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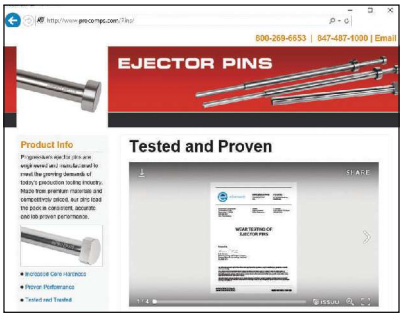

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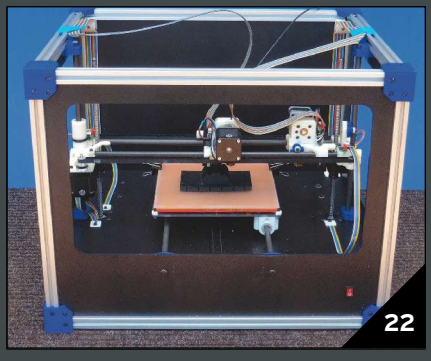

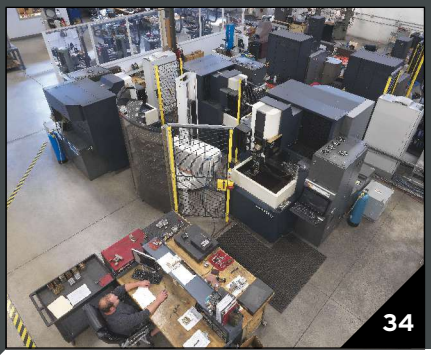

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ON THE COVER

Image courtesy of Schmolz + Bickenbach USA. This month's cover shows a mold made from Corroplast FM, a pre-hardened, free-machining, stainless steel mold base material, ideal for resisting corrosion that is associated with high-humidity environments and for occasions when corrosive resins are used in production. This material also is an optimal mold base material for medical and food packaging applications. Corroplast FM exhibits homogenous microstructure for improved machinability, re-sulphurized chemistry for optimal machinability, minimal levels of coarse carbides to improve cutter life and reduced carbon and higher chrome content for improved corrosion resistance. See the related story on **page 14**.

Images (left to right) courtesy of Master Tool and Mold Inc., Avante Technology LLC and Makino.

VIDEO ACCESS

5 TRICKS OF THE TRADE
Great Tips from This Issue

1. Intense Prices
Electrodes are causing mold material price increases because electrodes are in short supply. Graphite electrodes are the key heating element used to create the intense heat needed to run an electric arc furnace in a steel factory.
PG. 14.

2. Customers First
Understanding customers' business and providing mold designs that give them a strategic advantage are key to remaining competitive.
PG. 30.

3. Automation ROI
Summit Tooling got a full return on the investment of its automated manufacturing cell about six months after installation. Sales doubled even as the group continued to run one shift and maintained the size of the staff.
PG. 34.

4. Tax Tips
Under the Tax Cuts and Jobs Act of 2017, a mold shop that leases a piece of equipment and then purchases the equipment will not qualify for bonus depreciation because the equipment is not new to the mold shop.
PG. 38.

5. Powerful Duo
CAD-for-CAM tools enable quick, temporary model changes that do not impact the final part design but can streamline toolpath generation and promote better part finishes.
PG. 48.

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Then and Now

This year has been a bit reflective for me so far as I look back on 20 years of covering the moldmaking industry. One of the things that has come to light is the topics. After two decades, the topics are fairly consistent, but each iteration of key topics becomes more and more advanced.

In 1998, we were covering:
- Network infrastructure
- Mold material selection
- Hot runners
- High-speed machining
- At-the-machine CAM
- ISO certification
- Polishing
- Hard skills training
- Welding
- Vertical machining centers
- EDM as the focus of an entire issue
- Texturing
- Customer communication
- Mold spotting
- Mold heating
- Employee stock ownership plans
- Anticorrosion solutions
- CAM automation
- Rapid prototyping/tooling

Today, we are discussing:
- IoT and Industry 4.0
- Data management
- Aluminum molds
- Robots and cobots
- Lights-out production
- EDM automation and reduction
- Hot runner controllers
- Multi-tasking and hybrid machines
- Massive machine tools
- Modular and high-feed tooling
- Software automation
- Process simulation
- Laser welding
- Reduced polishing
- Better surface treatment
- Additive manufacturing
- Five-axis machining
- Local-level training
- ISO updates
- Supply chain management
- Workforce development

Some of the big advances in 20 years have been automation, standardized mold components, more hot-runner usage, five-axis machining becoming more common, fine-tuned inspection processes, maintenance and repair becoming more than just an afterthought, the use of 3D printing for conformal cooling inserts and an increased interest in learning about plastics, plastic processing and molding.

Overall, I would say that the biggest gamechanger for moldmaking over the past 20 years has been data. From mold design, 3D printing, quoting, job scheduling, machining, automation, inspection, measurement and maintenance, data impacts products and processes across the entire moldmaking operation. Data is king. Now it is a question of learning what to do with all this data that is available to gather and analyze. MMT

Christina Fuges

Christina M. Fuges
Editorial Director

Follow MMT on: Follow @MMT_ChristinaF

THIS MONTH ON moldmakingtechnology.com

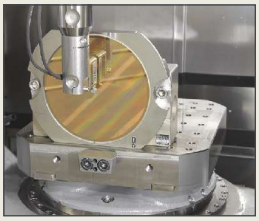
VIDEO: Five-Axis Machining Giant Tackles Large Machining Projects

Baker Industries installed an Emco Mecof PowerMill five-axis machining center, which is the largest and most versatile milling center in the Midwest region and the first of its kind to enter the United States. Baker Industries installed this machine to expand its capacity in servicing original equipment manufacturer and Tier 1 customers' largest machining projects.
short.moldmakingtechnology.com/baker

BLOG: MoldMaking Technology Celebrates 20-Year Anniversary

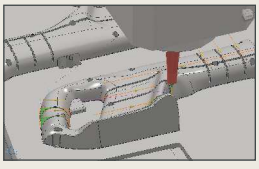
Editorial Director Christina Fuges notes the 20-year anniversary of *MoldMaking Technology* and the upcoming coverage planned for 2018. Founded in 1998, *MoldMaking Technology* remains committed to everything moldmaking, from design to first shot. The *MoldMaking Technology* team is honored to celebrate this milestone with the industry and looks forward to many more years.
short.moldmakingtechnology.com/20mmt

SLIDESHOW: A Mix of Machining Products



As NPE, Amerimold and IMTS gear up, Managing Editor Karen Cornelissen shares some of the latest machining centers, machining accessories and innovations on the machining market.
short.moldmakingtechnology.com/mixmachine

WEBINAR: The Key to Optimal Machining Productivity



In this webinar, Autodesk demonstrates how moldmakers can machine the most complex cavities, cores and sliders that require no manual polishing or re-work with exceptional levels of precision and quality using the latest CAM solution.
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Technology Considerations

Will J. Cipkar
Technical Sales
Crest Mold
Ontario, Canada

Will Cipkar, MMT *EAB member and Crest Mold technical sales manager, shares his factors to consider before investing in new technology. He believes that as technology evolves, so must manufacturers to keep pace with customer expectations. However, companies often see the next big thing and make an investment before fully understanding its capabilities, potential and impact. Instead, companies need to take an initial pause and ask the question: Is this new machine or new software going to drastically improve the business?*

I've seen companies buy new technology and assume it is going to take the business to the next level. While that is often the case, there are real instances when that same approach ruins a company. It is always a good idea to take a step back and evaluate your business for areas to improve before buying a new product or piece of equipment. This includes identifying personnel challenges and bottlenecks.

People. If you have talented people pushing the limits of the equipment you currently have on the shop floor, then the burden of performance falls on the company to empower these people with better tools for continuous improvement.

You know that a new machine has its own costs, but what about the personnel required to operate it? Are you bringing in a technology that is completely foreign to the team? If so, you are now looking at another big investment in people, which entails either providing training on the new technology or hiring new staff that have more experience with the new technology.

That fancy new technology is only as good as the person who is driving it. Investing in people will always pay far more dividends than the technology itself. This is because a talented employee will grow with your business and become an asset, whereas machines have hard limitations.

Bottlenecks. Improving current workflow is always a win. If bringing in a new CNC machine will drastically improve quality and efficiency because it cuts faster and offers more options (like multi-axis capabilities) that can reduce other operations that require longer cutting (like EDM and polishing), the machine will pay for itself quickly.

Another workflow consideration is outsourcing. Most shops outsource work because of the ebbs and flows in the industry. How do you know if it is time to bring that work in-house by investing in the technology to do it yourself? Outsourcing can be tracked and assigned a dollar value. Simply put, if the cost of a new machine is less than the average total work you send out each year, then new technology may be a worthwhile investment. MMT

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A Conversation with ...

Master Tool and Mold Inc.

Image courtesy of Master Tool and Mold Inc.

It's all about family, family values and a versatile, cross-trained team at Master Tool and Mold. Family includes the shop dog, Donuts. Here, company President Jim Sperber and his daughter, Kat Froehlich, flank a large mold that the company's team of 10 built using OKK CNC machining centers that run 24/7 without automation.

How do you manage workflow 24/7 with 10 employees working one shift?

Jim Sperber, president: At Master Tool and Mold Inc. (MTM), we do not run automation, but all of our machines can run multiple tools and multiple programs unattended through the nights and weekends. Our ability to react quickly and efficiently to our customers' needs is key. I tell customers that if they call me at 5 a.m. on any day (except Sunday, when I am at church until 9 a.m.), I will be there within the hour to pick up a job, and we will be ready with any parts needed to dive into the job and get it done.

Also, MTM is fortunate to have a great team of dedicated employees who have a wide array of skills. Cross-training is essential. Our moldmakers are highly skilled CAD operators, designers and programmers. They know how to run the EDM and CNC machines, grinders and other equipment, they can polish tooling, and they are always willing to extend their skill sets to include new advances in the field. We call it great teamwork because our employees train each other without a formal training program in place. The team is routinely updated on the latest Solidworks and PowerMill software through training, and we regularly send them to American Mold Builders Association (AMBA) conferences, webinars and vendor classes and demonstrations to learn the latest technologies. At an AMBA conference in 1994 and 1995, for example, one of the keynote speakers said, "High-speed machinery, controls, programs and software will change. Iron won't change, so buy a good chunk of iron." This was a pivotal moment. From then on, we were committed to quality iron and machinery, particularly OKK machining centers.

Additionally, we expanded our building by adding 4,000 square feet in the third quarter of 2015. This made it possible to add several new machines, including an OKK VR76 vertical machining center equipped with a Mitsubishi M830 control (the first control like it in the United States at the time). We purchased cranes that can lift heavier molds and workpieces than what we previously used. With our new capabilities, we can build a 32-cavity unscrewing mold, a 20,000-lb. stack mold, and a single-cavity prototype mud insert, all while keeping up with our daily, and sometimes hourly, repair work (which we pick up and deliver) to keep our customers up and running.

Does MTM have a special, niche market?

Sperber: Our niche is that we do not have a niche. We focus on whatever our customer is focusing on, and that provides for a diverse customer base. If we can lift it, we will do it. No is not an option. Most shops target a specific type of work, but we target a specific type of customer—a customer who does a great variety of work. That's where the variety comes into play. Our ability to run constant repairs fills in all the

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- Was founded in 1972 by Lyle Sperber, father of current owner and president Jim Sperber, who purchased the business in 2005.
- Is based out of a recently expanded, 10,000-square-foot facility with 10 full-time employees.
- Builds plastic injection molds and diecast dies and offers part and mold design, sampling and "extremely fast and precise repair work."
- Builds molds for the medical, housewares, lawn and garden, automotive, recreational and plumbing industries.

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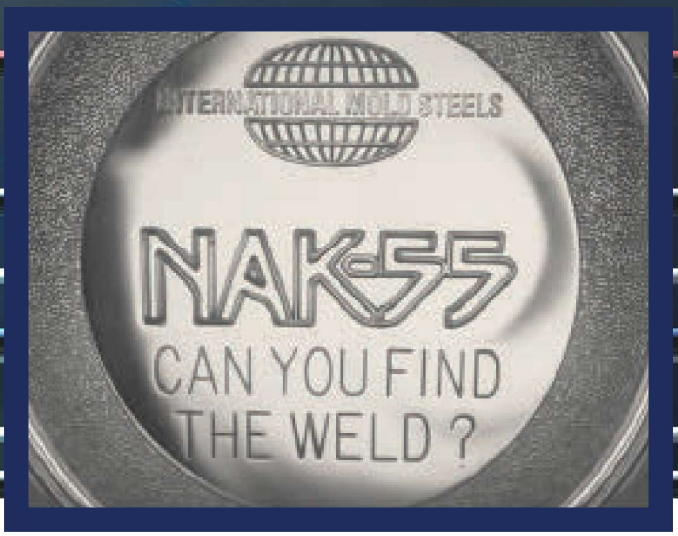

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other gaps. My father Lyle's shop was small, but he knew that with hard work, dedication and sights set on the future, the shop would grow and become an integral part of manufacturing. That is still our way.

What systems or tools does MTM use to manage customer relationships and grow?

Sperber: MTM has taken big steps over the last few years to grow in its approach to business and to adapt to a new era of technology and information. For example, we launched a new, cloud-based sales program, Salesforce CRM, to help build and manage our customer base. Salesforce is a data management software. If we hear that Molder X is expanding and could be a good fit for us, we will put that company's information into Salesforce and customize when and how we want to interact (via email, sending a brochure, calling them and so on). Once this information is entered, the program will track how often we contact Molder X, our quote-to-job ratio with this customer and if we should stop quoting and move on to other opportunities based upon our quoting history. Additionally, Salesforce reminds us who we are due to contact in a particular week or month (including both potential and current customers). It's easy for small business owners to be sidetracked by the technical end of our work and forget about the importance of sales.

By the same token, customers who work with us get a personalized experience. Although plenty of work and sales take place online, we have found that strengthening our relationships with our customers strengthens our employees and our business. MTM's first "big" project was a 32-cavity mold that produced the top of the Kraft Parmesan cheese shaker container that is still in use today. Much has changed in the 46 years since we built that first mold. The world is changing and many of the smaller shops and industries have moved forward with a greater emphasis on production and profits. We believe that the best possible business encompasses a mixture of old family values like honesty, integrity, quality work at a good pace and the best price for the best work, integrated with modern technology and advancements.

What is MTM's next-generation workforce strategy?

Sperber: MTM is moving into the future with the best team possible for progress and innovative ideas. My daughter Kathryn (Kat), who has a Master of Science degree in Compliance and Business Ethics, keeps the business running. She upholds OSHA standards along with its consistent and cumulative regulations and passes along the training programs that are OSHA-proof to any other business that needs help with OSHA compliance. She maintains the front office and is an integral part of the daily management of MTM.

Workforce development is a passion of ours. Young adults have come to believe that the only option for financial, social and personal success is through a university degree. In addition, many schools have phased out the important classes that focus on skilled trades. At MTM, we have addressed these issues by working with local high schools and bringing students into our shop to show them the process behind their studies. For example, an engineering class at a local high school created a key ring tag with the school's logo. The students designed the mold and then MTM built it while they witnessed the process. The students were able to visualize the idea and bring it to a real event.

We also have our shop dog, Donuts, who is so-named because our people have to bring in donuts on their birthdays or when they are late to work! MMT

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By Cynthia Kustush

This article is part of a series of roundtable discussions with industry suppliers addressing recent trends in moldmaking, the challenges moldmakers are experiencing and the latest solutions that are or will be available to resolve them.

Performance and Price Drive Developments in Mold Materials

Mold material suppliers are working to develop new, improved mold-material grades that will deliver on customers' need for machinability, toughness, thermal conductivity and price.

With increasingly complex mold designs comes the need for mold materials that enable moldmakers to machine cores and cavities more efficiently, keep production costs down and meet short delivery times. *MoldMaking Technology* approached a few materials suppliers to get the latest scoop on mold material trends and the driving forces behind them.

Material Usage Trends

All five material supplier companies participating in this feature called out the resurgence in moldmakers' use of pre-hardened materials. Rich Polenick, technical manager at Ellwood Specialty Steel (New Castle, Pennsylvania), says, "Moldmakers are looking for higher hardness levels that promote the ability to polish for critical-finish molded parts like lenses. Consumers like all the design-driven frills that are offered in the automotive sector. For example, there are these large instrument panel tools with geometric patterns, Class 8 highway trucks with large, textured internal and external parts and lens components that keep increasing in size. With all these new demands come challenges like achieving a perfect result using acid etching methods for intricate texture patterns, especially for tools that have large, molded surface areas."

Moldmakers are looking for higher hardness levels that promote the ability to polish for critical-finish molded parts like lenses.

Paul Britton, vice president and director at International Mold Steel Inc. (Florence, Kentucky), attributes the revival of pre-hardened materials to moldmakers' need for quicker turnaround on lead times. He adds that customers also are looking at non-traditional mold steels for certain applications. "For example, one customer had a 48-percent glass-filled material and needed something harder than a typical H-13 or S-7 material so he would not have to coat the mold," he says. "Others are building molds for thin-walled parts, with cores that are very thin—thin enough where, if the cores are not inserted, they will break. For that, they need something tougher because P20 or H13 just isn't strong enough."

John Stocker, sales director at Schmolz + Bickenbach USA (Carol Stream, Illinois), says that in addition to the increased use of pre-hardened materials, many moldmakers are looking to material suppliers for additional, value-added services like phase-one machining, which includes providing six-sided machining and holes for eyebolts. "The benefit is that they can streamline their processes by eliminating the time-consuming preparation work, which in turn enables them to use their highly skilled employees more efficiently and effectively," he says.

Kilian Wagner, sales director at Edro Specialty Steels, exclusive distributor of Bohler tool steels in the United States (Walnut, California), says, "The introduction of low-carbon steel grades combined with new re-melting techniques (like pressurized electroslag re-melting processes (ESR)) has resulted in the development of new grades with improved toughness, cleanliness and thermal conductivity. For example, a new modified 420-type has shown similar levels of toughness (in impact-bending strength) to H13 ESR and thermal conductivity improvements that exceed 30 percent in comparison to standard 420 ESR," he says, noting that for superior toughness, vacuum melt and re-melt (VMR) grades also are commonly used. "Other interesting developments are powder metallurgical grades and special, high-alloyed products that offer other outstanding properties for a variety of special requirements. Finally, additively manufactured mold components designed with new, conformal-cooled geometries are trending."

Image courtesy of Ellwood Specialty Steel.

Forged blocks of mold and die steel are stacked for shipment to mold manufacturers across the United States from Ellwood Specialty Steel. Demand is up, suppliers say, but materials are in shorter supply, and therefore prices are going up. To serve customers' needs better, suppliers are developing new grades of steel to improve performance characteristics like hardness, installing equipment to process orders more quickly and educating customers so they can choose the best material for their projects.

As much as demand for pre-hardened materials is on the rise, Wagner says that surface treatments continue to play a critical role for moldmaking and molding. "The use of surface coatings for mold inserts is increasing, relating to features like wear resistance, part release and surface finish. More coating choices are available today that provide solutions for specific applications," he says. For example, diamond-like carbon (DLC) coatings can provide hard substrate surfaces and are suitable for use on most materials. Also, DLC is typically applied below tempering temperatures, making it eligible for most steels.

An Education in Mold Materials

"With the market picking up and metal prices on the rise, we have seen more interest in materials education," says David Wirth, mold plate product manager at Clinton Aluminum and Stainless Steel (Clinton, Ohio). "Metal pricing has gone up tremendously, so moldmakers are being even more diligent about finding the right aluminum alloy for the right application." He explains that it can be a frustrating task for moldmakers to select the material that is best suited to deliver their desired results. This is because no two alloys are alike—each has its own strengths and weaknesses. It is important to understand how the varying grades of alloys react to molding temperatures. For instance, on paper, a 7,000-series aluminum product is the toughest out there, but moldmakers molding at high temperatures of about 280°F or higher will probably experience some problems regarding mechanical properties.

Paul Britton of International Mold Steel concurs with the steel pricing trend, saying that the industry is seeing some shortages regarding what suppliers are carrying in inventory. "Electrodes are causing the price increases because they are in short supply. Electrodes are necessary to make steel." Graphite electrodes are the main heating element used to produce the intense heat (2,912°F) that is needed to run an electric arc furnace in a steel factory. In mid-2017, after about four years of a soft market and surplus materials, the U.S. steel industry rebounded. Still, many graphite electrode producers closed their doors. This happened domestically because of low capacity utilization and in China because environmental restrictions were put in place, and the closings caused the current shortage. "One major electrode supplier closed, and another major supplier in China is raising prices. Most of the major materials suppliers have announced price increases because of changes like this that are occurring in the steel marketplace," he says. "Business for moldmakers seems to be steady or is even picking up, making lead times longer because of low inventory. Suppliers are simply running out, and this applies to almost every grade of steel." To address these challenges, Britton says that International Mold Steel is increasing the tonnage on its floor and adding new equipment to keep delivery times at a minimum. "We are trying to minimize the pricing increases, but we can only absorb so much, so we are adding materials handling equipment, saws and so on to speed production and order fulfillment," he says.

Kilian Wagner of Edro Specialty Steels says, "Many end users specify traditional AISI-designated tool-steel grades and heat treatments for their molds. This limits the moldmakers' own input and choice of materials. At Edro, the availability of information on new products and the technical support for these products is a core focus." He says that soon the company will introduce several unique tool-steel grades that were developed and introduced outside of the United States over the last five to 10 years. The company will place a strong focus on education and technical training to ensure that customers know what is available and how these products can help the performance of their tooling.

> The introduction of low-carbon steel grades combined with new re-melting techniques has resulted in the development of new grades with improved toughness, cleanliness and thermal conductivity.

Rich Polenick says that Ellwood Specialty Steel's in-house R&D team continues to evaluate improvements in mold steels. "However, improving moldmaking, maintenance and repair or even the molding process is a tall task for steel. As in all

business decisions, there is a cost-to-benefit factor," he says. "One can use alloy steels of a higher level that may perform better in different applications, can polish more easily, texture better, run faster in a mold or have better mechanical properties, but they are more expensive than the traditional low-alloy mold steels. Cost is always a driving factor in material selection." To assist, he says that Ellwood Specialty Steel offers group seminars to original equipment manufacturers (OEMs), Tier-1 suppliers and moldmakers to learn more about the process of steelmaking, forging and heat-treating. "This seminar also enables all parties to understand specific challenges that we all face, like mold life, maintenance or cooling and cycle time and brainstorm on innovative or collaborative ways to address these issues. Ellwood Specialty Steel has deep metallurgical experience and our doors are always open to help solve our customers' challenges."

Greater Acceptance of Aluminum

While tool steels remain the materials of choice for moldmaking, suppliers are noting that aluminum also continues to make a strong showing. "There is increasing interest in aluminum mold products in an array of applications," David Wirth of Clinton Aluminum and Stainless Steel says.

Image courtesy of Franchino Mold and Engineering.

The use of aluminum alloys for larger molds is increasing because of price, weight and cycle-time reduction benefits. Suppliers have developed new alloys that are proven to be capable of high volume production and of withstanding the rigors of those processes over time.

"For example, we were recently contacted by a blow molder interested in an alternative to an expensive, forged material. After discussing the project, we learned that the pinch area was to be inserted with beryllium copper. We then directed them to a cast aluminum product that is more readily available, easier to repair and more cost effective." He says that cycle-time reduction is the biggest reason for choosing aluminum. "If 50 percent of the cost of a part for the OEM is press time, and it is possible to save 15–30 percent on cycle time, then that's the motivating factor."

Wirth adds that as the mold industry moves toward larger aluminum molds because of price, weight and cycle-time reduction, there is an increased need for thicker and wider moldmaking materials. "Clinton Aluminum now offers mold plate up to 42 inches thick," he says. Clinton Aluminum and Stainless Steel also has recently added several new alloys that Wirth says will serve to fill the void between cast aluminum and a less available, costlier forged product when it comes to Brinell hardness and tensile strength. "Because moldmakers are pushed for faster lead times, the availability of material will be more crucial than ever," he says.

Ellwood Specialty Steel's Rich Polenick says that there is greater acceptance of aluminum alloys to build production molds for high-volume parts. "Aluminum alloys were traditionally used only for prototype tooling because they were easily machined and suited the need for molding limited quantities of parts. But, they were considered 'soft' and inappropriate for the making of long-term, high-volume parts," he says. "Aluminum alloys have recently been developed that have been proven to be capable of high volumes and of withstanding the rigors of those processes over time." He notes that packaging applications have used aluminum for quite some time while the automotive industry is gaining acceptance as their vehicles become more high-mix or low-volume regarding production needs. "Hardened-steel molds may not be required," he says. "Most importantly, the higher thermal conductivity of aluminum yields the benefit of faster cycle times."

Striving for Better Materials Performance

Polenick says that Ellwood Specialty Steel has a 108-year history in metalworking and is always working to develop better products for its customers, including ongoing testing and development of steels in the company's core molding grades (P20, H13 and stainless steels). "Efforts are focused on the production of cleaner steels, which are those that contain fewer non-metallic inclusions that are always found in steelmaking

because of the process and the alloying elements. Cleaner steels can address the aforementioned mold-finish challenges while maintaining the mechanical properties that are expected," he says, adding that great improvements have been made by all steel producers in this. Also, the company is evaluating the expansion of its re-melt steelmaking capacity, and its research metallurgists have been exploring a grade of P20 steel (the most common grade for injection molds) that will help mitigate the risk for potential polishing or texturing issues.

Kilian Wagner of Edro Specialty Steels says that the company's research and development team is dedicated to supporting new tool-steel product advances that deliver advantages in the areas of toughness, machinability, the ability to polish and thermal conductivity, to name a few. These advances can be found in innovative alloying concepts, new production processes, surface treatments and in the new kid on the block: additive manufacturing.

Meanwhile, International Mold Steel's Paul Britton says that his company is working to develop more stable materials that do not move during heavy machining or welding processes, higher-hardness materials and materials with a finer grain structure. "We are always looking to bring in new products to help moldmakers with repair, maintenance and molding," he says. Schmolz + Bickenbach USA's John Stocker says that his company also has developed materials with machinability, mold repair and maintenance and mold performance in mind. For example, customers have access to materials with improved weldability to increase the efficiency of maintaining molds. "Because domestic moldmakers are continually challenged to reduce lead times, our company seeks to provide new materials and value-added solutions that make it possible for our customers to optimize efficiencies in the moldmaking process and improve mold performance," he says. MMT

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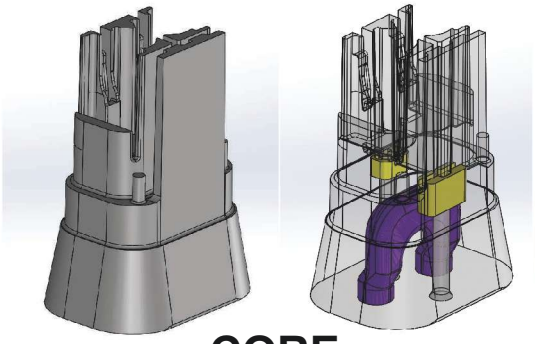

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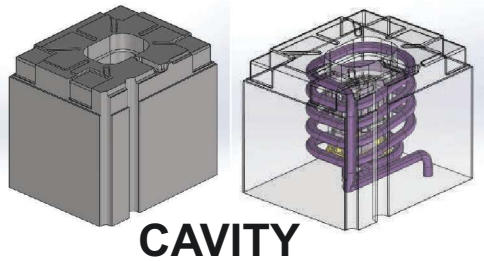

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By Rocky Huber

Unintended Consequences of Maximized Cooling

Here are five reasons *not* to maximize coolant flow rates with cores that are cooled by bubbler tubes.

The plastics industry has been incorrectly sizing waterlines for years. This is most prevalent in mold designs that use bubblers to deliver the cooling medium. In the equivalent hydraulic diameter method (DH = 4A/P), "dh" is the hydraulic diameter, "A" is the area section of the passage, and "P" is the perimeter of the passage. Using this method to determine the correct bubbler size to maximize coolant flow rates increases water flow, reduces clogging and decreases cycle time. However, it also can have some unexpected, negative results.

Here are five reasons not to maximize coolant flow rates, especially when using bubbler tubes to cool the cores.

1. Incomplete cavity fill. When sizing bubblers using the equivalent hydraulic diameter method, the cooling is so drastically increased that thin sections of the part may freeze before the cavity filling is complete.

Figure 1 shows an example of a polycarbonate part with an L/T (length-to-thickness) ratio of less than 65 and a final wall thickness of 0.027 of an inch (0.68 millimeter). The moldmaker heated the mold for this part to 160–200°F and injected the polycarbonate at pressures up to 40,000 psi (pounds per square inch). Also, the part was valve-gated at the top flange. When the moldmaker installed an optimized smaller bubbler, the part froze prematurely and could not be filled. The optimized bubbler allowed fluid to pass through the bubbler/core circuit at a rate of 5 gallons per minute.

The part was injection-molded successfully using a standard-sized bubbler that gave equal area inside and outside of the bubbler. The standardized bubbler also greatly reduced the flow rate to 0.7 gallons per minute. The problem was not temperature. It was heat transfer.

2. Wide variation in shrinkage rates. In parts with thick and thin sections, there will be a wider difference in shrinkage rates. The thin sections of a plastic part cool very rapidly because of increased heat transfer that occurs when using bubblers sized with the equivalent hydraulic diameter method. The thick sections cool faster too, but the thin sections freeze so quickly that the expected shrinkage rate is not achieved. As a result, there may be very little shrinkage in the part's thinner sections (see **Figure 2**).

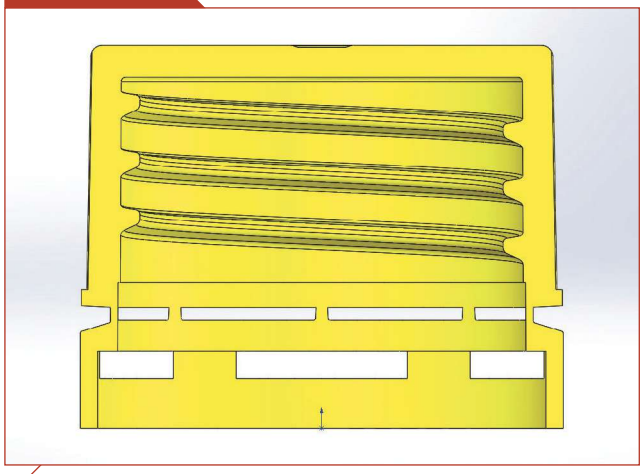
3. Excessive flow rates. Larger parts that permit more room for increased cooling channel sizes can have excessive coolant flow in the mold. It is important for moldmakers to calculate the appropriate amount of cooling when incorporating the cooling system into the mold design. It can be expensive and wasteful to exceed the amount of cooling that is required.

FIGURE 1

This polycarbonate part with an L/T (length-to-thickness) ratio of less than 65 and a final wall thickness of 0.027 of an inch (0.68 millimeter) was successfully injection-molded using a standard-sized bubbler.

Figures courtesy of DZynSource.

FIGURE 2



The tamper-evident band in this part, which has thick and thin sections, barely shrank. If a steel-safe adjustment is an economical option, then this may not be a problem. Mold design is critical here. Ask this question: If the molded part is too large in the area with the thin-wall section, can a steel-safe adjustment be made economically? If not, then go back to the larger bubbler and the lower heat-transfer rate. With a little advanced planning at the design stage, a moldmaker can make both optimized and standard bubblers and interchange them as required.

For example, a moldmaker designed and built a 2 by 64 stack mold for a closure, with a 38-millimeter major diameter thread and a height of 0.400 of an inch inside the cap, without calculating the actual cooling requirements for the mold. The part was a 3-gram polypropylene cap with wall thicknesses in the 0.040–0.050 of an inch range and with maximized cooling. The moldmaker pumped water through the mold at 275 gallons per minute. The moldmaker calculated the amount of water that was necessary to remove the heat from these caps and discovered that the required minimum coolant flow was closer to 50 gallons per minute. Much energy was wasted pumping the excess water through the mold at 225 gallons per minute.

4. Molded-in stresses. When the cooling rate is not the same on both sides of a molded part, the result is molded-in stress. For example, when using semi-crystalline materials, the slower cooling side will form larger crystals that shrink more than smaller crystals, which results in excessive stress and warpage. Amorphous materials shrink more on the slower cooling side as well, and the corners of rectangular parts with sidewalls often cool last, which can cause parts to deform inward.

5. Gate freeze. When adding cooling to a cavity, sprue or gate insert, particularly with hot runner molds, moldmakers need to ensure that the cooling is appropriate, as the heated probe may not be able to supply enough heat to keep the gate open. The hot runner supplier can provide cooling recommendations and cooling design approval.

The bottom line is that moldmakers must put more engineering into mold designs to avoid the added expense and problems of over-designing and under-designing molds. The key is properly calculating the required amount and location of cooling. MMT

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By Christina Fuges

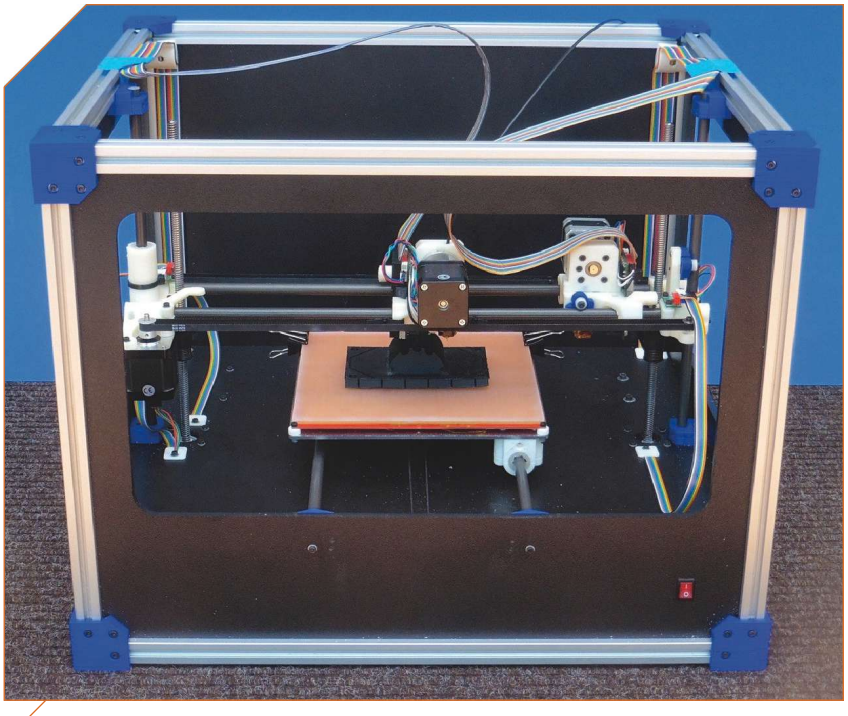
Democratizing 3D Printing of Injection Molds

Full-service design and mold delivery, moldmaking materials and a low-cost, high-precision printer minimize the technical risk of 3D-printed mold tryout.

Bob Zollo believes we have been doing it all wrong: using the wrong materials, building inaccurate machines and improperly designing parts for additive manufacturing (AM). Rather than selecting these parameters from existing options, Zollo has actively developed 3D printing materials, technology and design guidelines specifically for 3D-printed injection molds.

Zollo is a founder and CEO of Avante Technology LLC (Cheyenne, Wyoming), which focuses on assisting companies seeking to incorporate desktop fused deposition modeling (FDM) 3D printing as part of their process. He started out as a field application engineer for Pfizer's industrial division, developing custom proprietary plastic formulations. He then launched a design and integration firm focused on custom projects for original equipment manufacturers (OEMs) in business-to-business and business-to-consumer industries, which has been in business for 26 years. One such project in 2012 involved an OEM customer looking to get into building desktop 3D printers. Zollo was asked to develop the controller and software stack for the machine. Before he began the project, he recommended a technical audit of their machine design as well as others on the market to see if their expectations were realistic. The audit revealed 22 issues related to the quality and precision of the part produced, of which the most glaring was materials.

"Back then, there were limited material choices. For example, PLA, ABS and a little bit of nylon were available, none of which were exactly the materials typically used to produce precise extrusions or useful parts," Zollo says. So, he decided to recommend new materials with better mechanical and printing performance. The customer said, "It's only plastic; what's the big deal?" And that was his "eureka" moment.



Images courtesy of Avante Technology, LLC.

This proprietary, high-precision desktop 3D printer has automatic print bed contour profiling and spring-loaded pins to measure the exact height of 25 points on the print bed.

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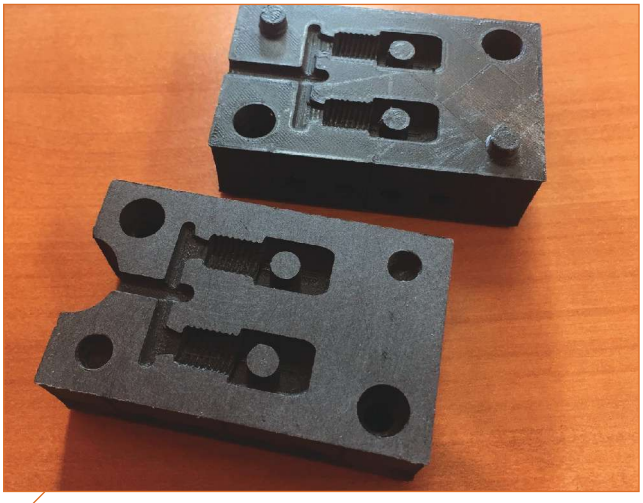
Material Matters

Zollo now understood that the industry was ill-equipped to make significant advancements in 3D printing due to a lack of technical understanding of plastics and how to apply material science. He also identified a gap between his customers' engineering knowledge of part and tooling design and his company's expertise in designing for 3D printing using FDM extrusion technology and optimizing printing strategies for high-precision parts.

There are thousands of experienced engineers trained in designing parts and molds using traditional, subtractive manufacturing technology, and there is a growing number of engineers with some level of experience or training in 3D printing parts. However, at this time, there are very few engineers who have both skill sets and fewer yet who have relevant experience in designing, printing and using plastic 3D-printed molds, according to Zollo.

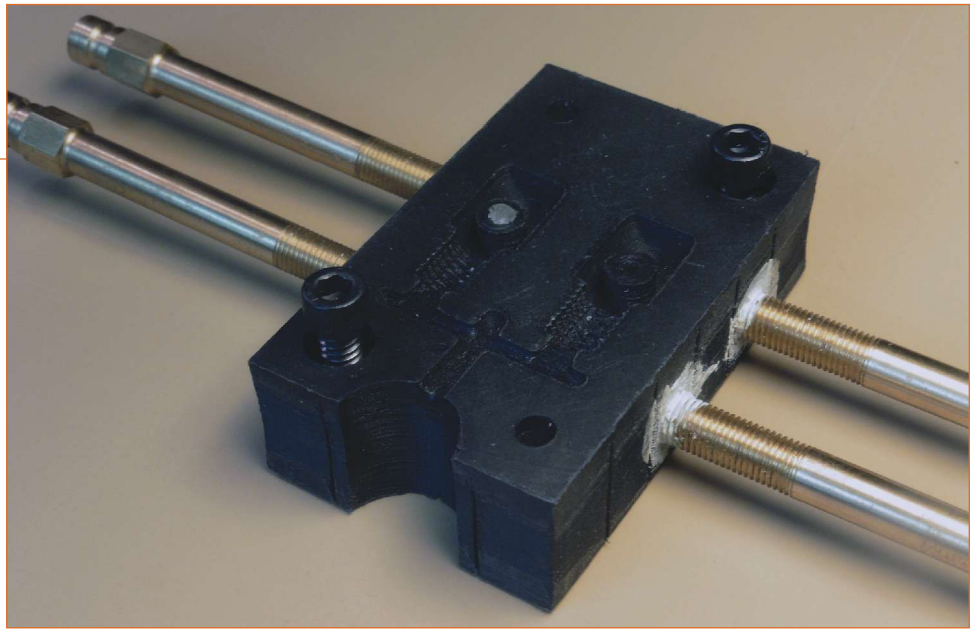
Zollo believes that this lack of know-how in designing injection molds for 3D printing is the next major obstacle to a broader adoption manufacturers 3D-printing molds. Designing injection molds is all about managing plastics flow and transferring heat efficiently. Printed plastic composite molds differ from metal molds in their surface energy, mechanical strength and heat conductance, Zollo says, and these differences must be accounted for when designing the mold.

"Here's a simple example: Increase the draft of internal pins and structures to ensure smooth movement between mold halves. If 3 percent draft was specified in the CAD drawing for metal molds, revise this to 4 to 5 percent for printed plastic molds," Zollo says. Holes should be printed slightly smaller in diameter, so they can be postprocessed to smooth the interior.



A completed two-cavity plastic composite mold was 3D-printed on a proprietary high-precision desktop 3D printer using a carbon nanotube-reinforced, high-performance composite filament. The upper half shows the surface finish prior to post processing and the lower half is partially sanded.

A few other examples of principles that need learning and application include how to adapt the infill and outer layer print strategy to optimize mechanical strength; how to orient the print job for optimal parting lines; how to properly dimension holes for alignment and knock-out pins; and how to properly design printed-in cooling channels.



This two-cavity mold was printed for a short-run of threaded eyelets. The mold was fitted with twin cooling tubes to improve cycle time. The tube fittings were epoxied to the mold to ensure a water-tight fit. Water was run at 65°F. Cycle times were less than 90 seconds. The threaded bolts were added to ensure high-precision alignment with the knock-out pin assembly. The mold face was sanded to 0.005 inch to provide a tight, no-leak closure with the top mold half. After 125 cycles of molding HDPE parts, there was no visual wear in the cavity and gate. The threaded parts met spec and worked well.

"Engineers designing a part usually begin with mechanical and other physical characteristics and then select their material based on these requirements. For me, it seemed logical to start with the mechanical and chemical properties that are required to create high-performance parts and molds and formulate the material to meet these requirements," Zollo says. It was then that he began to focus on developing materials for finely extruded parts. He went back to the lab and worked with a few of his previously developed materials and discovered that some of the compounds worked well for 3D printing. These high-performance composite formulations caught the attention of an automotive manufacturer that was looking to make some soft tooling. At the time, there were no quality injection mold materials available for use on open-source FDM technology. The result of Zollo's R&D was a carbon nanotube reinforced, high-performance composite filament for printed plastic composite molds, which he says could advance the state-of-the-art when it comes to material in injection and compression molding.

To qualify for this demanding application, the material must meet certain requirements: It must print at very low-layer heights (0.1 millimeter or lower). It must support injection of common molding plastics, possess mechanical strength under high temperature and pressure, flex under high pressure to align to metal holding plates and alignment pins, and flex to a 100-percent seal between mold halves under pressure. It must withstand sanding, polishing, drilling, tapping and threading; have low surface energy, offer a relatively high rate of thermal transfer, adhere strongly to the print bed to ensure a precision print within desired dimensions, and exhibit very strong layer-to-layer bonding. Finally, the material must be chemically nonreactive to the thermoplastic being molded.

> "It seemed logical to start with the mechanical and chemical properties that are required to create high-performance parts and molds and formulate the material to meet these requirements."

"The right composite material can handle a lot of stress, but more importantly it is resilient, which is important to the molding process. It also possesses low surface energy (like Teflon), which means the injected material comes in and just glides over the surface. The carbon nanotubes act as micro bearings that make the surface tough and slick, creating a heat barrier while the material is being injected," Zollo says. The carbon nanotubes are also excellent heat conductors within the mold that help overcome the relatively low rate of heat transfer exhibited by most plastics. Zollo explains that the proper design may include a variety of cooling channel configurations that produce good heat flow to preserve the integrity of the mold. Cooling channels can be printed as close as 2 to 3 millimeters from the cavity surface, creating a relatively short distance for cavity heat to travel.

"This combination of higher heat transfer rates and conformal cooling channels improves cycle time over third-party thermoset plastic molds. When designed and properly printed, there is basically no melting of the cavity surface, not even at the gates. The key is getting the heat out when it needs to get out," Zollo explains.

Zollo's company has teamed up with an experienced plastics molding company that has customers with short-run requirements to experiment with material science for 3D-printed molds. This technical collaboration led to his ability to create commercial-grade molded tools that have successfully run in production environments. "We are fortunate to have technical staff with experience and training in both disciplines and collaborative third parties who are helping us improve our techniques. This enables us to get the most out of the design to improve the precision, strength and finish of printed molds, as good as or better than what can be produced using more expensive industrial grade printers," Zollo says.

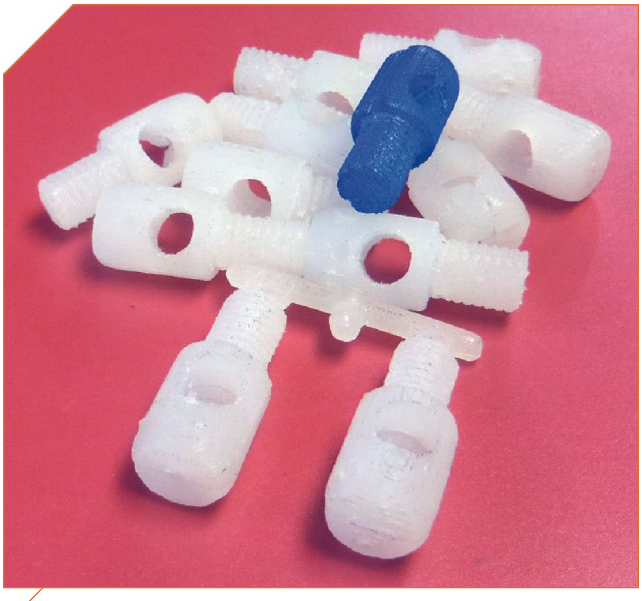
Printer Problems and Potential

Then there is the printer and the high cost of operating industrial-grade 3D printing systems for short-run injection molds. Options can cost anywhere from $100,000 to roughly $600,000. About 18 months ago, Zollo tested printing precision molds and parts on a range of open-source printers. He was not satisfied with the precision, reliability and quality of any third-party printers.

"Imprecisions are built into the typical systems that must be fixed, but companies just don't have the money or expertise to fix these machine issues," he says. So, he and CTO Ron Aldrich set out to develop and produce a proprietary high-precision desktop printer, which is his primary mold printing system.

"The printer is just the delivery system of the actual (real) product: the printed plastic part," Zollo says. His approach was to develop and optimize a printer for the material being used, which is inverse to the current industry thinking. According to Zollo, his way is far more successful for printing high-performance parts. He believes that to accommodate a range of materials, the printer must be designed to be adaptable. The delivery system should adapt to the material selected, not the other way around.

"Our high-precision 3D printer looks like a conventional FDM printer, but there are several important unique features, that are not obvious, which enable printing a precision mold," Zollo says. Unlike most conventional printers that



These molded HDPE parts were produced in the 3D-printed composite mold. Blue spray paint makes it easier to see that the threads molded well and the part is functionally correct. There are faint print lines in the head, so this mold would require additional burnishing of the cavity to optimize aesthetics, if required by the customer. The composite material is formulated to be sanded, burnished, drilled, tapped and threaded in post processing, allowing these printed molds to be prepared in a similar manner to aluminum mold inserts.

provide print bed leveling, this printer performs a 25-point measurement of the entire print bed surface before each print job, creating a 3D profile of any deviation in flatness. This profile is used to create offsets in the print commands, automatically compensating for any imperfections in the Z axis across both X- and Y-axis movements of the printer nozzle. The printer uses an ARM Cortex processor-based controller board that runs an embedded real-time operating system (RTOS). This real-time operating system supports multi-threaded printing operations to optimize printing performance, which minimizes any latencies that could impact precise movement of the printer's extruder assembly. The printer also utilizes proprietary printer driver controls of the stepper motors. Finer motor control, combined with real-time processing of G-code with automatic offsets for imperfections in the print bed results in more precise printing.

"We also have customized the STL file-slicing engine software to deliver more consistent plastic flow on the external surfaces of each printed part, resulting in a denser, smoother finish than what is typically seen with FDM printers," Zollo says. The printer's nozzles are optimized for printing low layer height extrusions of the company's proprietary composite filament. The solid outer layers of the printed mold are designed with postprocessing in mind. The printed mold is sanded using conventional abrasives to 0.005-inch tolerance. The printed mold halves are quite stiff, but still exhibit a small amount of flex under pressure, Zollo says, which allows the mold halves to close tightly to prevent flashing.

On a printed cubic-inch comparison, the UV-curable digital ABS used on third-party industrial printers for producing molds is fairly dense, has a relatively low rate of heat transfer and costs roughly $5.00 per printed cubic inch. Each layer of this material must be UV-cured to create the thermoset and print the molds solid, which requires very long print times on expensive, industrial printing systems with long cycle times. "Depending on the in-fill printing strategy, our high-performance composite filament runs in the range of $4.00 to $7.00 per printed cubic inch on printers costing between $4,000 to $15,000," Zollo says.

When he originally tested printing molds in his lab, he expected to be able to print small, simple molds capable of molding 10 to 20 units before wearing out. He was pleasantly surprised to learn that his printed molds could easily support 100+ cycles, depending on the design of the mold and the material being molded. While none of his clients have attempted to mold more than 125 cycles to date, inspection of the molds after this many cycles indicates no visible wear on the cavity, gates or sprues. Zollo sees no technical reason why molding parts in HDPE, ABS or PP would not hold up to 500+ cycles. He believes this compares quite favorably with molds produced on third-party printing systems. He is hearing from service providers that typical life expectancy of printed plastic molds ranges from 5 to 25 parts, depending on the plastic to be molded.

Zollo does note that there are a few practical limitations. "So far, we have focused on designing and printing simple, two-part, one- and two-cavity injection molds. The largest outer dimension printed to date is approximately 6 by 6 by 4 inches. We are working on methods to print larger molds that exhibit the desired dimensional precision, and expect to expand the range of dimensions in the near future through improved printing process control," Zollo says.

A second limitation has to do with aesthetics. Although molds produced using his company's composite materials are designed to be sanded and polished, it is difficult to completely remove visibility of the print lines in the surface of the molded part. He continues to research new methods to improve surface finish. For parts that have an aesthetic requirement, he recommends embossing the surface with a pattern, either in the print design or via post processing.

Gaining Ground

To widen the field of compatible printers for users, Zollo's company tested and validated precision printing of the high-performance composite filament on a number of new open-source printers. To date, he determined that European-based German RepRap, the Italian printer maker Roboze and the American manufacturer Airwolf produce printer models with

the required precision to support printing molds using his composite filament, which range in size, features and price from $4,000 to $25,000.

These printers have improved bed leveling and print-head calibration capabilities, offer enclosed chambers for improved control over temperatures, exhibit precision control of the extruder assemblies, offer even heating of their print beds and some feature beltless robotic control for the most precise control over extruder movement. "A lack of any of these capabilities makes it difficult to print a quality injection mold," Zollo says.

He says that he continues to test new third-party, industrial-grade printers as they become available. He strongly believes that the industry needs to have options and the power to select the appropriate printing system for its application. His focus is on two key markets: manufacturers seeking pilot production and low-cost, quick-turn, short-run molded plastic part production.

"We quickly learned that this is a conservative industry, as manufacturing engineers asked for technical validation before investing, even at our extremely low pricing. It was a logical next step to offer full-service from design to mold delivery to reduce the technical risk and speed up the assessment process for the client manufacturer," Zollo says.

His company can take the customer's CAD file and STL files for the part or mold and redesign it, or start from the customer's part design and implement the entire design and build process. Once customers are confident in his approach, they have the option of buying the high-performance composite filament and printing their own molds if they have a printer with adequate precision. If they need to upgrade their 3D printer, Zollo can offer the customers a range of printers from his own high-precision desktop printer for small jobs, or the range of German RepRap printers for larger printing projects. For the highest precision, Zollo recommends the Roboze line of industrial-grade FDM printers.

This integrated solution, which provides a service supported with the right technical background and technology, builds a bridge to AM for those looking for economical mold solutions. MMT

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By Deborah L. Douglas

This series will review how the world of plastics M&A works, including M&A interest areas, mechanisms to assess impact, the sale process and successful transition to new ownership.

Preparing for Mergers and Acquisitions: Interest Areas

Understanding the most intense merger and acquisition interest areas will better prepare moldmakers for the process.

Mergers and acquisitions (M&A) activity has had a great impact on plastics-related companies in North America for years. When these companies sell to private-equity funds or powerful strategic players eager for new business opportunities, company owners are given a mechanism for exit or retirement. Such transition nourishes the influx of new blood, ready capital and creative new approaches for growth.

While all plastics processors have long been accustomed to buying and selling activity, the capital-intensive mold and tooling providers have experienced less M&A action because prior to the rising maturity and growth of North American mold and tooling, most tooling came from Europe or South America. M&A activity is now becoming stronger in the United States and Canada, as previously offshored product comes back to the region. This activity has prompted equity firms, original equipment manufacturers and injection molders to inquire about buying tooling vendors to capitalize on a critical, high-value industry and to better control mold sourcing or to internally add a mold source division, respectively.

The topic of preparing for mergers and acquisitions will be a four-part series that focuses on sharing tools and knowledge about how the world of plastics M&A work, so shops can be better prepared and remain healthier and stronger through the process. The series will identify the areas of most intense M&A interest, mechanisms to assess the likely M&A impact on a company, the sale process and successful transition to new ownership.

M&A Interest Areas

As shop owners grow their companies, it is important that they understand which features offer premium value to potential buyers. One of the most impactful is industry expertise, especially in areas known to have steady growth. Such areas include medical products, medical packaging, aerospace products, pet products and food packaging.

Some buyers are so focused on industry specialization that they look only for target companies with a heavy and well-known concentration in a specific niche product. The Douglas Group has found that a company with a specific niche and a strong reputation can experience a 20- to 50-percent increase in transaction pricing. This is because buyers assume that the mold provider with exceptional expertise in a defined segment will command stronger pricing and better margins.

Capabilities with a wide range of materials also play a vital role in attracting buyers, as they demand much sought-after expertise. For example, plastic molds are made from materials like zinc, aluminum and steel. This requires capabilities that create access to special customers with thinner competition, which can be a strong basis for added value to a buyer. Additionally, any unique ability or tendency to improve reliability or precision will help salability and enhance value. Examples include specialty projects such as multi-cavity molds, insert molds, shuttle molds, silicone rubber handling, resin transfer molding and various prototype molds.

Other key criteria beyond the basic industry expertise of a given company might include facilities. Specifically, a facility that may be of particular value to a buyer is a location within a specific geographic range that is being targeted or a location that houses a pre-identified capability that is necessary for substantial expansion. People, their skills and a company culture that closely aligns to key corporate cultural issues like continuous improvement initiatives matter. Efforts to enhance capabilities in applications that are slightly more difficult, more costly and more unique offer increased value and potential for greater long-term marketability, which in turn can improve profitability and make access to growth capital more certain.

Processor M&A Versus Moldmaker M&A

In the world of plastics M&A, often-accepted "norms" for plastics processors apply differently to moldmakers, so it is important for both parties to understand the differences. For example, the Douglas Group works with injection molders with sales ranging from $25 million to several hundred-million dollars, and there are not many moldmakers who fit in that range. Often, the difference in sales makes it difficult for molders to appreciate the value of a much smaller supplier of an adjunct part.

On top of that, an injection molder's assessment of a moldmaker's financial performance subjects the moldmaker to the "norms" of injection molding. For example, buyers looking for moldmaking capabilities commonly determine profitability as they do for buying and selling activity in injection molding. That is, they look for financial performance with earnings before interest, taxes, depreciation and amortization (EBITDA) that is strong enough to compare well with injection molding operations around the country. Companies with EBITDA of 7–13 percent of sales are considered average performers. Those with EBITDA in the high teens are perceived as great performers, commanding a higher acquisition price.

Speed of collection is another vital difference between processors and moldmakers that all parties must consider. Buyers inevitably look for strong cash flow and a solid balance-sheet performance. However, moldmakers commonly face customers that delay full payment for molds until the molds are in use and producing income. Buyers do not expect to add increased risk by accepting long delays in customer payments. This should be another consideration for the buyer who is assessing a moldmaking acquisition opportunity.

M&A activity in moldmaking can give companies a great boost toward available capital and financial resilience. In 2018, this series will continue to provide insight to help moldmakers better prepare for any M&A opportunities in their future. MMT

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By Barbara Schulz

Looking Beyond Your Borders to Improve Process Efficiency

Visiting a mold shop in Germany inspired a Canada-based mold shop president and CEO to look at job scheduling a whole new way.

Images courtesy of Barbara Schulz.

StackTeck's Randy Yakimishyn takes pride in giving tours of this state-of-the-art manufacturing facility, which is pictured here in front of a row of high-speed milling centers. Getting insight into European shops like Phoenix Contact is invaluable for him to drive his business.

Randy Yakimishyn is a big believer in collaboration. The president and CEO of StackTeck (Brampton, Canada), a provider of sophisticated, integrated plastic tooling solutions for the injection molding industry, knows that it is critical to encourage people's quest to learn, share, collaborate and engage in meaningful ways to stimulate innovative thinking. It helps companies stay globally competitive.

"Some reputable mold shops in Europe are very strong, and we have many competitors there," he says. "We are often compared to the top tier competitors based in Europe. Everyone has to find their own value proposition. What shops in Europe and StackTeck have in common is that our customers aren't those who make buying decisions based on price. If we share our business challenges and collaborate with other companies, including potential competitors, we can only win. StackTeck leads the industry in many ways, including big sophisticated molds, optimized cycle times and flexible Quick Product Change—however, we're always looking for a better way to get the job done."

Yakimishyn came across an article about Phoenix Contact (Blomberg, Germany) that was published in *MoldMaking Technology* in 2017. The piece describes how the Phoenix Contact implemented an in-house, global tool-shop information system that offers transparency across all databases and manufacturing processes. Yakimishyn contacted the company to find out how the fully transparent and flow-optimized production environment helped Phoenix Contact cut lead times in its tool shop by 50 percent.

"We have invested more than $8.5 million in new equipment and automation in 2015 and 2016 to ensure strong support for customers' new product launches," Yakimishyn says. "Similar to what I read in the article, we have implemented a new scheduling system to track and manage jobs that come through the manufacturing floor more closely. New machines and robotics add productivity throughout the plant, allowing us to get work done more efficiently and effectively. We are also very lean, conduct Gemba board walks in the morning and have boards on the factory floor to visualize our processes. But to me, it seemed that Phoenix has taken the concept of lean, process visualization and transparency to the ultimate limit, so I decided to visit their shop as soon as possible."

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Scheduling System Takes Visualization to New Heights

Phoenix Contact did not disappoint his expectations. Sven Holsten is head of Phoenix Contact's tool shop, and he provided a warm welcome for his Canadian visitors and spent half a day showing them around and explaining the scheduling system and all of the processes. The massive touch screens, which can be found all over the factory floor, are not merely a means for the display of information, but are the core of Phoenix Contact's unique, transparent, automated and lean production system.

"For us, 'scheduling system' means downloading the current work schedule once a week. We monitor all the work in all work areas to identify constraints and conduct meetings at five different plant floor locations every morning for five to 10 minutes. We talk about the plan for the week every day. It works very well for us, but our solution is not as sophisticated as the one we have seen in Blomberg."

Phoenix Contact developed its scheduling software in-house, including all of the programming. "They are miles ahead as far as scheduling goes with their big touchscreens and how the program works. I wish I could buy that software package right off the shelf. Unfortunately, it's tailor-made to Phoenix," Yakimishyn says.

Three of the 180 employees are working full time just to further develop and program the software at Phoenix Contact, and Yakimishyn says that StackTeck is not going to go down that road. "We did a lot of follow-up based on what we saw. There is similar software commercially available through Microsoft or SAP, but even though they offer the same functionality, they are not the same. Those software programs are not laid out as nicely. I guess we have to live with that until we are crazy enough to develop our own dashboard. But, it was great to see that someone is doing it in the way that we envision. We are on the right track, so we will keep going," he says.

Sven Holsten, director of Phoenix Contact's tool shop plastics division, explains the company's "first in, first out" (FIFO) system, which dictates the order in which a part moves on to the next operation. The yellow cards next to the company's automated milling machine visualize the FIFO queue and update everyone with any possible delays. If a part's machining is delayed for more than two days, it is outsourced.

And that is exactly what his company does—it keeps going and growing. With 240 employees and 50 million dollars in annual revenue, StackTeck is a large mold shop. And, as far as packaging and closure molds are concerned, the company ranges among the top shops in the global industry.

Creating the Ultimate Customer Experience

While investment in new equipment, automation and optimum scheduling systems is important to remain competitive, it is essential to understand it is not just about delivering molds on time and making money, Yakimishyn says. "The customer is the reason for everything we do. It is about exceeding customer expectations, working leaner, stronger and more efficiently and building lasting relationships."

According to Yakimishyn, it is about understanding the customer's business and providing mold designs that give them a strategic advantage. From product and mold design to complete systems integration, StackTeck develops injection molds and systems to improve companies' cycle times, featuring the longevity and the quality that the customer expects.

And the efforts pay off. Since 2011, StackTeck's average yearly sales growth has been 7.5 percent, and the company is now positioned to grow much more rapidly. The company exports about 50 percent of its molds and systems to the United States and the other 50 percent to the rest of the world. "Last year was a fantastic year for orders. We have a strong order backlog and full order books."

Yakimishyn knows that there are companies that do things better than StackTeck, and there is always room for improvement. So, getting insight into European shops like Phoenix Contact is invaluable to drive his business. In his opinion, Europeans are very disciplined and regimented, which is a competitive advantage in business, and the apprenticeship scheme found in many countries, including Germany, is outstanding.

Yakimishyn is happy that he made the effort to travel to Europe to experience how other companies are organized and how they think and to witness what it takes to be a leader in one's field. "For me, it was an inspiration. It was nice to see the Phoenix tool shop, and it is reassuring to see another leading company on a similar path." MMT

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Automated Machining Cells **Simplify Moldmaking**

Summit Tooling (McHenry, Illinois) routinely runs 24/7 unattended machining. Robots load and unload tooling and workpiece fixtures in three manufacturing cells, feeding nine machines that include a graphite mill, vertical mills and sinker and wire EDM machines. Summit Tooling President Dan Martin credits this capability to the partnership that his company built with Makino, which supplies Summit Tooling's machine tools and the engineering services that Summit Tooling used to implement these complex automation systems.

Dan Martin and his wife Michelle founded Summit Tooling in 1996. The company designs and manufactures small to medium precision prototypes and production molds for a variety of applications including over-molds, two-shot injection molds, insert molds, spin-cavity technology, hydraulic-core pull technology and thin-wall molds. Customers hail from medical, pharmaceutical, consumer packaging and automotive markets as well as from the electric utilities industry. The company has 30 employees.

Efficiency through Automation Aids Growth

Like most mold manufacturing companies today, Summit Tooling competes with manufacturers from around the world that offer lower labor prices. Customer requirements for increasingly complex mold designs with tighter tolerances and demands for shorter lead times and reduced costs also challenge the company.

"The biggest challenge today is speeding up the moldmaking process to deliver products faster, and automation is the only way to do this," Martin says. "Unattended run time is the main reason we are delivering projects much, much more rapidly today."

Martin researched and met with a variety of mill and EDM suppliers, seeking not just a machine manufacturer but also a partner to play a strategic role in how Summit Tooling would grow. The company began investing in the first of its 11 Makino machines in 2008. The same year, Summit Tooling purchased an a61 horizontal machining center and two S33 vertical machining centers from Makino. Shortly thereafter, in 2011, Martin enlisted the support of Makino's automation and engineering services to integrate the company's first fully automated EDM cell, a Makino EDAF2 sinker EDM machine. Martin did not invest in full automation of loading and unloading of tooling, parts and fixtures at this point because, as he says, "I'm a conservative person, so I tend to move cautiously." Nevertheless, Summit Tooling replaced 12 commodity milling machines with the three new Makino machines

Images courtesy of Makino.

This aerial shot shows one of Summit Tooling's EDM cells that was installed in 2014–2015. It combines two Makino U32j and one U53Tj wire EDM machines that are loaded and unloaded by a System 3R Workmaster robot. Summit chose these machines because of their programmable work tanks and ergonomic access to the work zone. These features also provide flexibility in the ways that the automated cells are configurable on the shop floor.

SUMMIT TOOLING

PROBLEM: Meeting customers' requirements for delivering complex molds with shorter lead times while also reducing costs.

SOLUTION: Makino EDM and CNC machining centers that are equipped with robotics that are configured into automated manufacturing cells.

RESULTS: Machines run unattended 24/7, which resulted in decreased delivery times and costs and doubled sales and production.

because of a host of tool monitoring and control capabilities that Makino machines provide as standard features that enable users to achieve extended machining hours with no labor costs.

"These milling machines provided a variety of technologies to help improve speed and efficiency," Martin says. The a61 offered a ring-type, 60-tool magazine and an automatic pallet changer with a seven-second pallet-change time. On the S33 machines, we were able to reduce setups and improve utilization rates with a 20-position tool magazine and automatic tool changer (ATC) that performs tool exchanges in 1.3 seconds."

Speed and efficiency were not the only noticeable changes in performance. Both the S33 and the a61 were equipped with Makino's proprietary SGI geometric intelligence servo control, which Martin says "provided exceptionally smooth machined surfaces—even in high-feed rate machining operations and complex, 3D-shaped features."

These early steps toward automation illustrated how well the machines performed on their own and led Martin to consider ways of organizing them into manufacturing cells. For the next step, Summit Tooling added a System 3R material-handling robot that Makino recommended to one of its existing commodity EDM machines.

"The first thought for many of our employees was, 'You are trying to eliminate our jobs.' No, we were making their jobs easier and more efficient so that we could push more work through and make more money. It is all about staying competitive and bringing in the revenue to provide good paying jobs, and there's simply not enough qualified labor to grow otherwise," Martin says.

> The reality is that had we not automated our mold-making operations, we would not be in business.

Automation Investment Pays Dividends

Martin says that his company realized a full return on its investment of its initial automated manufacturing cell in about six months after the installation. Sales doubled while Summit Tooling continued running one shift and maintained the same number of mold shop employees. The company could do this because its EDM machines and horizontal and vertical machining centers were integrated using System 3R material-handling systems that could robotically load and unload electrodes and workpiece holding fixtures. This freed up the operator to handle other tasks like performing

micro-welding for repairs and tooling alterations while keeping pace with EDM production.

These results led Summit Tooling to add a second EDAF2 EDM machine with a fine-hole EDM drilling option to the cell in 2012 for the purpose of producing high-tolerance, small-hole tooling features. The fine-hole machining option makes it possible for the EDAF2 to change 0.0039-inch-diameter by 12-inch-long pipe electrodes with its ATC. Special automatic dressing routines also are capable of discharge-dressing electrodes as small as 0.0035 inch in diameter, which can produce finished hole sizes of 0.004 inch in diameter using the EDAF2 fine-hole option.

"We have two customers that use nano-injection molding for surgical applications. You need a microscope to see the parts. Some are 0.125 inch in length and 0.003 inch in diameter. The fine-hole option allows us to produce holes smaller than 0.012 inch, which is a typical limit using traditional hole-popper EDM machines. The difference with the EDAF2 is that the holes it produces are always within size and straightness specifications," Martin says.

Summit Tooling also has increased productivity 30 to 40 percent by replacing older commodity machines that required operators' continual attention. Machinists can now manage several manufacturing cells simultaneously and take on new roles in the company's growing plastic-injection molding operation. Operators set up automated cells and then run laser welders and other machines during their shift while the cells run unattended overnight and on weekends, providing improved delivery times.

Completely Automated Cells Change Processes

Martin made a bigger step toward full automation in 2011, when he hired Makino to integrate an EDM cell that includes a Makino F3 vertical graphite machining center with a pressurized system to vacuum carbon dust for high-speed electrode milling. The cell also has two EDAF2 sinker EDM machines for the production of slides, core pins, cores, cavity details and cavity-forming shapes. A larger System 3R Workmaster system feeds tooling and workpieces to each of the machines.

"Adding the cell changed how we do things enormously," Martin says. "It takes a change in mindset to get used to running machines unattended 24/7. A change in mindset was especially necessary considering that now we can set up the machines, leave on Friday and then come back on Monday morning, realizing that we just ran 72 hours' worth of work through three machines, and none of our employees were here."

The company has since added two more automated cells. One is a milling cell with a Makino F5 vertical machining center that Summit Tooling installed in 2013 and integrated with the two S33 vertical machining centers that the company purchased in 2008 using a second System 3R Workmaster. This cell replaced nine commodity vertical mills. The second is an EDM cell that Summit Tooling installed in 2014–2015 combining two Makino U32j and one U53Tj wire EDM machines that are loaded and unloaded by a third System 3R Workmaster system.

The U32j and U53Tj wire EDM machines feature Makino's Hyper-i control, which uses touch-screen controls with pinch, swipe and spread functions similar to functions in modern smartphones. According to Summit Tooling, operators have been able to adapt to the interface easily and implement it easily. The on-board digital manuals, help functions and e-learning training system have given operators practical support tools to boost machine productivity.

The Hyper-i control also includes HyperCut technology that Makino claims can produce a 3-micron-Ra (16-microinch-Ra) surface finish and 1-micron (0.00004-inch) straightness in three machining passes, while simultaneously reducing cycle time. After installing the first U32j, Summit Tooling tested it against one of its older commodity EDM machines by running a job that previously took 12 minutes. A Summit Tooling operator produced the same part, running the same program used on the older machines, in less than five minutes. Wire consumption is down by 14 percent.

"Our previous EDM machines were five to seven years old. We want to stay ahead of the technology curve, so we invested

Automation has given Summit Tooling the ability to run EDM and milling machines unattended 24/7. Owner Dan Martin credits automation and Makino support with advancing his company's ability to compete successfully on a global scale, to offer customers faster delivery times and to lower costs.

in these three Makino EDM machines because they utilize less wire, give better finishes and enable us to produce parts faster," Martin says.

One of the reasons that Summit Tooling chose the U32j and U53Tj EDM machines was their programmable work tank and ergonomic access to the work zone. "The automatic rise-and-fall tank makes loading and setups easier for our operators in the non-automated configurations. At the same time, the automatic rise-and-fall tank supplies access to robotic loaders from three directions for our automated cells. It simply makes our lives a little easier across all processes," Martin says. Summit Tooling also produces mold components with the a61 HMC and another EDAF2, both operated as stand-alone machines.

Automation Lays Foundation for Existence

Since 2008, sales have doubled while Summit Tooling has kept its mold and die shop employment steady at 16 operators, programmers and engineers. Operators program and load the three manufacturing cells to run unattended overnight and on weekends to increase productivity and to finish orders more quickly. Reduced labor costs that Summit Tooling realized by investing in automation and reliable high-performance machines enabled the company to further diversify its services by adding employees to the company's growing plastic-injection molding business. Next in Summit Tooling's drive to automate manufacturing is a plan for a third EDM cell. The company anticipates that a third cell will increase capacity and provide backup to help Summit Tooling avoid any disruption in delivering molds and components on-time to customers.

Mold and die shop owners have viewed automation as expensive, complicated and better suited for higher-volume production of milled parts. Owners visiting Summit Tooling often tell Martin that their traditional, manual processes with an operator in front of every machine are necessary to produce the complex shapes and tight tolerances of prototypes, small orders for unique molds and cavity and component repairs. Martin and his team chose another way. "The reality is that had we not automated our moldmaking operations, we would not be in business," Martin says. "Automation is hugely instrumental in our profitability and our ability to succeed in the tough times that our industry has had during the past several years." MMT

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The Impact of Tax Reform on Moldmaking

By Michael J. Devereux II, CPA, CMP

In December of 2017, Congress passed, and President Trump signed into law, the Tax Cuts and Jobs Act of 2017 (the Act), making numerous changes to the way that moldmakers are assessed and how they pay their income taxes.

The Act dropped tax rates across the board, changed tax credits and incentives and limited or altogether eliminated deductions. Overall, mold builders' U.S. tax bills should decrease. Here is a breakdown of the changes that are most likely to impact mold builders and related suppliers.

C Corporation Changes

The Act, which went into effect on January 1, 2018, permanently reduces the corporate tax rate to a flat 21 percent, replacing the graduated rates of 15 to 35 percent. For shops with non-calendar year-ends, the IRS will use Internal Revenue Code (IRC) §15 and apply the different tax rates on a pro-rata basis, based upon the number of days before January 1, 2018 and the number of days after December 31, 2017.

In addition, the Act eliminates the corporate Alternative Minimum Tax (AMT) for tax years beginning after 2017. The Act also allows tool shops to request refunds of the AMT credit carryforwards over the next four years. Any AMT credits remaining in 2021 will be refunded to the taxpayer.

Pass-Through Entity Deduction

The Act allows individuals and some trusts that own an interest in a partnership, S Corporation or a sole proprietorship to deduct 20 percent of domestic qualified business income for tax years beginning after December 31, 2017 and before January 1, 2026.

> If Congress was aiming for simplification with the Tax Cuts and Jobs Act of 2017, it missed the mark.

However, some limitations exist. For example, the deduction is equal to the lesser of the combined qualified business income of the taxpayer or 20 percent of the taxable income. The deduction reduces taxable income, not adjusted gross income. Also, eligible owners are entitled to the deduction whether they itemize their deductions or claim the new, greater standard deduction. Consultants, attorneys and accountants working with moldmakers may have additional limitations to the deduction.

What is more, the deduction is limited to the greater of 50 percent of the W-2 wages that the mold shop pays. Or, the deduction is limited to the sum of 25 percent of the W-2 wages that the mold shop pays plus 2.5 percent of the unadjusted basis, immediately after purchase, of all qualified property. The unadjusted basis is the basis of property that would be used to figure a gain on the sale of the property but without reduction for any depreciation deductions.

Property and Equipment

In one of the only retroactive provisions, the Act allows for 100-percent bonus depreciation for eligible property that is placed into service after September 27, 2017 through December 31, 2022, with the benefit phased out over the next five years as follows:

- 80-percent bonus depreciation for property placed in service during 2023
- 60-percent bonus depreciation for property placed in service during 2024
- 40-percent bonus depreciation for property placed in service during 2025
- 20-percent bonus depreciation for property placed in service during 2026

In a change from past bonus depreciation rules, this applies to both new and used qualified property, assuming it is "new to the taxpayer." That is to say, if a mold shop leases a piece of equipment and then purchases the equipment, it will not qualify for bonus depreciation since the equipment is not new to the mold shop.

Additionally, shops may elect under IRC §179 to deduct the cost of qualifying property placed in service during the tax year rather than elect to recover the costs through depreciation deductions. The Act increases the §179 depreciation limit from $510,000 to $1,000,000 for tax years beginning after December 31, 2017. The IRC §179 limit is phased-out, dollar-for-dollar, for purchases exceeding a threshold amount, which the Act increased from $2,000,000 to $2,500,000.

Research Incentives

The Act keeps the R&D tax credit in its current state, so moldmakers can continue to use it to reduce their tax liabilities. This credit actually became more beneficial because of the decreased corporate tax rate. However, moldmakers must begin to capitalize their research expenditures that are paid or incurred in tax year 2022 and thereafter over a period of five years (or over a period of 15 years for research performed outside of the United States).

Methods of Accounting

Historically, most moldmakers have been required to use the accrual method of accounting in reporting their revenue and related deductions. However, for tax years beginning after December 31, 2017, mold shops with average annual gross receipts of $25 million or less for the prior three tax years may use the cash method of accounting, regardless of the shop's entity structure. That is to say that the shop will recognize revenue when it receives the cash and claim deductions when the expense is paid. These shops also are exempt from accounting for inventories in a traditional manufacturing sense, meaning that they can treat their inventory as incidental supplies and deduct the inventory when it is used in the manufacturing process. Lastly, these shops will be exempt from the Uniform Capitalization (UNICAP) rules, and will not be required to capitalize their indirect expenditures and overhead into the cost of their inventory.

New Limits on Deductions

The Act places specific limitations on interest deduction and net operating losses. For tax years beginning after December 31, 2017, the deduction for net interest expense that a shop incurs with average annual gross receipts greater than $25 million is limited to the sum of the business interest income and 30 percent of the adjusted taxable income. Any amounts exceeding this limit may be carried forward indefinitely.

Also, the net operating loss (NOL) deduction is limited to 80 percent of the taxable income for NOLs arising in tax years beginning after December 31, 2017. Excess NOLs can be carried forward indefinitely, but NOLs can no longer be carried back.

Specific Deduction Eliminations

The Act eliminates the deduction for entertainment expenses but preserves the limited deduction for business meals. It also eliminates the domestic production activities deduction for tax years beginning after December 31, 2017.

If Congress was aiming for simplification with the Tax Cuts and Jobs Act of 2017, it missed the mark. The Treasury will be issuing significant guidance to interpret these new rules over the next couple of years. While guidance is needed, one thing is for sure—the overall tax liabilities of mold shops should decrease, making them more competitive in the global marketplace. MMT

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Index Starts 2018 Breaking Records

New orders and production lift Index, at 60.2 for January.

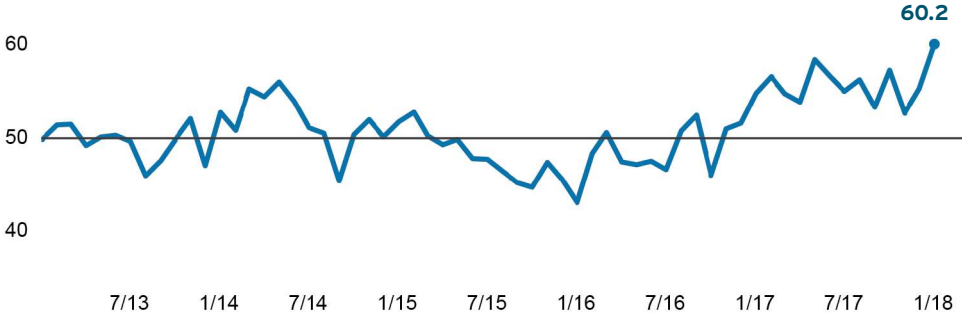
Registering 60.2 for January, the Gardner Business Index (GBI): Moldmaking expanded at its fastest pace in recorded history. Compared to the same month one year ago and to the average reading for 2017, the Moldmaking Index increased by 9.0 percent and 7.6 percent, respectively. Gardner Intelligence's review of the underlying data for the month revealed that new orders jumped drastically in January with the new orders reading increasing approximately 12 points since December. The reading for production also showed significant expansion. New orders and production lifted the Moldmaking Index higher while backlog, supplier deliveries and employment minimally impacted the Moldmaking Index. Exports was the only component that significantly lowered the Moldmaking Index during the month. However, no components contracted.

For a second month in a row, new orders expanded faster than production, and it did so by a considerable margin. Reviewing past trends from the Gardner Business Indexes reveals that when growth in new orders exceeds growth in production, it is typical for manufacturers to experience additional growth in future months because manufacturers are adjusting to increased demand. MMT

ABOUT THE AUTHOR

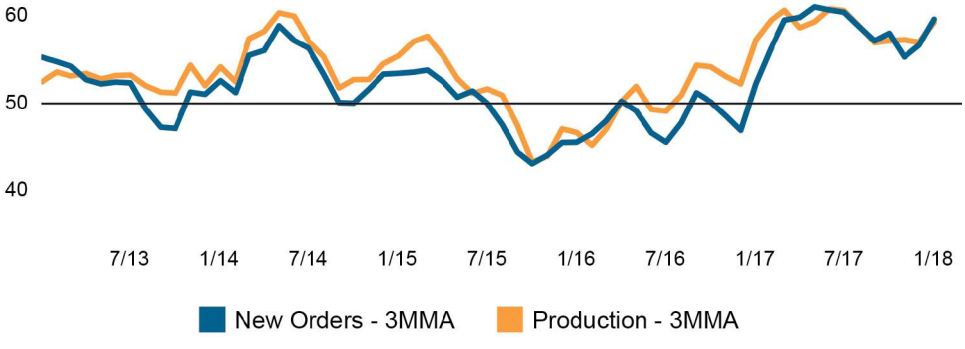
Michael Guckes is the chief economist for Gardner Intelligence, a division of Gardner Business Media (Cincinnati, Ohio, United States). He has performed economic analysis, modeling and forecasting work for nearly 20 years among a range of industries. He is available at mguckes@gardnerweb.com.

Moldmaking Index



January's reading of the Moldmaking Index at 60.2 set a new record-high and was well above the prior month's and the average 2017 calendar year readings of 55.4 and 55.5, respectively. For a second consecutive month, no components of the Moldmaking Index contracted.

New Orders and Production (3-Month Moving Average)



The strongest drivers of the Moldmaking Index in 2017 and in the first month of 2018 have been new orders and production. The outpacing of growth in new orders to growth in production has resulted in a sharp increase in backlogs.

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Electronics Revenue Projects Modest Growth in 2018

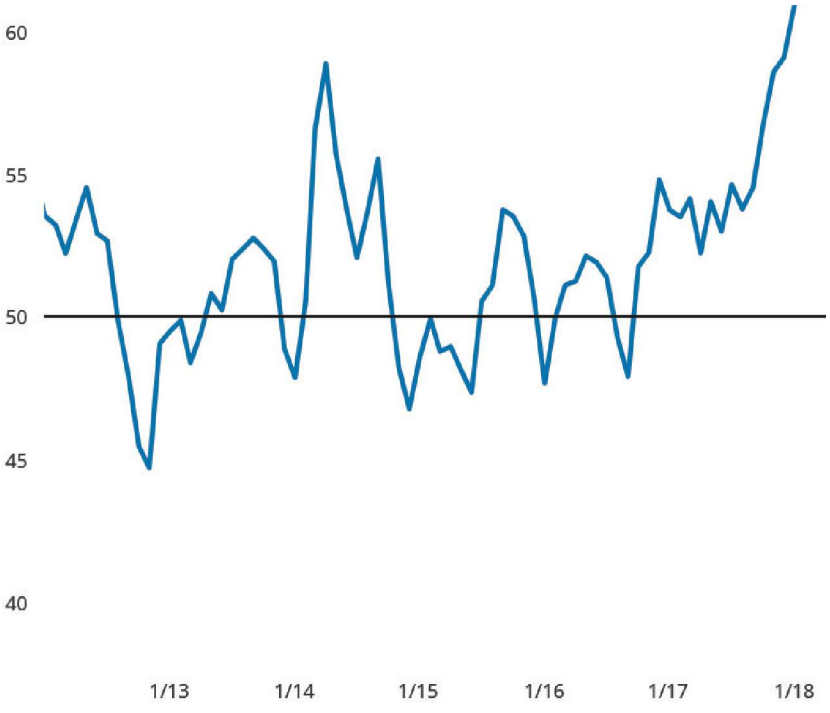
Forecasts of electronics industry spending have steadied, but recent Gardner survey data signals that expansion may be just ahead.

Excluding projections for Apple Inc., Gardner Intelligence's review of Wall Street's forecasts for 136 publicly traded electronics industry and industry-related firms indicates that growth in the electronics industry is projected to slow in 2018. From this data, expectations are that industry revenue growth in 2018 will be muted compared to the robust expansion that the industry experienced in 2017.

Data from the Gardner Business Index (GBI) corroborates this view, as the average GBI reading from our electronics industry participants in 2016 registered 51.5, which indicated only slight industry expansion, and the 2017 average reading of 55.2 represented the fastest annual expansion rate for the industry since at least 2012. To provide context, recall that the Gardner Business Index is a diffusion index in which a reading of 50.0 indicates no change, but readings that deviate from 50 indicate industry expansion or contraction. A reading reflects a more rapid rate of expansion or contraction the more that the reading deviates from 50, which shows that a reading of 55.2 can be noteworthy.

Gardner's review of capital spending data by job shops and fabricators servicing the electronics industry suggests that shops with fewer than 50 employees at the beginning of 2018 left their 12-month projections on capital spending statistically unchanged when compared to their spending expectations from one year ago. During the first quarter of 2017, the average projected capital investment spending per plant over the next 12 months was between $300,000 and $400,000. For comparison, data from the latest three months ending with January indicates that expected capital spending has not materially changed. Among larger facilities, capital expenditure projections increased only for firms with 50–99 employees but not for any of the plant size categories above 100 people.

GBI– Electronics Supply Manufacturers
(3-MONTH MOVING AVERAGE)



Although the above measures point to a modest 2018 for the electronics industry, data from job shops and fabricators that supply the electronics industry and that participate in the Gardner Business Index signify that the fourth quarter of 2017 experienced strong expansion in production, new orders and supplier deliveries. The average fourth-quarter GBI reading of 58.1 solely among shops and fabricators that serve the electronics industry represented the fastest rate of expansion for the electronics industry during a single quarter in the history of the GBI. Recent headline announcements of new capital investment by consumer and industrial electronics manufacturers during the early weeks of 2018 imply that capital spending and growth in the electronics industry may yet challenge the expectation of equities analysts. MMT

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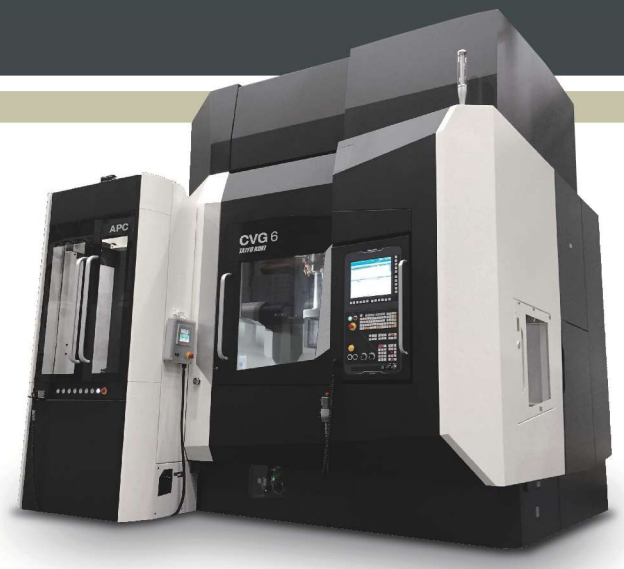
MACHINING

Clamping System Streamlines Palletizing and Clamping to Reduce Setup Time

Röhm says its Power-Grip Zero Point Clamping System delivers both palletizing and clamping capabilities–all with one device and in single setups–to significantly increase productivity, process reliability and precision, as well as cut set-up times by as much as 90 percent. According to Röhm, the new modular palletizing system is customizable to make the best use of a machine tool's entire work-envelope space. Machine tool output also increases because the system makes it possible for workpieces to be positioned and clamped on the pallet outside the machine tool while it continues to work.

RÖHM Products of America / 770-963-8440 / rohm-products.com



Pallet Changer Increases Productivity of Grinder by Improving Spindle Runtime

The CVG series vertical universal cylindrical grinding machine with an optional pallet changer from Taiyo Koki Grinding Machine Company, a **DMG MORI** company, is available in three different part-swing diameter sizes: 25.5", 37.5" and 53". The machine is able to grind OD/ID and faces all-in-one part chucking with guaranteed machine roundness accuracy of less than .00004". The machine has opposing twin wheel spindles. One is a larger, heavy-duty spindle dedicated to OD and face grinding that uses a 14" diameter wheel, and the other spindle is used primarily for ID and face grinding. Both grinding spindles are high-frequency.

The optional pallet changer increases productivity by improving the spindle runtime. Parts can be loaded onto a fixture outside of the machine while the machine is running. Machinists can add an available part-clocking station with a dummy spindle, which enables parts to be rotated and "clocked-in" at the part-loading station. Machinists can run multiple jobs simultaneously by registering and setting different workpieces outside of the machine, which automatically selects programs and tooling for a different workpiece. Being able to run different jobs through the machine at the same time improves productivity and throughput.

DMG MORI / 847-593-5400 / dmgmori.com

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PLASTICSHOF.ORG

MACHINING

ATC Provides Ample Workpiece Storage for Unmanned Operation of Machine

Mazak's Variaxis i-300 five-axis vertical machining center is more flexible and efficient with the addition of a high-capacity Auto Work Changer (AWC). Mazak designed the Variaxis i-300 AWC for automated small- to medium-size part-processing operations and for machining aluminum and other nonferrous metals for a wide variety of industries, including aerospace, medical and automotive. The machine comes standard with a multiple drum-tool storage system that holds as many as 145 tools, while the 32-position AWC accommodates workpieces up to 13.779" in diameter, 12.401" in height and weighing as much as 135 lbs. This combination of ample tool and workpiece storage capacities enables shops to achieve continuous unmanned operation and single-setup, done-in-one processing. As production needs increase, shops can expand the AWC and tool storage capacities to 40 workpieces and 505 tools (in increments of 60 tools), respectively.

Mazak Corporation / 859-342-1700 / mazakusa.com

Dual Spindle Design of Vertical Machining Center Increases Productivity

The DMP 500/2SP from **Doosan Machine Tools** is equipped with two spindles and two automatic tool changers (ATC). Compared to single-spindle machining centers, the DMP 500/2SP doubles productivity by machining two parts simultaneously and by reducing work loading, unloading and idle times. The company says that the machine is highly productive, compact and reliable. For reduced setup times, the right spindle features a W-axis adjustment of 20 mm (0.8"), making it possible to compensate for any variability in fixture heights between spindles.

The machine center has 12,000-rpm direct drive spindles with 87 lb-ft of torque. Features like 8,000-rpm spindles with 211 lb-ft of torque are optional. The load capacity (1,763 lbs) and table size (47" x 20.5") accommodate a variety of workpieces and fixtures. Together with the 20.5"-Y axis stroke, the load capacity and table size offer a machining space that is well-suited for a range of parts. The machine comes with dual 24-tool capacity magazines. Features like 30-tool and 40-tool magazines are optional. The dual ATCs boast 1.7-second tool-to-tool times, which keeps the tools in the cut longer.

Doosan Machine Tools / 973-618-2500 / doosanmachinetools.com

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TIP

SOFTWARE

CAD-for-CAM Toolboxes Help **Design Better Molds**

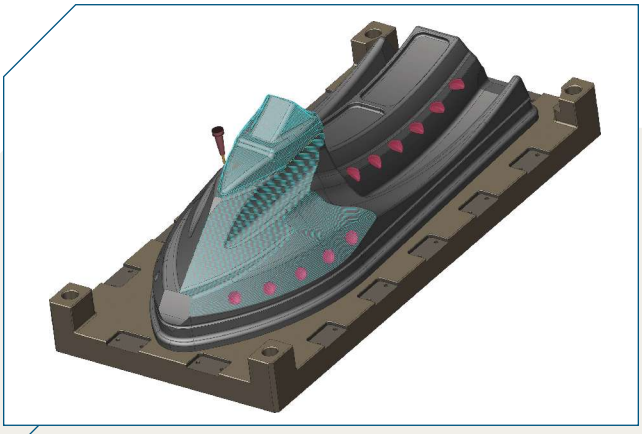

Image courtesy of CNC Software.

CAD-for-CAM tools frequently promote better part finishes.

By Ben Mund

Most part-manufacturing processes today begin with a CAD model. For subcontract mold shops, it may be the finished part model file that comes in from the customer's design staff. Then, it is the moldmaker's turn to construct the CAD model of the mold that will form the finished plastic part. That has its own inherent challenges because moldmakers have many things to think through about the mold, which the part designer may not consider. One of those things is part removal.

Most CAM software packages accept a wide variety of CAD file types. Many also have a robust CAD engine of their own, giving the user the ability to create the model from scratch, if necessary. CAM software packages also provide a number of tools to easily adjust the CAD file. Crucially, CAM packages can offer moldmakers specialized CAD-for-CAM tools that focus on the machinist's needs after the machinist opens the part file.

CAD-for-CAM tools enable quick, temporary model changes that do not impact the final part design but can streamline toolpath generation and often promote better part finishes. These often start with the ability to "heal" flawed surfaces or solids data, making the part usable.

Other tools are geared toward temporarily filling holes or shallow pockets and identifying solid-model features that the machinist can quickly turn "on" or "off" in the CAM package for programming purposes. This can make the cut over a part smoother before those details are machined and help yield a higher-quality finish at a faster pace.

Other powerful CAD-for-CAM tools focus on the creation of the mold itself. Parting line calculation is crucial in ensuring that the mold is sectioned properly. Good CAM software will offer the ability to calculate optimal parting lines from the CAD model, which is something that the part designer often does not consider. Similarly, tall, thin elements on a molded part can pose challenges to the machinist, who has to try to separate areas where electrodes might be appropriate. Automated CAM tools that automatically pull EDM electrodes from a CAD model make the process much faster and more precise.

Generally, designers are more focused on the nuances of the finished part, while CAM programmers, engineers and machinists are concerned with making the part, and the first step is the mold. That is no small feat, and machinists often need to be every bit the artist that a designer has to be to manufacture a good mold. Happily for moldmakers, excellent tools in CAD/CAM packages are available that make the job easier. MMT

CONTRIBUTOR

Ben Mund is a senior market analyst for CNC Software, Inc.

FOR MORE INFORMATION

CNC Software / 800-228-2877 / mastercam.com

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