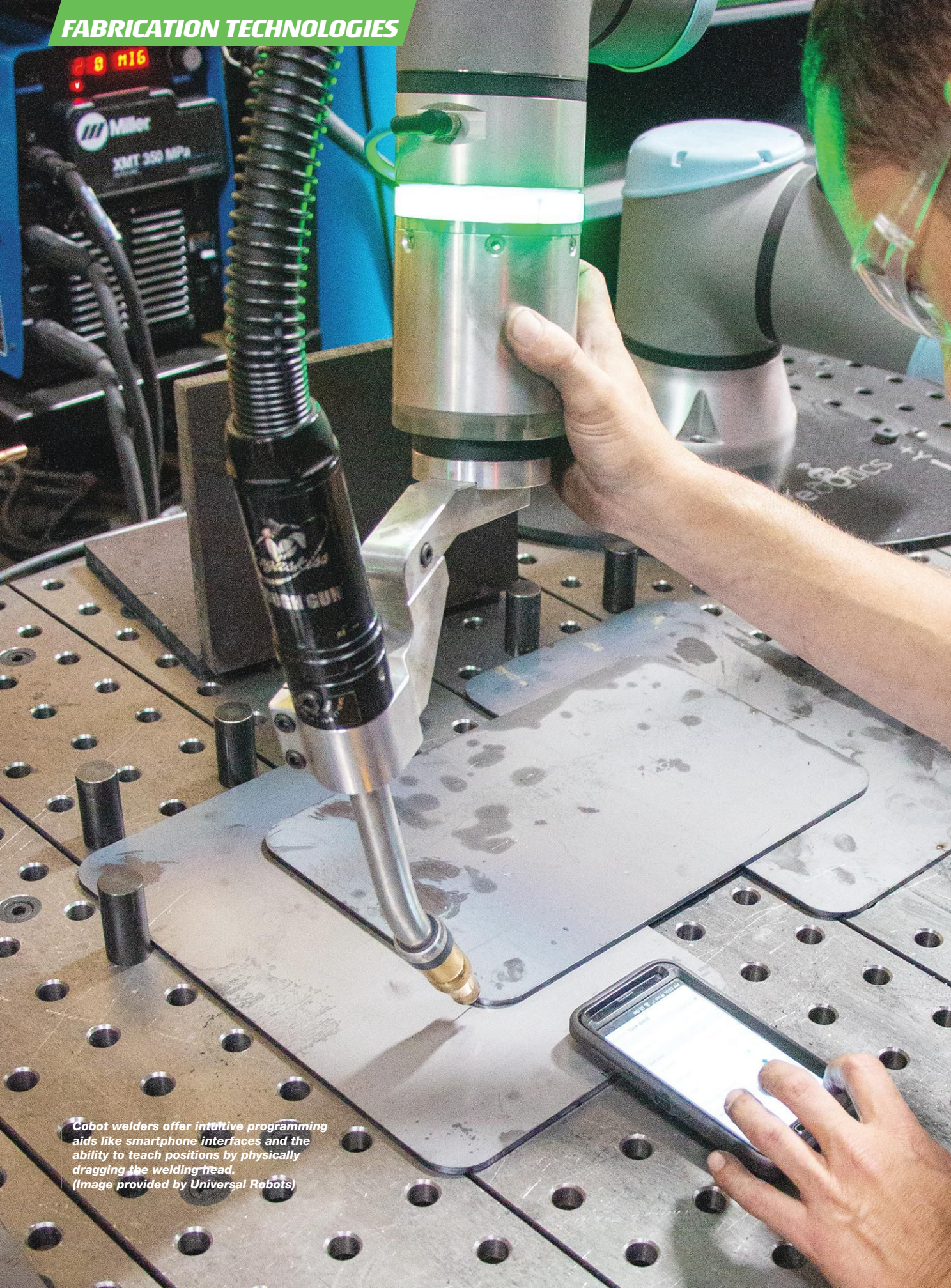
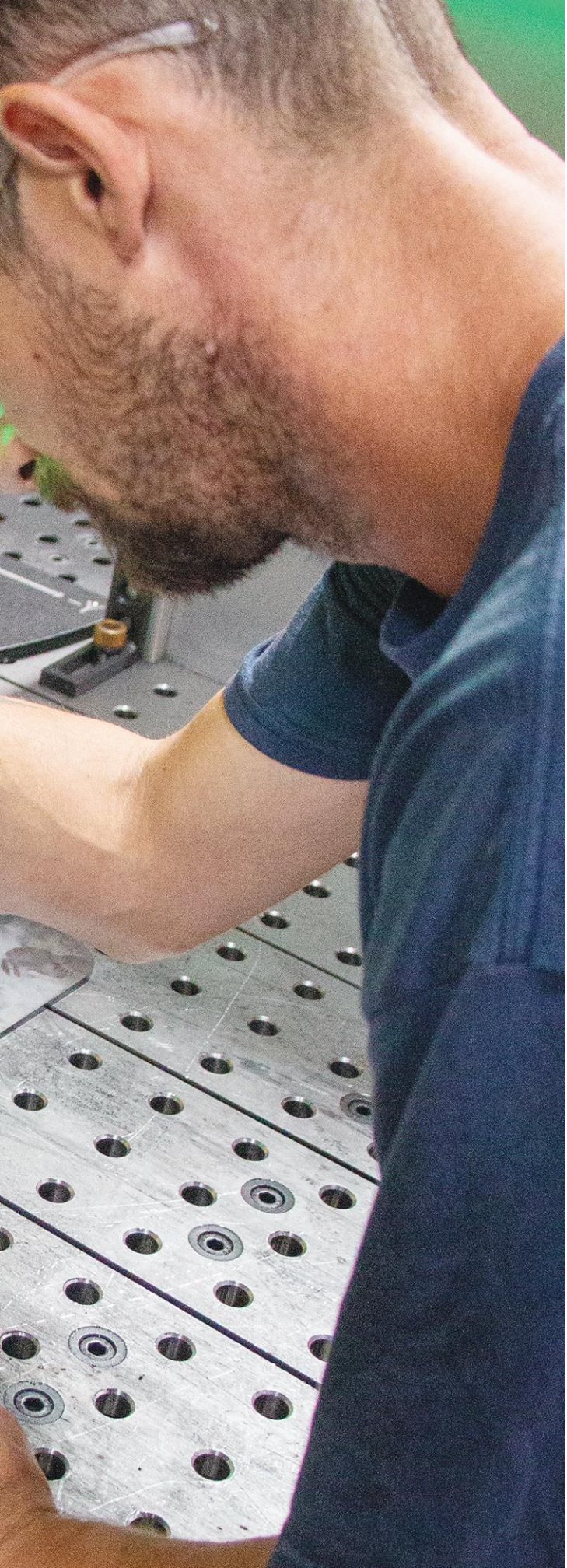



*Cobot welders offer intuitive programming aids like smartphone interfaces and the ability to teach positions by physically dragging the welding head.*
*(Image provided by Universal Robots)*



# Making Welding Accessible to All

*Automating repetitive welding jobs allows welders to focus on higher-value tasks*

**ED SINKORA**
Contributing Editor

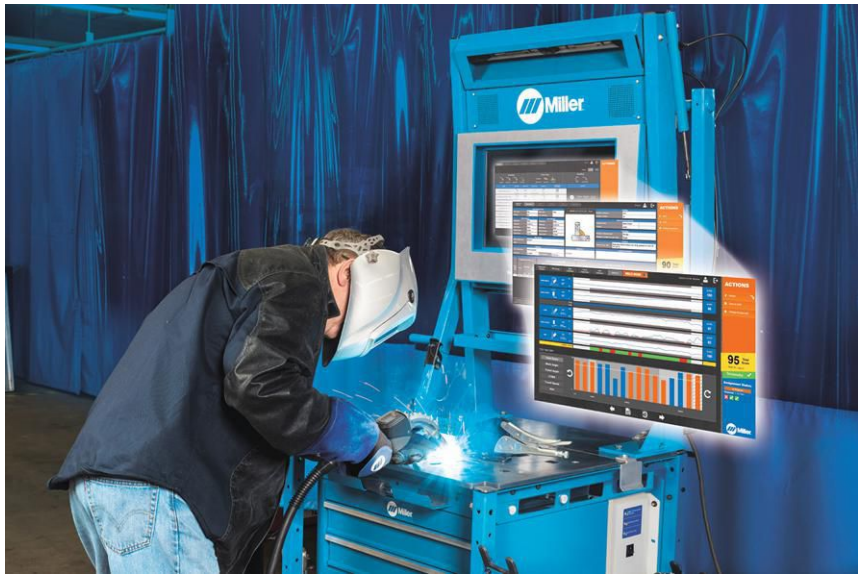
With the ongoing shortage of skilled workers and the pickup in the economy, suppliers of welding equipment are finding ways to making welding easier for those working in manufacturing. Automation is the leading technique among many.

A common rule of thumb states that a robot welder is three times more productive than a person, depending on the application. But, added Ross Fleischmann, marketing manager for Miller Electric Mfg. LLC's Welding Automation Group, Carol Stream, Illinois, "we find improved quality can be more important than productivity in justifying the move towards robotic automation." Fleischmann went so far as to say that if the application is suitable for automation, you might achieve yet another multiple on your payback in lowering the cost of quality. Additionally, Fleischmann referred to U.S. Bureau of Labor Statistics information on workplace accidents and injuries, which shows incidents to be lower in automated versus manual welding.

"Manual welding is an area with a very high degree of repetitive motion injury, resulting in turnover and associated costs," he said. "OSHA puts out a statistic that says any

investment in safety yields a six-to-one payback. So, robotic welding is an investment in safety, as well as productivity and quality. Take all these factors into account and you get a pretty big payback number."

If automation looks like the right fit, the question becomes how best to implement it. Fleischmann observed that many of the older robotic systems throughout industry are relatively intimidating for even an experienced human welder to program. But now cobot welding is emerging as an exciting new way to automate. As Joe Campbell, senior manager of applications development for Universal Robots USA Inc., Ann Arbor, Mich., explained, companies like Hirebotics, Vectis, and THG are integrating cobots with welding technology from Miller and others to create flexible solutions.




***Miller's LiveArc AR training system gives manual welders accurate, real-time feedback on their work angle, travel angle, contact-tip-to-work distance, travel speed and aim, both during actual welding (as shown here) and in simulation mode. (Provided by Miller Electric Mfg)***

For Fleischmann, it isn't so much the ability of cobots to function in proximity to people that's important. It's the fact that these companies have come to the market with "a clean sheet of paper" in terms of the user interface and programming. "The user interface has more modern tools and techniques. And the welder can manually move and position the robot to the physical locations on the parts when they're programming. That's an intuitive thing for a welder to do. They're not intimidated by positioning the torch on the part, pushing a button, and creating a program."

Campbell said programming approaches have differed a bit. For example, "Hirebotics believes a welder is going to be more comfortable doing a setup via a smartphone than they will through any teach pendant. Vectis' alternative approach is that the teach pendant offers a higher concentration of information in bigger graphics that's easier to see." Whatever the approach, the integrator builds on Universal Robots' open software architecture, which allows third parties to create specialized applications.

Beyond easy programming, he said their cobots are also easy to deploy and redeploy because they're light, 120 V, and can be oriented in any way. "You can mount the cobot upside down, on a wall, tilted. With most traditional robots, different orientations require different products because of how they structure the bearings and the lubrication systems."

## What's Your Need for Speed?

David Savage, product manager for Miller welding automation systems, complimented another aspect of cobot programming. "Some of the software being implemented on these cobots prompts the user with default welding parameters based on the material type and thickness, and the type of weld. We've gotten a lot of feedback that this is a huge bonus for users that may be breaking ground on welding automation." Savage said Miller offers similar functions on traditional robot welders using the Panasonic power supply, but he hasn't seen it on a wider range of products. His explanation is that "the type of user that is interested in a cobot is different from an automotive or high-volume user—like stamping shops where welding is perhaps 20 percent or less of their manufacturing processes."

Likewise, Savage said, it's hard to see the benefits of using cobots in a traditional welding robotics application. He explained that the lower positioning speed of cobots (their "air movement," if you will), makes them less productive. Campbell agreed. "We tell customers that if you're going to make a million of one part per year and you have to make them at high speed, it's not for us. We're never going to compete on speed with some of the highest

speed traditional products." But here's why cobot welding is exploding, he continued. "The bulk of the market is not running at ultra-high speed. The bulk of the market has been running, and continues to run, at cobot speed."

### Adapting to Smaller Shops

"There are about 250,0000 manufacturing establishments in the U.S.," Campbell continued. "About 90 percent of these establishments have fewer than 100 employees. These are small- and medium-enterprise businesses. They don't have a multimillion-dollar, high-speed line. They're probably higher-mix, lower-volume businesses. Probably a little bit batch oriented. And so, there's still a tremendous market for automation in those spaces."

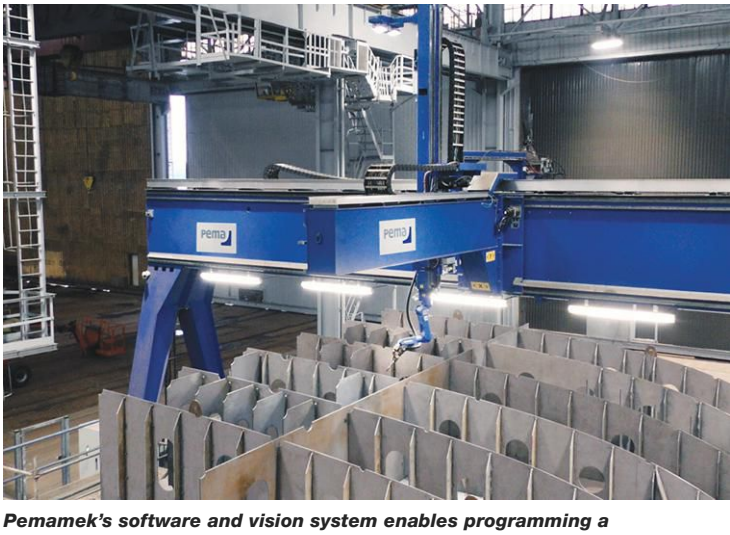
Thus, ease of programming and versatility are more important factors than speed. "The adoption of traditional automation in the small and medium enterprises is very, very low. That's because the combination of cost, complexity, time and effort required to program, set up and redeploy a traditional robot has made it prohibitive." Conversely, Campbell said, "you can buy a cobot arc welder today, fit it out with a power supply, a wire feed, a work table and a torch, and be ready to weld in a matter of hours for $85,000. That's less than you're going to pay a skilled welder, if you can find one who will come to work for you."

Campbell observed that many small and medium shops use cobots for their "simpler, higher-volume, more repetitive parts. It's allowing them to put their higher-skilled workers on higher-value parts. And it's a triple win because it reduces costs, increases the margin for the shop owner, and it's also more gratifying for the welder. Welders are like artists. They don't get a big thrill out of making 1,000 little widgets a week. They want to work on a big, complex weldment."

Campbell also returned to the issue of quality. Asking a human to make lots of the same part all day is an invitation to boredom, poor quality, and repetitive motion injury. “I’ve had more than one shop owner tell me you can see the quality drop off at the end of a long shift.”

### Sophisticated Off-Line Programming

While cobots are making it easier for a wider range of companies to automate their welding, there have also been significant improvements that ease the implementation of traditional robots. Savage pointed to Miller DeskTop Programming and Simulation (DTPS), which—like cobots—is especially helpful for “high-mix, low-volume, job shop types of customers. They can mitigate risk upfront. Whether it’s quoting a potential job to put on the robots, or estimating their potential gains for automating certain parts of their shop or potential customers, they can do that all upfront in DTPS. It’s very accurate. They can make better business decisions with the tool, and they’re limiting the time they take the robot out of production to introduce new products.”



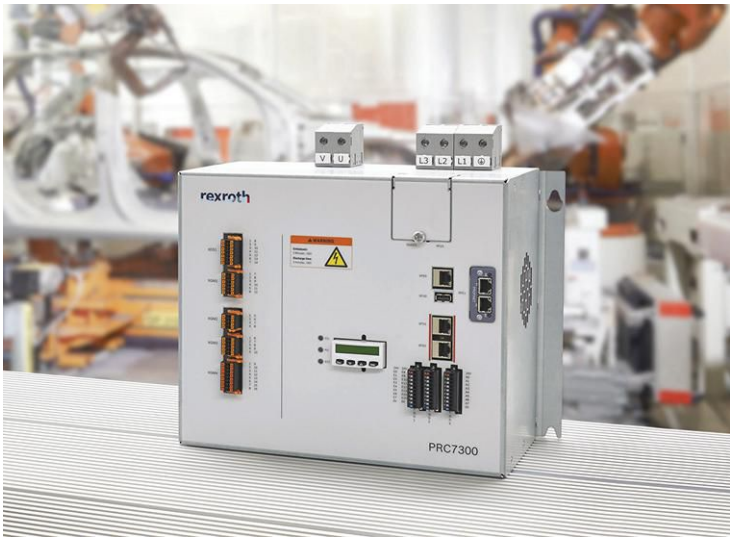

***Pemamek’s software and vision system enables programming a weld from afar, such as with this very large assembly, and the system includes live laser scanning of the weld volume in order to monitor and control the process. (Provided by Pemamek)***

For very large, heavy items—whether you need laser-hybrid, TIG, MIG, or gas metal arc welding—look to a company like Pemamek LLC, Mason, Ohio. As North American Director Michael Bell explained, Pemamek has invested 21 years in developing software that “takes the welder and makes him an operator. And, in turn, he’s given the vehicle to transmit his knowledge to the next generation. It truly

enables the tribal knowledge to transfer between the older group to the newer group." If the shop has already created its welding procedure specification (WPS), Bell explained, it will save that in the Pemamek software database.

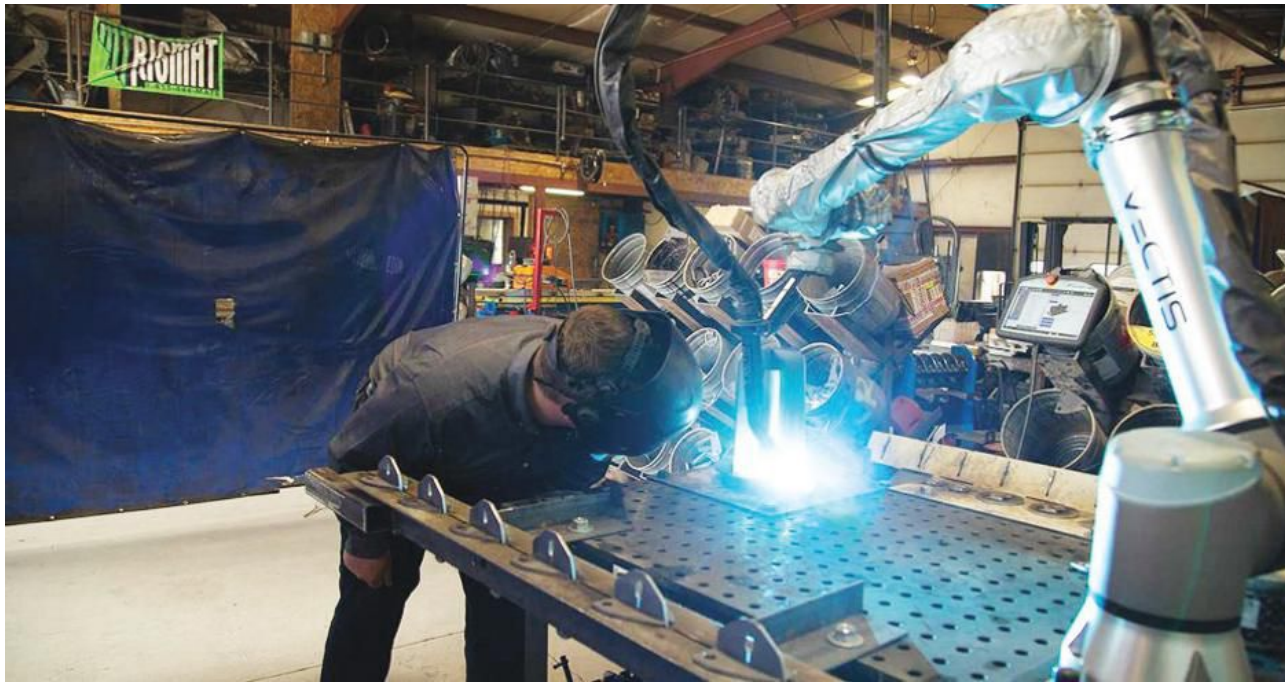
"That would instill confidence in the newer generation coming in. But let's say you're starting fresh and have never seen a Pemamek system or robotic welding. We import your existing 3D drawing and convert it into a file that's in robot program language. Then all you have to do is act like you're playing a video game and position the welds with your mouse. We use a vision system to go and double check what you have programmed to make sure that those elements exist. Then you press go and it's welding."

Pemamek's graphical user interface can combine the drawing with the photo overlay of what the system scanned, plus the program's data points, plus the current operation on a single screen. "You can have everything going simultaneously, or make the screen just the camera if




***The Bosch Rexroth PRC700 controller for resistance spot welding expands the number of heat blocks available so programmers can fully customize the electric current waveform for each weld. (Provided by Bosch Rexroth)***

you like." In addition, Pemamek's system includes live laser scanning of the weld volume in order to monitor and control the process. The system is so good, said Bell, that a weld can be programmed from an office thousands of miles away with no input from the on-scene operator other than starting the job. The system is limited to larger components though, explained Bell, because it's difficult to put the vision equipment on the end of a robot while also keeping it out of the way when welding complex components in tight spaces.




***Cobots are a good fit for simpler, repetitive jobs that would bore a human welder, and they can work in close proximity to people. (Provided by Universal Robots)***

## Adaptive Arc Techniques

One important advance making both manual and robotic welding easier, said Fleischmann of Miller Electric, is what you might call "adaptive arc techniques." One challenge for all forms of arc welding is "the task of maintaining the proper stick-out, travel speed, and work angle," he explained. Miller offers solutions called Regulated Metal Deposition (RMD), Accu-Pulse, and Versa-Pulse that help a manual welder by "monitoring the stick out and the arc, and then doing some sophisticated work with the power supply and the power that's being delivered to make it easier for the welder to accomplish the weld. So if, for example, they miss and one of those angles changes a little bit, or the stick-out distance changes a little bit because they had a momentary lapse in their manual dexterity, it makes it easier for them to execute the weld. The welding process is more compliant, more forgiving." He added that these techniques are also applied to robotic welding—not because robots are inconsistent, but because there can be geometric variations in the workpiece.

## Training with 'Bacon Frying in the Pan'

Improvements in vision systems and computing capability have also enabled effective training with augmented reality. Miller's offering is called LiveArc and it covers manual MIG and stick welding. It uses a working torch with a constellation of LEDs that track with an overhead camera, so the system can calculate the trainee's work angle, travel angle, contact-tip-to-work distance, travel speed and aim—even in simulation mode. As Savage explained, "when the student pulls the trigger and they draw the torch along the coupon, the system is able to look at the torch and crunch all those numbers. It can give them live feedback about how they're traveling, or their push angle. Then, when the student feels ready to actually strike an arc, they can turn the arc on, pull the trigger, and now it's keeping track of what they're doing as they're actually laying a bead."

Fleischmann added that for decades welders have used sound as key feedback, with a good weld often compared to the "music" of bacon frying in the pan. "These virtual reality systems are also modeling the sound. So when you're practicing, you can look at where your torch is and not have to look at some other indicator. We're giving realistic audio feedback."

### Resistance Spot Welding

John Slayton, national sales manager for welding at Bosch Rexroth Corp., Rochester Hills, Mich., said "the introduction of high-speed adaptive control of resistance welding has dramatically improved welding quality, helped increase throughput and significantly improved safety by reducing weld expulsion. The latest technology makes it even easier and more accessible to incorporate high-speed automated welding of the highest quality, with data on the quality of every single weld captured as part of the resistance welding process."

Bosch Rexroth's latest advance in this area is its PRC700 weld controller, which Slayton said "dramatically expands the number of heat blocks available so that welding system programmers and technicians can fully customize the electric current waveform for each weld. Through user-friendly programming tools, each weld can be configured to have as much, or as little current and time as is needed to handle the specific conditions for each weld."

He added that "the PRC7000 has a more advanced adaptive welding function [than the previous generation], allowing even faster real-time processing to make sure the physical weld more closely represents the desired weld-curve. This greatly increases the quality of the weld, and, because aluminum is being used more widely in the industry, this is becoming a very important feature for our customers."

## FYI

**Bosch Rexroth Corp.**
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**Pemamek LLC**
513-206-0807 / pemamek.com

**Universal Robots USA Inc.**
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