directly on the subvoxel-accurate surface determination for scanned parts or material samples consisting of one or more materials. The individual components of multi-material objects are translated into volume meshes with congruent tetrahedron faces and shared nodes at material interfaces. Each cell of the generated volume mesh can be loaded with additional information required for simulation, such as fiber orientations, fiber volume fractions, porosity volume fractions or gray values.



To further support users, the company has also added a new technical consulting unit that provides professional consulting and evaluation services.

**Volume Graphics Inc. / 704-248-7736 / volumegraphics.com**

## ADVERTISERS' INDEX



## THIS MONTH ON SOCIAL MEDIA


### YouTube Videos

Take a look at some of the highlights from Amerimold 2019 in Rosemont, IL! youtube.com/c/moldmakingtechnology

### Popular Posts

For generations, robots have fascinated humankind, so it is no wonder that battling robots are magnets for youth and industry "veterans" today. Heidenhain was a sponsor of a recent National Robotics League battle bots competition at the California University of Pennsylvania. facebook.com/moldmakingtechnology

### @MMTMag Hot Tweets

Part of the fun of winning Leadtime Leader honors is celebrating with one's peers and team members at Amerimold. Twitter.com/MMTMag

### Conversations

As our systems continue to become more connected worldwide, more opportunities for an attacker to gain access to your network emerge. Growing frustration with the failure to keep data secure, the damage to reputation, the cost of investigating and addressing a breach, and potential legal ramifications continue to raise the risk of not addressing the threat. Since cybersecurity continues to be a critical issue for manufacturers, *MMT*'s Christina Fuges reached out to Paragon D&E's president David Muir to see how the company handles cyber threats. linkedin.com/company/moldmakingtechnology

### Photo Share

Never get tired of checking out these works of art. instagram.com/moldmakingtechnology

CUTTING TOOLS

# How to Achieve **Accelerated Milling**

By Vic Dodd

Cycle time plays a major role in productivity and often determines the profitability of any given job in today's hypercompetitive machining market. Simply increasing the speed or revolutions per minute (RPM) may appear to decrease cycle time. However, the time it takes to change inserts hampers any reduction in cycle time, as the increase in speed or RPM shortens tool life, increasing cutting tool cost.

High-feed milling (HFM) is a solution to this problem. The tool works at elevated feed rates with modest speed or RPM, which reduces cycle time while extending tool life. These flexible and versatile tools can yield dramatically reduced cycle time and cost, long tool life and high-quality finished parts.

## How It Works

First used in mold and die machining, HFM pairs shallow depth of cut with a high feed rate up to 0.08-inch per tooth to maximize the amount of metal being removed from a part, resulting in machining more parts faster.

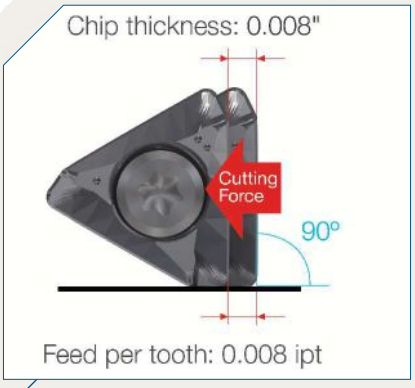
First used in mold and die machining, HFM pairs shallow depth of cut with a high feed rate up to 0.08-inch per tooth to maximize the amount of metal being removed from a part, resulting in machining more parts faster.

The HFM mechanism is based on the chip thinning principle. Chip thinning depends on the lead angle of a milling cutter. A cutter with a 90-degree lead angle has no benefit of chip thinning, as 0.008-inch of feed per tooth only delivers the same 0.008-inch of chip thickness. In the case of a cutter with a 45-degree lead angle, a 0.01-inch of feed per tooth creates a 0.007-inch of chip thickness, which allows the feed to be increased, resulting in reduced cycle time.

HFM specializes in long-reach applications such as deep-hole and pocket machining. Its ramping capability allows the high-feed cutter to perform helical interpolation (when the tool moves in a circular motion to the X and Y axis, while simultaneously moving downward on the Z axis).

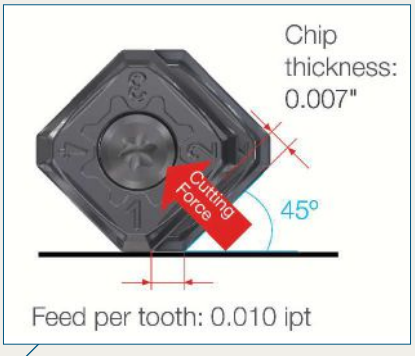
When it comes to large parts, HFM is strong and fast, but machinists must make an additional finishing pass to clean up the rough surface it generates. Today with the incorporation of wiper inserts, HFM cutters can deliver an outstanding surface finish with a slight reduction in feed rate on the final finish pass, improving the efficiency of the overall machining process by reducing the need for a finish tool.

Despite the small depth of cut of HFM, it provides a high metal removal rate, which makes workpiece materials closer to the desired shape in one operation. HFM can often eliminate semi-finishing operations and simplify the finishing process. This characteristic is ideal for 3D machining. MMT

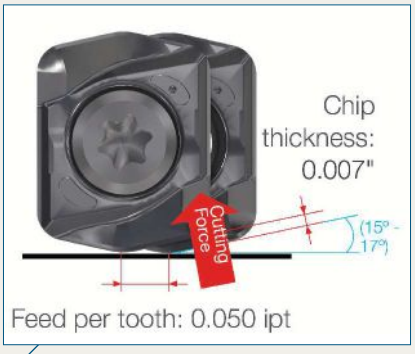



Figures courtesy of Tungaloy America.

A 90-degree cutter produces cutting force that acts perpendicular to the spindle, putting incredible pressure on the tool.




Cutting force acts against the spindle at a 45-degree angle for a 45-degree cutter.




The chip thinning effect is where a 0.05-inch of feed per tooth provides chip thickness of only 0.007-inch, and cycle time is typically decreased by 50% or more. Low cutting force is also an HFM benefit. The lead angle on a cutter decides the direction of the cutting force.

CONTRIBUTOR

Vic Dodd is a product manager for rotating tooling for Tungaloy America.

**FOR MORE INFORMATION**

Tungaloy America / 630-227-3700 / info@tungaloyamerica.com / tungaloy.com/us / mdodd@tungaloyamerica.com

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