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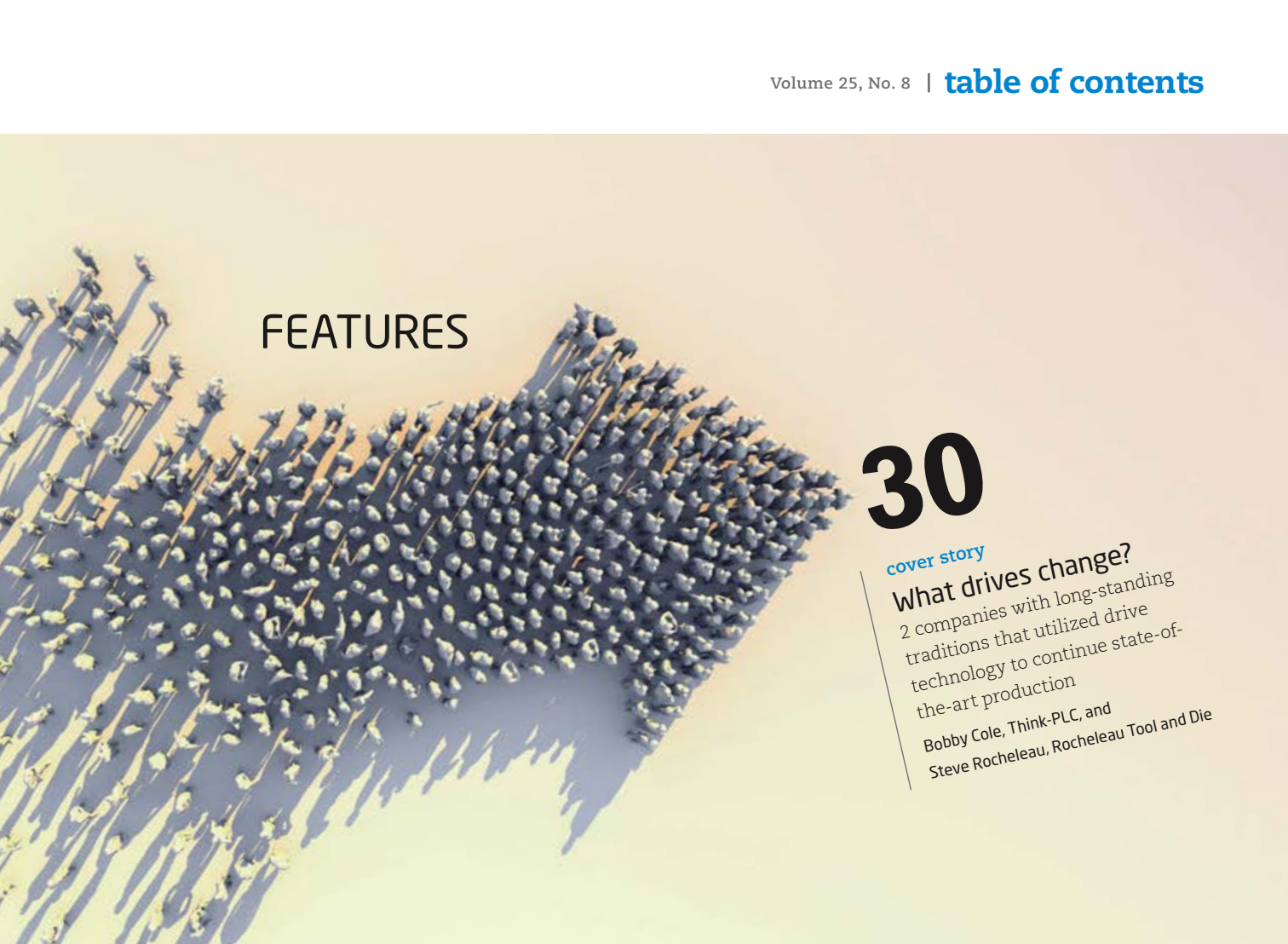
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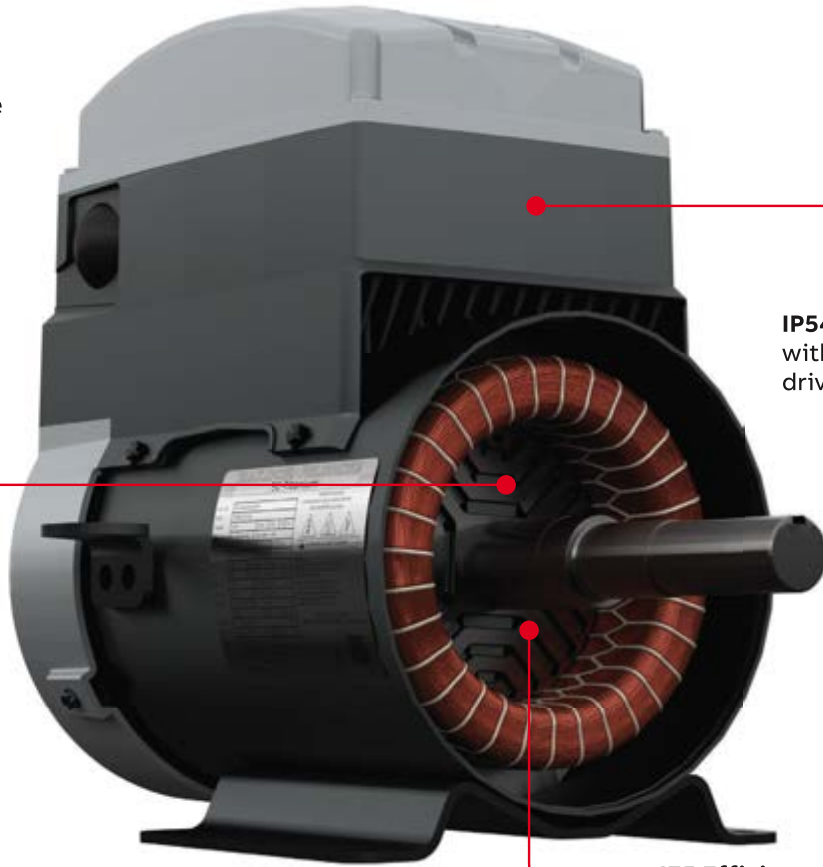
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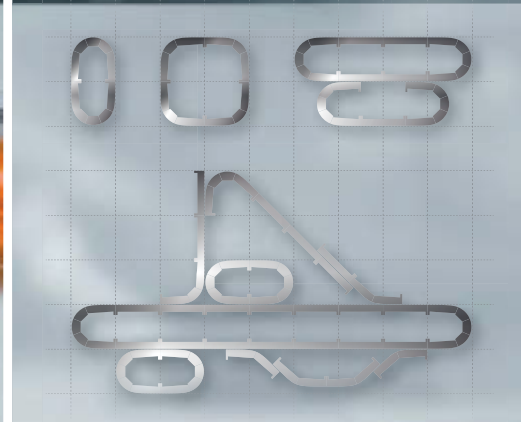
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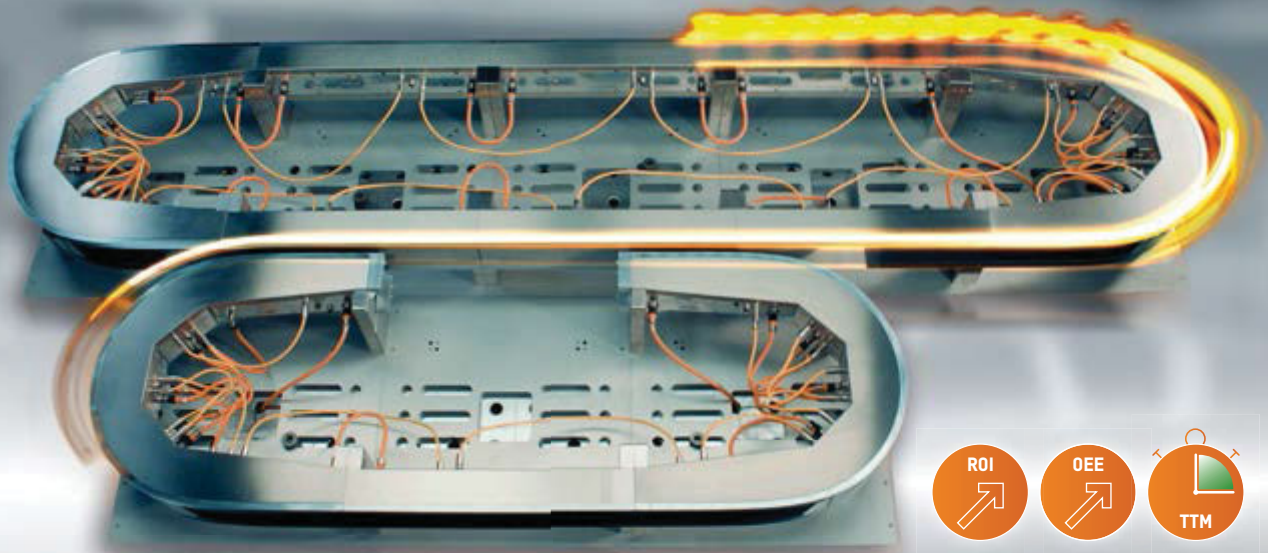
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<b>Other</b>	<b>2,857</b>
<b>TOTAL</b>	<b>40,020</b>



## Mike Bacidore

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# Ready to press the flesh?

**LIVE EVENTS ARE BACK.** Trade shows, conferences and symposia are reopening this fall, like the blooms in a hardy bed of New England asters or Japanese toad lilies. Autumn is a time of rebirth.

But, just when we thought it was safe to go back in the conference center, the more infectious but seemingly less deadly COVID-19 Delta variant has coronavirus cases spiking once again, with many states requiring individuals to put their masks back on, at least for now. And the prospect of foreign attendance is an unknown at this point.

Time will tell how severe and how inconvenient this first COVID-19 echo will be. But many show organizers are optimistic. Two in particular are ready to revive.

Fabtech, North America's largest metal forming, fabricating, welding and finishing event, is set for September 13-16 in Chicago's McCormick Place, and the conference lineup has been announced.

Fabtech is produced by five event partners, all from the manufacturing industry. They include the American Welding Society, the Chemical Coaters Association International, the Fabricators & Manufacturers Association International, the Precision Metalforming Association and SME.

Eastec, the biennial manufacturing trade show held at the Eastern States Exposition in West Springfield, Massachusetts, also will include educational sessions when it takes place October 19-21, produced by SME and AMT. Eastec is one of four events in the Manufacturing Technology Series, which also includes Houstex in Houston (October 5-7), Southtec in Greenville, South Carolina (October 26-28) and Westec in Long Beach, California (November 16-18).

"Fabtech is thrilled to be providing companies of all sizes the opportunity to prioritize training," says John Catalano, SME senior director, Fabtech. "As the industry looks to address key issues like managing steel prices and advances in automation, we believe education is critical to finding solutions."

Fabtech conference tracks will include 3D/additive manufacturing, automation, cutting, finishing, forming & fabricating, job shop, laser, lean, management, marketing & sales, smart manufacturing, stamping, welding and workforce development.

Eastec attendees from industries such as aircraft and aerospace, automotive, medical, defense and industrial and commercial machinery can expect keynote addresses discussing smart manufacturing and how to thrive in a post-recession/post-COVID economy, as well as a panel discussion about optimizing the plant floor with digital transformation. [CD](#)

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**Many show organizers are optimistic. Two in particular are ready to revive.**

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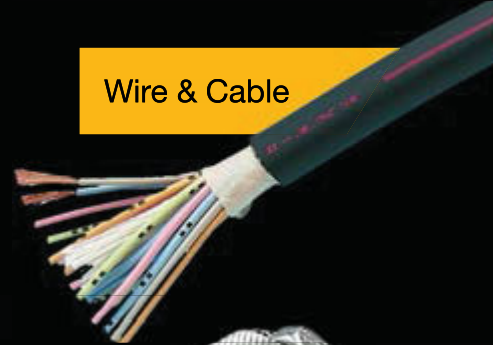
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**Jeremy Pollard**  
jpollard@tsuonline.com

# 5 vision system trends

**IF 2020 SHOWED** North America anything, it is that our supply chain for various products needs to be addressed. This means in a lot of cases manufacturing must be brought back to the mother ship.

A big problem with bringing manufacturing onshore is the cost of the final product. People in North America are paid way more than their counterparts in offshore locations.

In order to remain competitive in the marketplace, people need co-inhabitants such as robots and vision systems.

Getting back to vaccine production, it is also imperative to have 100% inspection of the bottles before filling. The same could be said of the beverage industry. So how do they do that? Vision.

The speeds at which product is made requires the use of high-speed cameras to do the inspection that a human cannot do at the speeds required.

This inspection is needed at the points of defect, which can be varied and would be needed in multiple places to reduce waste, as well as detect production issues that can crop up at any time.

While I am unfamiliar with the actual cost of making a vaccine dose, and we need to have as many 100% good quality vaccines as possible, this cannot be done with the use of vision systems.

A vision system characterized by a 360° inspection profile for vaccine bottles can utilize one camera per location and detect multiple deficiencies.

Vision systems—simple and complex—have been used for ages in the field of automation. Bottle inspection in the beverage industry has been employed forever. The future was very bright 20 years ago and has only gotten better as the years past.

What does the future hold now?

According to the industry, vision-system trends can be summarized in five areas.

**1.** 3D vision (imaging) is gaining a lot of traction in the packaging industry in general but specifically in applications where 2D imaging is not efficient. Depth-of-field detection can be very valuable depending on the application. With the advent of cobots, depth-of-field detection will become more important due to social distancing issues that may stick around for a while due to COVID-19.

---

**With the advent of cobots, depth of field detection will become more important due to social distancing issues.**

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**2.** Advances in sensor technology have allowed shortwave infrared (SWIR) line cameras to penetrate industries such as medical imaging and material sensing applications. One application would be the detection of non-visible (to the naked eye in visible light) features such as separation of Product A and Product B and of course detection of foreign parts that are not supposed to be there. The main component for success is contrast. SWIR cameras detect absorbed light instead of reflected light allowing it to be used in the discerning applications where

the material composition needs to be consistent or detecting the percentage of difference between colors such as light and dark.

**3.** One specification of camera speed is transmission of the result to the automation system.

Back in the day I used a vision system that interfaced with the PLC over serial. That bottleneck determined the throughput rate of product. Today Ethernet-connected cameras can do well into the Gigabit range. There is a specification called CoaxPress 2.0, which is used for higher-speed camera applications for semiconductor inspection and other electronic applications.

**4.** Edge vision systems may be coming to an application near you in the future. Field programmable gate arrays (FPGAs) and the camera's ability to make its own automation decisions can drastically reduce processing time in a high-speed application. FPGAs provide this ability, and to have the camera as your automation partner in any application may prove more cost-effective than standard PC-based vision solutions.

**5.** Vision-guided robots have been around for a while, but with COVID-19 there has been a growth spurt in order to reduce personal contact and social distancing. Cobots can be used to pick parts from trays, but how about from a rotary feeder? The robot's vision system would have to align the end effector in order to pick up the part in its correct orientation to hand to its human counterpart. Expect to see more vision-guided robots as we move forward. [🔗](#)

---

JEREMY POLLARD, CET, has been writing about technology and software issues for many years. Pollard has been involved in control system programming and training for more than 25 years.



**Rick Rice**

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# Servo, stepper or variable frequency drive

**A MORE THAN** casual side benefit of working for a company that provides an essential service is that demand for what we produce increased dramatically over the past 16 months. Complicating this greatly has been a large dip in the pool of staff to run the lines and, now, a negative impact in the guise of lack of supplies to make product. All of this makes sense as a global pandemic put the immediate brakes on much of the manufacturing sector and a rapid ramping up as life re-opens has caused a lapse between demand and supply. A nice benefit of this momentary gap is we get a chance to catch our breath before the next onslaught.

It is during this gap that my colleagues and I had a chance to really dive into the impact that fewer resources, aka people, has meant to our team and our prospective output.

Purely incidental, while our general workforce has dwindled over the past year, quite a few of our key people have arrived at retirement. Like many businesses, we are faced with the very real problem of not being able to pull in skilled people to replace these long-time employees who have finally reached the golden years. Faced with the same expectations as far as new production lines and vintage equipment replacement/rebuilds, we have had to re-evaluate how we go about things from a design standpoint, with the emphasis on re-engineering the solution to use a smaller workforce to get the same or more work done.

From an automation standpoint, we have finally decided to jump in with both feet and embrace distributed I/O on our machines. Now this might seem like a strange admission in 2021, but, for our needs, distributed I/O never really came up in conversations. We are pulling controls off 60-year-old packaging machinery, and, while using modern components, we have just wired them up the same old way.

It suited our needs, and it was familiar to the people who, in some cases, have been operating and maintaining these machines for 40 or more years. As the collective age of our workforce has increased and is now stepping off into post-work life, we have a new generation coming in that isn't tied down by years of doing the same thing. We began to rethink the driving force of our packaging machinery.

Traditionally, our rebuilds of horizontal packagers—pouch

makers—and horizontal and vertical cartoners involve simply modernizing the VFD-driven versions of yesteryear. However, we recently took it upon ourselves to rewrite the software for a previously converted horizontal packager that we had an outside company do for us.

That machine used servo drives and broke out the three main machine functions into individual servo axes that camed up to follow the main cycle shaft. Our rewrite simplified the OEM code and we've had rave reviews from our work mates on the form and function of the newly revised control system.

Following this success, one of the key observations was the impact that automated pouch placers and collaborative robots to palletize production have had on our bottom line. Ownership took notice and

wanted to automate everywhere. The challenge then is how does one put new machine technology on 60-year-old, or even 30-year-old, machines. Well, in some cases, you really can't.

In a bold proposition, I suggested that I might be able to take one of the kits that were purchased to be a horizontal packager upgrade, with the servo drive previously mentioned, and make it a horizontal cartoner upgrade instead.

We really don't need the sophistication of a servo to drive a horizontal cartoner; we are not splitting off any functions to multiple axes. But the distinct advantage would be that we would use the same control components and either produce a cartoner or a packager as needed. Had we really just come up with a truly modular control design?

Let's take a look at what went into our VFD-driven cartoner design. We would need a variable frequency drive, an inverter duty motor and a means of feedback to trigger operations such as bar code scanning, carton coding or flap gluing.

If we were to use a servo instead of a stand motor with VFD solution, we would still need a drive and motor, but the feedback would automatically be included because a servo is a closed-loop control system.

One of the drawbacks we had with our VFD solution is we also had to add a pseudo-jam detection system to detect carton/product jams so that we didn't suddenly stop and load up the chains moving the product through the machine.

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**A smaller pool of people to do the work became the roadblock that sent us off on a new path.**

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## technology trends

The shock relay we employed was designed to detect load on a chain and comes from the chain manufacturer, but it really wasn't designed to be used as we use it. It basically provides a means of setting a maximum current draw over an adjustable duration and use that to drop out a relay that is in series with the VFD output.

The major setback to this attempt at having torque feedback is there is a very fine line between the current required to get the cartoner in motion and the current rise that will happen when the main drive is locked up on a product or component jam.

The challenge is amplified by the gearbox between the motor and the driven device as that multiplies the torque output but does little to the current required to drive the machine. Suffice to say that this hasn't worked as well as we had hoped.

Summing up all this, the cost of a VFD, motor, encoder, shock relay and all associated wiring brings the investment very close

to the cost of a servo drive and motor. The servo utilizes feedback and also provides true torque feedback with a means to cut out and alarm on torque overload, which is a much shorter response time than the shock relay of the VFD solution.

One great sidebar to all this is my team has come up with a way to build the same control system for multiple applications, and that means the code is very similar, as well.

One can't help but wonder what the OEMs of the original equipment would think if they knew that a horizontal packager and a vertical cartoner were practically the same machine from a control standpoint. Our need was to do the same things we normally do with a significantly reduced workforce. All is possible if we just put in the effort to color outside the lines of what we normally do. [CJ](#)

RICK RICE is a controls engineer at Crest Foods ([www.crestfoods.com](http://www.crestfoods.com)), a dry-foods manufacturing and packaging company in Ashton, Illinois.

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# AI allows scientists to detect gravitational waves

**RESEARCHERS** at Department of Energy's Argonne National Laboratory report that they have used artificial intelligence (AI) to dramatically reduce the time it takes to process data coming from the Laser Interferometer Gravitational-Wave Observatory (LIGO).

As LIGO and its international partners continue to upgrade their detectors' sensitivity to gravitational waves, they will be able to probe a larger volume of the universe, thereby making the detection of gravitational wave sources a daily occurrence. This discovery deluge will launch the era of precision astronomy that takes into consideration extrasolar messenger phenomena, including electromagnetic radiation, gravitational waves, neutrinos, and cosmic rays (Figure 1).

Recently, computational scientist and lead for translational AI, Eliu Huerta of the U.S. Department of Energy's (DOE) Argonne National Laboratory, in conjunction with collaborators from Argonne, the University of Chicago, the University of Illinois at Urbana-Champaign, NVIDIA and IBM, developed a new production-scale AI framework that allows for accelerated, scalable and reproducible detection of gravitational waves.

This new framework indicates that AI models could be as sensitive as traditional template matching algorithms, but orders of magnitude faster. Furthermore, these AI algorithms would only require an inexpensive graphics processing unit (GPU), like those found in video gaming systems, to process advanced LIGO data faster than real time.

The AI ensemble used for this study processed an entire month (August 2017) of advanced LIGO data in less than seven minutes, distributing the dataset over 64 NVIDIA V100 GPUs. The AI ensemble used by the team for



## Wave sensitivity

LIGO will be able to probe a larger volume of the universe, launching an era of precision astronomy that takes into consideration extrasolar messenger phenomena, including electromagnetic radiation, gravitational waves, neutrinos and cosmic rays.

this analysis identified all four binary black hole mergers previously identified in that dataset, and reported no misclassifications.

“As a computer scientist, what’s exciting to me about this project is that it shows how, with the right tools, AI methods can be integrated naturally into the workflows of scientists — allowing them to do their work faster and better — augmenting, not replacing, human intelligence,” said Ian Foster, director of Argonne’s Data Science and Learning (DSL) division.

Bringing disparate resources to bear, this interdisciplinary and multi-institutional team of collaborators has published a paper in *Nature Astronomy* showcasing a data-driven approach that combines the team’s col-

lective supercomputing resources to enable reproducible, accelerated, AI-driven gravitational wave detection.

“In this study, we’ve used the combined power of AI and supercomputing to help solve timely and relevant big-data experiments. We are now making AI studies fully reproducible, not merely ascertaining whether AI may provide a novel solution to grand challenges,” Huerta said.

Building upon the interdisciplinary nature of this project, the team looks forward to new applications of this data-driven framework beyond big-data challenges in physics.

“This work highlights the significant value of data infrastructure to the scientific community,” said Ben Blaiszik, a research scientist at Argonne and the

University of Chicago. “The long-term investments that have been made by DOE, the National Science Foundation (NSF), the National Institutes of Standards and Technology, and others have created a set of building blocks. It is possible for us to bring these building blocks together in new and exciting ways to scale this analysis and to help deliver these capabilities to others in the future.”

Huerta and his research team developed their new framework through the support of the NSF, Argonne’s Laboratory

Directed Research and Development (LDRD) program and DOE’s Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program.

“These NSF investments contain original, innovative ideas that hold significant promise of transforming the way scientific data arriving in fast streams are processed. The planned activities are bringing accelerated and heterogeneous computing technology to many scientific communities of practice,” said Manish Parashar, director of the Office of Advanced Cyberinfrastructure at NSF.

The new framework builds off of a framework originally proposed by Huerta and his colleagues in 2017. The team further advanced their use of AI for astrophysics research by leveraging Argonne supercomputing resources through a two-year award from the Argonne Leadership Computing Facility’s (ALCF) Data Science Program. This led to the team’s current INCITE project on the Summit supercomputer at the Oak Ridge Leadership Computing Facility (OLCF). The ALCF and OLCF are DOE Office of Science User Facilities.

---

## Beckhoff opens Milwaukee office

**BECKHOFF AUTOMATION** opened its office in downtown Milwaukee inside the Global Water Center after a yearlong delay due to the pandemic. The office is housed in the same building as water-stewardship nonprofit The Water Council (TWC), which Beckhoff is a member of, and it provides new opportunities for the company to interact directly with its growing customer base in Wisconsin. The 3,660-square-foot facility includes space for sales, engineering, support and training, and has access to additional common area meeting spaces and a unique water test lab.

The Milwaukee office is another key footprint expansion for Beckhoff in the Midwest region, and it will help support business development and increase market share across all industries. For expanding in Wisconsin and championing smart manufacturing technology, Beckhoff received an award from SelectUSA, part of the U.S. Department of Commerce.

Located amidst the Great Lakes, water and wastewater processing is a

particularly important industry for the local Beckhoff team, with one prominent water treatment customer, North Shore Water Commission, mere miles away. As a member of TWC, Beckhoff shares the mission of promoting innovation in

freshwater technology to address critical water challenges, and sharing an office building helps facilitate open collaboration with the 501(c)(3) nonprofit organization and other members.

“The new Milwaukee office offers





Beckhoff a home base in Wisconsin to expand our engineering, sales and support services, and provides training opportunities for new and existing customers across the state,” said Jake Schieffer, Midwest region manager for Beckhoff Automation. “This location in the Global Water Center shows our commitment to delivering leading-edge automation and controls technologies not just for machine builders and manufacturers, but also for process industry customers, particularly in water and wastewater treatment.”

In addition to the expansion in Milwaukee, Beckhoff is opening new U.S. facilities in 2021 in or near Denver, Houston and Orlando. Along with its U.S. headquarters in the Minneapolis area, Beckhoff maintains numerous regional offices in key metropolitan areas across North America. Headquartered in Cambridge, Ontario, Beckhoff Canada maintains regional offices in Montreal, Quebec, and Vancouver, British Columbia. Beckhoff Mexico was established in 2019 in Mexico City.

# TE Connectivity named among Forbes’ Best Employers for New Graduates

**TE CONNECTIVITY**, a manufacturer of connectivity and sensors solutions, was named among *Forbes* magazine’s Best Employers for New Graduates in the United States.

“I’m pleased that TE’s purpose of working toward a safer, sustainable, connected and productive future has resonated with recent graduates just embarking on their careers,” said CEO Terrence Curtin. “I believe we have created a workplace culture in which they can build their skillsets, discover their passions and help us change the world.”



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XCSR RFID Safety Sensor & XUSL4M Light Curtains with muting for automated machine shutdown, XCSLF switch for entry prevention, & XY2CED Double-sided Cable Pull Switch for fast emergency manual shutdown.

The Forbes ranking was determined through a survey of 20,000 Americans with fewer than 10 years of experience working for businesses with at least 1,000 employees. Respondents were asked to rate their companies on a variety of criteria, including workplace safety, compensation, opportunities for advancement, diversity and inclusion initiatives, and company image.

TE's presence on the list doesn't come as a surprise to the members of TEYP,

an employee resource group for young professionals consisting of more than 2,300 people around the world.

"From the very first day I discovered TE at a career fair, I was instantly impressed and was drawn to the company," said Brooke Glassman, a product development engineer based in Middletown, Pennsylvania, who joined TE in 2019. "This wasn't only because of the innovation and technology they were working on, but because they emphasized how much

they cared about their employees and their personal and professional development. TE is a company that is willing to develop and invest in the next generation of employees, and to me, that stands out."

TE has committed to building a pipeline of new talent through internships, as well as its rotational program, which offers new graduates exposure to a variety of careers and industries within the company along with the support of experienced mentors, the company says.

## Fanuc announces production of 750,000 robots

**FANUC CORP.**, a supplier of CNCs, robotics and factory automation announced the production of its 750,000th industrial robot, representing a high point in the robotics industry.

Currently, Fanuc is capable of producing 11,000 robots per month in fully automated factories that use its own robots to make robots, controllers and machine tools that offer reliability, precision, speed and easy operation, the company said.

"With 750,000 robots installed globally, Fanuc has become a household name in manufacturing," said Mike Cicco, president and CEO, Fanuc America. "I'd like to thank our customers, authorized system integrators, suppliers and employees for helping us achieve such an impressive and important milestone."

Fanuc's customer base covers a wide range of industries including automotive, aerospace, food and beverage, consumer goods, medical and pharmaceutical, warehousing, and many more. "Now more than ever manufacturers are embracing automation and

robotics to solve production challenges. I'm proud to say that Fanuc is in a position to meet the growing demands for easy-to-use automation solutions that help our customers increase ef-

iciencies, improve their competitive position, and realize a quick ROI. We look forward to helping as many companies as possible achieve their goals," Cicco added.



SOURCE: ALEXANDER TOLSTYKH / SHUTTERSTOCK.COM

The KEB logo is displayed in white text on a red rectangular background in the top right corner of the image. The background of the entire advertisement is a photograph of a KEB R6 Line Regen Unit installed in an electrical cabinet. The unit is white with a control panel featuring a red LED display showing 'rE66n', several function buttons (START, STOP, ENTER F/R, FUNC SPEED), and a red KEB logo with four horizontal stripes. To the left of the unit is a grey CTE component. Various cables are connected to the units.

## R6 LINE REGEN UNITS

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## Absolute Machine Tools earns Diamond Partner status from Mitsubishi Electric Automation

**ABSOLUTE MACHINE TOOLS INC.**, recently earned the title of Diamond Partner Systems Integrator from Mitsubishi Electric Automation Inc., an affiliate of Mitsubishi Electric that focuses on production solutions. The partnership is expected to expand opportunities for and bring value to both companies.

The Diamond Partnership program is so named for its strength and its multi-faceted approach to automation relationships. These four facets are the customer, the Diamond Partner, Mitsubishi Electric Automation and Mitsubishi Electric. As a Diamond Partner Systems Integrator, Absolute will have access to a comprehensive software portal to stay up to date on demonstrations and proof-of-concepts; a Systems Integrator Locator to showcase Absolute directly to customers; a hardware demonstration system; a complete software suite for programmable logic

controller (PLC), motion, human-machine interface (HMI), variable-frequency drive (VFD), and robot with automatic updates; and a strong support team for product training and technical resources.

Jason Jones, FESG Manager of Automotive & Central US at Mitsubishi Electric Automation conducted the interview that confirmed Absolute's eligibility for Diamond Partner status. Absolute Machine Tools Director of Marketing and A+ Automation Team Courtney Ortnier said, "Our ongoing contribution to Mitsubishi projects as well as our current and past automation projects were part of our qualifications."

Absolute was the only U.S. distributor to partner with Mitsubishi Electric Automation to create and build the LoadMate Plus, a machine tending robotic cell designed to add automation to CNC applications. Mitsubishi also

took the development of Absolute's A+ Automation Team into consideration when deciding to give absolute the title of Diamond Partner.

Ortnier created the A+ Automation Team in response to the growing need for automation and to help manufacturers find the best solutions to meet their production requirements. "COVID-19 pushed manufacturers to think even more seriously about automating their processes to remain competitive in an ever-evolving global economy and to fill the voids left by the virus and the lack of skilled labor," she said.

Ortnier added: "This achievement is just one more step in giving our customers the broader choices for automation. Being a Mitsubishi Diamond Partner means that Absolute can offer the most complete lines of automation products and solutions to the metal cutting industry."

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## Fraba launches new business units, brand identity

**THE INTERNATIONAL FRABA GROUP** announced the creation of two new business units: Ubito and Credemus. Building on the successes of the established Posital and Vitector businesses, these new enterprises will be marked by new logos and branding.

Credemus offers consulting and support services to mid-sized companies interested in adopting mass-customization manufacturing methodology that Fraba launched 15 years ago, anticipating the Industry 4.0 wave.

Ubito offers components for magnetic sensing, energy harvesting and wireless transmission with roots in Posital's pioneering use of Wiegand Technology in rotary encoders. Ubito will take this technology to new markets such as smart metering, Internet of Things and wireless power transmission.

The new business units and logos reflect a significant evolu-

tion of the Fraba group. Christian Leeser, the group's CEO and majority shareholder, explained: "The old Fraba company, which had been founded in 1918, specialized in electromechanical devices and systems, largely based in relay technology. By 1993, when we acquired the company, modern semiconductor technology had made much of this obsolete and we faced the challenge of updating both the product line and the company culture. We created the Vitector business unit with innovative safety systems for commercial doors based on optical technology. Posital was created as a specialist manufacturer of position and motion sensors, building on the base of optical encoders we inherited from the old company. New innovations included Fieldbus interfaces, Ethernet and precision multiturn magnetic encoders with Wiegand technology." 



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# How IIoT changes business models

5 industry experts tackle the sweeping landscape that comprises industrial automation

by Mike Bacidore, editor in chief

**THIS PANEL OF INDUSTRY EXPERTS** expects the Industrial Internet of Things (IIoT) and big data to change business models and alter the way products are designed and produced.

Paul Bocchi is general manager at ANCA Motion ([motion.anca.com](http://motion.anca.com)).

Keith Moyer is vice president of sales at Weintek USA ([www.weintekusa.com](http://www.weintekusa.com)).

Francois Claudel is marketing director at Telemecanique Sensors ([www.tesensors.com](http://www.tesensors.com)).

Aurelio Banda joined Motion as group vice president of automation. “Aurelio’s extensive industry background in automation distribution and manufacturing, combined with his education and training, make him a perfect fit to lead our automation strategy and accelerate growth,” says Randy Breaux, Motion president. “We look forward to watching our automation business flourish under his leadership.”

Banda most recently served as president and chief executive officer of PHD. Prior to leading PHD, he served as president and CEO—North America for Beckhoff Automation. Banda was also the owner and president and CEO of Controls Plus, an automation distributor. Additionally, he served as VP sales and regional sales manager for Motion Automation and as regional sales manager for Bosch Rexroth’s Electronic Controls & Drives.

A graduate of DeVry University with a degree in applied science in electronics, Banda furthered his education with an MBA in finance & operations from Notre Dame and completed Harvard Business School’s General Management Program.

The Control System Integrators Association (CSIA) announced its board of directors at the CSIA Town Hall Business Meeting in May. The new CSIA Board of Directors are:

- Adrian Fahey, board chair, managing director and CEO, Sage Automation (2021-2023)
- Ray Brown, director, ESCO Group
- Karen Griffin, director, Hargrove Controls + Automation
- Stephen Malyszko, director, Malisko Engineering
- Frank Riordan, director, DMC
- Greg Young, director, Automation NTH

- Daren Dieleman, director of operations, Interstates
- Luigi de Bernardini, past chair, Autoware.

The new board of directors was affirmed by a quorum of the CSIA membership during the virtual Town Hall Business Meeting. Fahey stated: “I’m thrilled to be affirmed by the membership of CSIA as the new board chair. It is an exciting time to be leading this organization as we begin to move toward a hopeful transition out of the global pandemic. I look forward to meeting in person again soon with our members at the 2022 CSIA Executive Conference in Denver.”

CSIA CEO Jose Rivera added: “Adrian Fahey follows Luigi de Bernardini as chair of the board. Both are CEOs of international system integrators, underscoring the association’s growing international presence. CSIA has members in 35 different countries, and certified members are headquartered on every continent except Antarctica.”

## What are three key things that a machine builder, system integrator or manufacturer should know about your organization?



**Luigi de Bernardini, CEO, Autoware** ([www.autoware.it/en](http://www.autoware.it/en)):

Autoware has developed smart-manufacturing solutions since 2001. We have 20-plus years in digitizing production processes in various industry verticals but mostly in FMCG.

Our motto is “tailored based on standard.” We believe in the importance of using standard platforms to develop our solutions, but, at the same time, we are fully aware that they need to be tailored to the specific client’s needs. Each company is different in terms of organization, culture and assets. Any solution needs to empower the strengths and solve the weaknesses, which are different company by company, even if they produce the same thing.

Autoware works mostly with big multinational and multisite companies all around the world. We have a long experience in rolling out solutions from remote, so we can serve our clients

wherever they are. We even provide priority support services up to 24/7.



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)): With headquarters in Australia, we

have been involved in motion control for more than 45 years. Our CNC and motion control technology has evolved over this time by proving its performance in demanding applications such as five-axis precision grinding and high-speed laser cutting.

Our highly skilled global team is passionate about motion control. To achieve high speed and sub-micron precision for demanding applications requires a multi-disciplinary team that understands their field to the smallest detail.

We design, manufacture and provide global support for all components in our solution from CNC IPC, software, servo drives, HMI, I/O and motors. Our unique LinX tubular linear motors are used in CNC and general automation applications where flexible positioning and machine dynamics is required.



**Francois Claudel**, marketing director, **Telemecanique Sensors** ([www.tesensors.com](http://www.tesensors.com)): Telemecanique


Sensors was founded more than 90 years ago, and we specialize in sensors and sensor-related technology. As a global player and leader in the sensors business, we help our customers select the right technology to get the best performance and reliability from their machines. We design our solutions around three core values: simplicity, proximity and expertise.

We can offer a very large portfolio of industrial sensors, which includes electromechanical switches, pressure switches and transducers, proximity sensors, ultrasonics and photoelectric

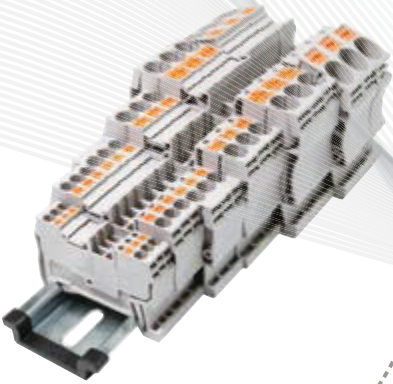
sensors, as well as RFID readers and safety solutions.


At Telemecanique Sensors, we do ev-

erything in house, from product design, validation and manufacturing to deliver high quality products to our customers.




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## More productive

Figure 1: An automated goods-to-service system is key to maximizing productivity in this Motion distribution center in Birmingham, Alabama. (Source: Motion)



**Keith Moyer**, vice president of sales, **Weintek USA** ([www.weintekusa.com](http://www.weintekusa.com)):

Weintek USA is a technology-driven company. We are driven by having cutting edge human-machine interfaces and associated products. Our R&D team keeps consistently ahead of the competition with innovations such as high-definition, capacitive touch HMIs with programmable gesture control and the fastest processors available in an HMI; CoDeSys-enabled HMIs and PLCs; affordable and flexible remote I/O solutions; highly secure and affordable remote access; and innovative mobile access.

We are a true manufacturer. The automation space is rife with rebranding and a lack of transparency. We manufacture

our products in our own factories. This puts us in control of our supply chain and in a good stock position here in the United States.

We are one of the largest HMI manufacturers in the world. Because of the large number of HMIs that we produce, economies of scale allow us to bring immense value to our customers.



**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): Motion offers a wide array

of electrical and industrial automation products, as well as many value-added services, including engineering, fabrication, repair and IIoT/Industry 4.0 solutions across these product groups to increase customers' productivity (Figure

1). Our proven approach is to partner closely with our customers and suppliers on applications and product developments for automation. Our principles to engineer products in designs, develop proofs of concept and deploy automation builds are keys to making a successful project with Motion.

## What new technologies are driving product development and why?



**Francois Claudel**, marketing director, **Telemecanique Sensors** ([www.tesensors.com](http://www.tesensors.com)): At Telemecanique

Sensors, being innovative is our motto and technology is driving our solutions. Let me share with you a few examples.



In the United States, on average 26 people are killed every year working on aerial platforms, and an estimated 10 fatalities per year could be avoided thanks to anti-collision systems.

Safety of the people and the assets is our top priority, and, besides our range of safety sensors, we are currently launching a new ultrasonic sensor that has a wide-angle detection area. This sensor is particularly interesting for any type of mobile equipment as it can reduce the risk of collision by detecting an obstacle present in the blind spot, for example, or power line.

It is a reliable alternative to more expensive technology and offers an opportunity to mobile equipment manufacturers to improve the safety of the operators and potentially avoid liability expenses.

Another example is, today, we all know that ecommerce has become a major growth driver for the logistics industry. Operating rates are required to increase, without impacting quality, to answer to this demand. For example, Amazon requires a 99.99% uptime for their business, which means no

time for failure and maintenance. A few years ago, we designed an innovative product specifically designed for conveyors: the photoelectric roller sensor. This product can be simply mounted on the conveyor between rollers. In addition to drastically reducing the installation time, it can detect packages of any size, shape or material, and it is not subject to shock from passing packages or handling errors from operators, which reduces conveyor failure.

Also, asset tracking is becoming predominant for a lot of applications. One of it is the food and beverage industry as more consumers want to understand and track what they are eating. Data collection and trackability can be done with solution leveraging on RFID technology.



**Luigi de Bernardini**, CEO, **Autoware** ([www.autoware.it/en](http://www.autoware.it/en)): We are looking mostly at machine learning and analytics. In my opinion, they are the two that create value to our customers and the ones that we need to focus on.

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**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): Technology advancements in machine learning, networking connectivity/protocols and ease of use in integration are the drivers leading the way in product development. As industrial automation applications expand rapidly in manufacturing, the objectives to care for improved worker safety, reduce costs, improve quality and increase flexibility underpin the technology advancements in product development deployments.



**Keith Moyer**, vice president of sales, **Weintek USA** ([www.weintekusa.com](http://www.weintekusa.com)): Everyone is focused on IIoT, and at Weintek USA we have been ahead of the curve there for years, but I think that the look and feel of a machine's user interface will be paramount in the coming years. The ubiquity of screens in our daily lives is leading to frustrations with slow, low-resolution HMIs in the industrial world. At Weintek USA we have introduced blazing fast HMIs with options for HD and capacitive touch that rival what we have all become used to in the commercial arena. Our industry is hungry for these technologies as machine builders seek to provide a topnotch user experience.



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)): Technology is moving at a rapid rate in many areas related to our product development ranging from the details of electronic design to macro trends such as IoT and big data. Our hardware products are currently evolving, utilizing ongoing advancements in areas such as silicon carbide power semiconductors and the increasing capabilities in microprocessors for servo control. This allows us to design more compact and efficient servo drives with additional computational capacities to add advanced control capabilities and diagnostics. In CNC applications, such as laser cutting, advances in fiber laser technology has resulted in laser power significantly increasing in a short period of time. This creates the exciting challenge to work with our customers to fully utilize increasing laser power by pushing machines and our CNC system development to produce the most productive laser cutting machines ever seen on the market. Ongoing trends and capabilities around IIoT and the ability to collect and communicate large amounts of data are driving development in core functionality to allow collection and communication of internally generated data, as well as that of integrated third-party sensors and devices. The growing acceptance of having machines connected to the Internet

also means a stronger focus on security, particularly on our IPC/CNC solutions.

## How does the Industrial Internet of Things figure into business strategy?



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)): As a motion-control provider specializing in CNC control, we primarily act as an IIoT enabler. At a core level, we provide functionality to connect to third-party devices and provide means to collect and communicate information relating to many detailed parts of the system. Information can be collected on motor currents, temperatures, axis positions, velocities and vibration. This information can then be utilized for a multitude of purposes including advanced diagnostics, prognostics for preventive maintenance purposes, process analytics and optimization, MES integration and development of digital twins. As our Windows-based IPC/CNC controller can act as an IoT gateway, security is an increasingly important consideration as part of our solution offering. As IIoT is an enabling set of capabilities and technologies, the ongoing challenge for a motion control company such as ANCA Motion is in finding new and innovative ways to utilize today's data collection and analysis capabilities to solve real-world problems. As our customers are often the application domain experts, this also requires working closely with them to understand their challenges, as well as those of their customers. All these elements mean that we are gradually shifting more focus toward software and information technology elements of our solutions as they increasingly lead the road our roadmaps will follow.



**Luigi de Bernardini**, CEO, **Autoware** ([www.autoware.it/en](http://www.autoware.it/en)): IIoT is one of our technological pillars. We recognized the trend in 2014 and partnered with a leading vendor to implement IIoT solutions based on its platform. IIoT has unique characteristics that allow overcoming some of the limits of traditional platforms. Reduced footprint, possibility to easily implement solutions in brownfield environments and connect legacy production lines or assets, allow to extend digitization to plants that could not afford traditional solutions. We are only seeing the tip of the iceberg; much more will come. One important enabler will be 5G, allowing to connect any type of machine or device without big investments of infrastructure

and reducing the network complexity. This is the reason why we are investing in it and growing our competencies in all the related aspects of it.



**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): IIoT has figured into business strategy with many manufacturing organizations

already piloting digital initiatives with IIoT at the forefront. The functional areas with immediate implications are in supply chain management, manufacturing operations management, plant maintenance and asset management. The deployment of IIoT systems has been on the edge, at the manufacturing site and in the cloud; certainly, having strategic implications on IT and OT strategy for the organization. Scaling IIoT to capture value is rooted in offering a manufacturer ready-to-use guidance, rollout and enablement while strategically orienting their business, organization and technology for broader success.

## How will machine automation and controls alter the way companies staff their operations in the future?



**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): As digital transformation implementations in manufacturing rise with machine automa-

tion and controls, organizations are developing roadmaps to staff their needs to address an automated factory. Companies are redeploying existing skills into new roles, while looking at what new skills are needed for external hires. Creating the right talent pool to take advantage of the automation benefits, as well as digital and analytical transformations, will be imperative for an organization to address the ongoing dynamic demand patterns in industry.



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)):

Over the years, we have seen ongoing increases in the level of automation on customers' machines. Depending on the application, machines equipped with automatic loading stations are now commonplace for long-batch lights-out production. Increasingly, we see capabilities develop in manufacturing around unmanned small-batch automation integrated with ERP systems that allow jobs to be scheduled and raw material to be delivered where required for machining. Improved automation across the manufacturing value stream

means that complex operations can occur fully unmanned including off-machine measurement and compensation feedback all integrated with manufacturing execution systems.

Manufacturing cells are increasingly striving toward being able to be treated analogously to a desktop printer where the print button is in the ERP system. Certainly, there are many challenges in this space, but the trend is there. Although always required, we expect the need for manual operators to decline in more sophisticated operations and be replaced by automation engineers.



**Francois Claudel**, marketing director, **Telemecanique Sensors** ([www.tesensors.com](http://www.tesensors.com)): The Internet of Things demon-

strated the importance of data. Thanks to all those data that can be collected on a machine, a plant, a building or a vehicle, it is possible to run some analytics to optimize the processes to improve people or asset safety, improve energy efficiency, reduce downtime thanks to predictive maintenance or increase production rate. The field of possibilities is immense, and this is why collecting data has become essential.

This can only be done with reliable and communicating sensors, and this is why the Internet of Things is integrally part of our strategy.

This is exactly why we recently launched our cloud-connected sensor XIOT that gives the opportunities to collect data even from remote and isolated locations. This sensor, which doesn't require external power supply, pushes directly the data to the cloud to notify the user in case of threshold or alarms. This for example can help a farmer to not lose his crop because of irrigation failure.

Besides that, it is also important to understand that many users, operators or technicians are not yet ready to switch to digital technology, and this is why we continue to offer traditional sensors such as our range of pressure switches and mechanical limit sensors that are by design robust, simple to install, easy to use and can switch power loads directly. There is still a need for simple, complete sensor solutions where the sensor does the control using electromechanical sensors and hardwired control logic.



**Luigi de Bernardini**, CEO, **Autoware** ([www.autoware.it/en](http://www.autoware.it/en)): That's a very interesting point. I don't know if the question

is how machine automation and control will alter the staffing policies or how the new generation staff will require to alter the machine automation and controls. It's probably a mix of the two. We are seeing two distinct forces at the same time.

New technologies allow adding more intelligence to machines. AI overall promises big changes in how machines will be managed. The increase of technology will require operators with different skills and capabilities. It will not be just technical skills, but even soft skills to manage a different interaction with the machines. On the other side, younger people are used to different technologies and have great expectations to use them in controlling machines and lines in an industrial environment in the same way they use them in their personal life. This is driving the demand for different ways to interact with machines. Moreover, the trend to stay in the same working position for a shorter time is driving the necessity to capture the user knowledge in some kind of repository to keep it part of the company knowledge that survives to the single operator.

## How is the development of software solutions impacting requirements for hardware?



**Luigi de Bernardini**, CEO, **Autoware** ([www.autoware.it/en](http://www.autoware.it/en)): Even in this case, it's a mix of different trends. The increased possibility to implement cloud-based solutions changes the way software is developed and the requirements for hardware. We are seeing an increased demand for computational power at the cloud level to support software with continuously growing complexity. At the same time, we are seeing an increased demand for edge computational capabilities, smaller devices with enough power to provide local data transformation. In parallel, we are seeing an increased demand for mobile—not so much wearable at the moment—to deliver information to the users wherever they are.



**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): Software solutions move the ease-of-use needle more and more, creating a plug-and-play requirement for hardware architectures. The digital transformation in manufacturing environments will be best served to scale by reducing the complexity of an automation solution through ease-of-use software solutions with scalable hardware offering implementation. Nearly every application is complicated to a brand-new user, and manufacturers are leaning toward automation solutions with software and hardware integrated to ensure the ease of use for operators. Manufacturers can quickly realize more self-sufficient automation systems, which are scalable, cost-effective with

faster ROIs, as the workforce in caring for these systems expands the operational profitability of the organization.



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)): We now operate in an environment where information gathering, connectivity and analytics at some level is becoming increasingly expected and commonplace. The influence this plays on our own hardware development is the requirement to be able to gather relevant information and communicate within a wider ecosystem. The adoption of modern microcontrollers in our hardware development allows us to implement relevant protocols while also providing significantly more processing capabilities and smarts than what was available during the development of earlier-generation hardware products.

## As engineering and IT continue their convergence, which one is and/or will be leading the direction of future automation and technology?



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)): The analogy of the evolution of the mobile phone is a good one in this context. Where once a mobile phone had little functionality other than serving as a phone, it has now evolved into a portable computing and communication device significantly more versatile than mobile devices from years ago. Where software capabilities drove the hardware development of the mobile phone, so too will we see enabling technologies and capabilities under the IIoT umbrella lead system and hardware development.



**Luigi de Bernardini**, CEO, **Autoware** ([www.autoware.it/en](http://www.autoware.it/en)): I believe that no one will definitely lead. In the end, the convergence will lead. Engineering cannot drive without taking into consideration IT, and IT cannot drive without taking into consideration engineering. The challenge is to create a culture of collaboration between the two or to merge the two aspects in new roles. It will take time since typically engineering and IT have different mindsets and approaches to solving problems.



**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): A leading direction from both engineering and IT disciplines will set the pace for

future automation and technology. For example, many manufacturing environments will be operating high-speed and high-volume production applications with the rise of automation and robotics acceptance in their facilities. Most advanced systems will conduct adjustments on the fly, switching seamlessly between product types without the need to stop the line to change programs or reconfigure tooling, a function of both engineering and IT disciplines. This integration convergence is seen through communication between machines/robots, the engineering discipline, on the factory floor calling on the IT discipline in oversight of the modern industrial-networking technologies.



**Francois Claudel**, marketing director, **Telemecanique Sensors** ([www.tesensors.com](http://www.tesensors.com)): One of the main consequences of the convergence between OT and IT is the need for more cyber-secured products. Historically, many devices only connected to a PLC, for example, or to a protected local network, were not embedding any cybersecurity measures.

In today's world, as it is not possible to define in advance how the connected products will be used and in which environment, it is essential that the manufacturer delivers products that can offer some protections against cyber attacks.

Also, today we are transitioning more from traditional sensors to communicating sensors, which are simplifying the installation, giving access to more data within the particular communication protocol IO-Link, and we should expect that more of those low-level communication buses that are today wired will become wireless.

## Looking into the future, how will technology change your organization or other organizations over the next five years?



**Paul Bocchi**, general manager, **ANCA Motion** ([motion.anca.com](http://motion.anca.com)): That is quite a broad question. The changing face of technology has had an ongoing and profound effect on our business from the products we develop to our internal operations. Some of these are planned and anticipated; others are not. COVID-19 was a dramatic example of the latter, acting as a war-time type catalyst in the development and adoption of new ways of working and accelerating the drive to automate manufacturing operations. The current environment has forced us to change and adapt in some ways that are more efficient than before. Where software- and IT-related product

developments and solutions were already becoming increasingly represented in our roadmaps, I expect this to continue to a point where the business model itself will transition from the traditional view of being primarily a hardware control/CNC supplier.



**Keith Moyer**, vice president of sales, **Weintek USA** ([www.weintekusa.com](http://www.weintekusa.com)): As a technology manufacturer, we are focused on providing our customers with cutting-edge technology at a great price. Because we have always pushed boundaries with our technology, we are well-equipped to continue to do so for the foreseeable future.




**Luigi de Bernardini**, CEO, **Autoware** ([www.autoware.it/en](http://www.autoware.it/en)): If two years ago I would have responded that technology was for sure modifying our organization slowly and continuously, after the COVID emergency I believe that technology will significantly transform our and all organizations. More than in the past it will be all-around people. In a service company like ours, but in a manufacturing company, as well, technology will be key in enabling and enforcing collaboration between people. It will support communication and sharing of information, of course, but mostly it will support data-driven decisions. The increased need to keep people aligned will grow the need to align them on data and make the collaboration in taking decisions based on analytics. Technology will not only change the way people will do things, but even the way people will look at things. It will impact the company culture, and the transformation will not be painless.



**Aurelio Banda**, group vice president of automation, **Motion** ([www.motion.com](http://www.motion.com)): The future of the organization is to leverage technology with the right balance on the overall operating strategy and business goals. Choosing the right level of technology implementation for future needs requires a deep understanding of the organization's processes and manufacturing systems. For example, every project with automation considerations must be examined for the right level of technology and the improvements it can offer to directly link to the organization's overall strategy. The outlook over the next five years shows an increase in technology accessibility due to automation platforms and networking connectivity available in the marketplace, driving the organizations to have their digital transformation road map in place to execute. [CDI](#)

by Bobby Cole, Think-PLC, and Steve Rocheleau, Rocheleau Tool and Die

2 companies with long-standing traditions that utilized drive technology to continue state-of-the-art production



# WHAT DRIVES CHANGE?

**T**he more things change, the more important it is to keep things the same. At Rocheleau Tool and Die, a machine builder in Massachusetts, and at Krispy Kreme's North Carolina manufacturing facility, as well as its stores, a heritage of high-quality production is continuously passed down.

At the heart of both companies' recent upgrades were drive technology that maintained the standards that customers had come to expect and improved upon the existing platforms.

At Rocheleau, it was the engineering know-how of a family brain trust that was complemented with Mitsubishi's automation expertise. At Krispy Kreme, it was the fresh spark of system integrator Think-PLC that turned change into a retrofit kit, comprising primarily Siemens components, that could be rolled out across multiple facilities.

From its early beginnings, the Krispy Kreme company has designed and built the proprietary machines that have given rise to its equally safeguarded doughnut recipe. The quality and

consistency of the global doughnut brand starts at the company's headquarters in Winston Salem, North Carolina, where a 105,000-sq-ft manufacturing facility houses research, design, testing, engineering and production.

The machines and processing equipment being built there use Siemens drives and controls, collaboratively integrated by Think-PLC ([think-plc.com](http://think-plc.com)), the automation engineering partner to Krispy Kreme.

Honestly, in my 20 years of experience, I've never seen an end user build such high-quality machines in-house. Krispy Kreme engineers and manufactures all of its production machines, from the extruders and conveyors through to the packaging, including its famous glaze waterfall.

Every Krispy Kreme store is a high-tech doughnut manufacturing facility. The speed at which an extruded doughnut moves through the store is a very, very big deal. Throughout the process, the shortening is kept within an exact range of



### Perfect integration

Figure 1: The integration of the drive is essential to the retrofit strategy developed by Patrick Betson (left), Krispy Kreme's director of equipment manufacturing, and Bobby Cole, president of automation consultancy Think PLC.

temperature, monitored with a 3-inch-long Pt100 resistance temperature detector (RTD) custom supplied by Think-PLC. We use the RTD inputs on the Siemens Simatic ET 200SP remote I/O module.

The RTD signal is processed through the Profinet I/O near the fryer. It's filtered, scaled and manipulated for multiple temperature-type displays, including European and North American units, on the Siemens TP1200 Comfort Panel on the doughnut line.

Doughnuts are cooked on both sides for a precise number of seconds on each side. The cooling conveyor cycles through the store at a set number of minutes.

Patrick Betson is Krispy Kreme's director of equipment manufacturing. Responsible for the machine-building side of the business, he has long understood the connection between the making of great machines and the making of great doughnuts. Having gathered insights from the company's service techni-

cians, store managers and customers, he had initiated a range of improvements leading to increased uptime and mean time between failure. Now those early strides pointed to the need for the latest drive technology, related software conversions and safety integration.

"Before there was much publicity about Industry 4.0 and IoT, Bobby Cole and I often talked about the data that could be generated by more advanced machine monitoring," says Betson (Figure 1). "It became increasingly clear that, by integrating the latest Siemens drives and controls on our machines and connecting them using Profinet communications, we could start putting that data to work."

Krispy Kreme's decision to use Siemens control automation would support an aggressive rollout of new stores and the swift retrofitting of existing stores. Integrating the latest Siemens variable-frequency-drive (VFD) technology was an easy decision. The hard part would be to figure out how to conduct those

retrofits in the shortest and most cost-efficient way in more than 600 stores worldwide.

A notice came from Siemens' supply chain that product cancellation was nearing for the original Micromaster drives, which had always been standard on the doughnut line. I informed my customer Patrick Betson that we needed to have contingency plans in place. In that conversation, there was much discussion regarding the ease of install, ease of cost and ease of support, as this could be a literal show-stopper if we didn't have our ducks in a row.

That's when Betson and I came up with the idea of a retrofit kit, one that would enable every store to quickly add new components and software to existing hardware, making massive technology conversion acceptable to all and therefore actionable in short order (Table 1).

## Kits for rapid retrofitting

The concept of a kit was inspired by the realization that, while the Siemens drives and controls installed around 2001 were now starting to show their age, they all shared a farsighted on-board feature: an SD card. This would prove to be a time-saving, cost-cutting advantage, because the SD cards in the older Siemens drives and PLCs have been maintained to match each store's unique set of machining and processing parameters.

In addition, each kit would include all that was needed for a local contractor to upgrade the legacy control panels, including parts for safety and power wiring. A bill of material having 15 parts would be reduced to seven. This would mean fewer parts to wear, troubleshoot and stock in the future.

The main purpose of the kit was to replace the older Siemens Micromaster

## PARTS INCLUDED

Name	Description	Quantity
Sinamics PM240-S	power module for drive	2
Simanics CU240E-2DP	control module for drive	2
Sinamics IOP-2	drive keypad	2
Simatic HMI memory card	new HMI program	1
Simatic S7300 memory card	new PLC program	1
Drive template	template for marking mounting holes for drives	1
8-32 screws	drive mounting hardware	3
#29 drill bit		1
8-32 tap		1
18 AWG blue and blue/white wire	for new control runs, if needed	3 feet
Wire labels	replacement labels, if needed	-
Panel tags	replacement panel tags (VFD-1, VFD-2)	2

## Retrofit kit

Table 1: The retrofit kit enables every store to quickly add new components and software to existing hardware, making massive technology conversion acceptable to all and therefore actionable in short order

drives with their Sinamics G120 drives (Figure 2). The SD card in the kit has software that we modified, and, with a couple flips of some switches, the drive is automatically programmed. Someone with absolutely no control experience can reload the new software into the new drives and the new PLCs.

There are two systems most commonly built. The larger doughnut line used an S7-300, which has migrated to the S7-1500. The smaller lines used to have the S7-200, and they were migrated in 2010 to the S7-1200.

The newly designed S7-1500 system integrates fail-safe features—safety—into the processor. This allows for Profisafe safety to be achieved within the topology network of drives and remote I/O. Safety can now be distributed through fieldbus instead of the costly and timely install manor of hardwired

signals to complex safety relays.

To prove the retrofit kit concept, we tested the kit's installation and use in the Krispy Kreme manufacturing plant in Winston Salem, North Carolina, followed by tests at various stores in the region. The new drives and PLCs installed smoothly. Their SD cards automatically updated and matched all previous store parameters. After two months, the stores reported the trial a success. But to further test the concept themselves, we made a whirlwind trip to retrofit every store in Australia over five days using the kits (Figure 3).

The retrofit kit concept had worked. It enables a store to replace its drives and controls in about two hours. This compared to the hours invoiced by a control technician to travel to a Krispy Kreme store to do the same—a time/cost difference that would be even greater, were





## Shop-floor automation

Figure 2: John Priddy, Krispy Kreme fabrication manager, installs the newly developed kit into the fryer section of a doughnut machine.

the SD card not a feature of the Siemens drives and PLCs.

During the doughnut frying process, the efficient pumping of heated shortening is critical to maintaining optimal doughnut quality and product count. When the flow rate is not at the desired constant, the wide range of viscosity becomes a problem. The melted shortening will not be filtered of dough bits and pieces. Temperature variances will soon occur, causing hot spots at any point in the frying process, including inside the fryer vat itself.

Behind the scenes, the Siemens Sinamics G120 drive addresses all of these

pump motor concerns, while visually reporting the operational status of each motor. Moreover, the drive is working to assure that all of the pump motors are keeping their cool, below the threshold for heat damage.

In many pumping applications, motor overheating is probably the number-one service issue. That problem is being removed by the drive's ability to set and hold a curve that assures the most efficient flow, at a low speed and at a high speed, from 7 Hz to 90 Hz. The accuracy of the fry time is also being increased by 12%, resulting in a more consistent product with less waste yield.

A big advantage of the drive is that it can run a motor slowly without the usual rise in motor temperature. When you run a motor at very low Hertz, it generates a lot of eddy current. It gets so hot that you can't touch the motor. And when you overheat the laminations of a motor, you greatly decrease the life of the motor. But we can monitor each drive through the Siemens TIA (Totally Integrated Automation) portal. We've seen the amperage reduced by almost 17%, and the temperature of the motor reduced by 34%. We expect this will more than double the life expectancy of every pump.



## Retrofit heroes

Figure 3: Retrofitting with ease—Betson and Cole found that they could retrofit every store in Australia in five days by using their technology retrofit kit concept.

## Remote monitoring

The successful grand opening of the Krispy Kreme store in New York's Times Square was not without the occasional behind-the-scenes drama for new store commissioning (Figure 4). A sudden pumping issue, it was the kind of problem that can happen at any hour, at any of the 500-plus global stores owned by the company. But it is also a concern that can be quickly solved on-site or from thousands of miles away.

The situation was addressed in a matter of minutes. I just went online through the Siemens secure TIA portal to see what the Siemens G120 drive was showing me. While setting up one of the machines, a motor had been miswired. I could quickly tell the local setup contractor where to look.

The TIA portal experience is like standing in the store at the drive's operator interface (Figure 5). When you open the door to the drive, a large display presents any fault messages. Select a fault message and you are given the related fault code that you would in the past need to look up in the user's manual. Now, all of the information you need—the details, what to check, how to reset—are on the display. Diagnostic screens help you debug the problem. And beyond this, faults and alarms can be data-logged in the cloud. Trends can be studied over the course of a year. Faults for a particular machine can be identified and addressed. A shortening pump that is tripping more often can be replaced during the store's next on-site inspection.

## Safety integration

Krispy Kreme employees are trained and dedicated to serving up the fresh-made doughnuts that flow from their store's unique production floor. So, if you are a Krispy Kreme employee, you do not need to understand what 60 Hz means. You are not thinking about the cylinders that are extruding the dough, the 100-plus feet of chain that is carrying the dough from the extruder to the fryer, the humidity of the dough for that particular doughnut and the exact amount of time that doughnut spends in the fryer. You see an operator interface that shows the image of a doughnut type. Press the button, and you see an hourglass representing the doughnut is in the fryer. That's it. You can go back to serving your customers. Behind the scenes, the humidity of the dough, the temperature of the oil, the speed of doughnut flow and the frying time are all automatically being taken care of.

And all of that is being done with your safety in mind. The Sinamics G120 drive supports the design of machines and processes that have triple-quadruple redundancy. Especially in areas where the fryer is exposed, employee safety is being reinforced. The new drives and PLCs being retrofitted into every store integrate with the

existing Siemens safety monitoring circuitry, inclusive of automated safety mechanisms and e-stop buttons. For example, if a hose were to break on the shortening pump, the flow stops within 100 milliseconds.

The Siemens safety circuitry is less complex and more integrated from feedback to operator standpoint, in lieu of a general e-stop active alarm. By incorporating ProfiSafe, we eliminated complex wiring, power contactor devices and hidden alarm messages.

### Portal to the future

Betson sees the big picture that is being made clear by the data now starting to flow through the Siemens TIA portal. Along with the ability to remotely use each store's data to plan for machine maintenance and prevention, the data can routinely be studied to measure and improve the design of the company's machines and processes.

The remote connectivity piece is very innovative in the sense we needed to support such a large customer as Krispy Kreme all over the world. We brought the world of IoT to a valued customer before it was a buzzword. With that, Think-PLC added value in experience, leading the way into the 21st century.

Having anticipated the emergence of Industry 4.0 and IoT, Betson now also sees how data can be used to guide employee training and best practices for human-machine interaction. Continuous improvement and operational excellence can be studiously amplified store-wide and in stores worldwide.

"The data we are capturing now and hereafter strengthens us in many ways," Betson says. "It's important to us as a machine builder, because it also reinforces our culture and Krispy Kreme's identity in our global marketplace."

### Light the way

At the end of the day, we do these magical things. From a safety perspective, from the standpoints of reliability and the simplicity of an operator interface, the Krispy Kreme equipment group in Winston-Salem are amazing machine builders. At any hour, including when a store's hot light is on to signal free doughnut samples are now available, or when a store is giving away free doughnuts to healthcare workers, you can't have a machine go down, disrupting what you promise.

That ethic has come naturally to a company that has always understood the connection between making great machines and making great doughnuts.

### No fear

The Rocheleau family motto, "fear no task," goes back four generations. It's also the motto of the family business, Rocheleau Tool and Die. It's not just a statement. It's a challenge: to innovate and make better products that bring new benefits to customers. As one of the



### Shop-floor store

Figure 4: The new Krispy Kreme store in New York's Times Square features a vertical cooling conveyor that was engineered and built by the company entirely in-house. Control integration was provided by Think PLC automation consultants using Siemens drives and controls.

top manufacturers of blow-molding machines for the plastics and packaging industry, this motto has served us well.

Founded in 1938 in Leominster, Massachusetts, Rocheleau Tool and Die manufactures extrusion blow-molding machinery and related tooling and trimming automation systems to support the packaging industry worldwide. Just like the longstanding tradition of the Rocheleau family and company, our relationship with Mitsubishi Electric controls has been exclusive since the supplier moved from relay logic systems to programmable logic controllers (PLCs) in the late 1980s. Mitsubishi Electric's automation technology is in every piece of equipment we produce, and we use that automation to control motors, temperature, pneumatics, hydraulics and other machinery conditions and actuators.

Rocheleau ([www.rocheleautool.com](http://www.rocheleautool.com)) manufactures extrusion blow-molding machinery, blow molds, related automation equipment and blow-molded products. Our machines have the flexibility to produce customized, high-tolerance plastic containers and parts. We offer machinery and support worldwide, with customers in more than 40 countries.

The importance of machine controls is similar to the role of your car's tires, says Kevin Hastings, electrical engineering manager, third-generation co-owner, and grandson of Rocheleau's founder, Leopold "L.A." Rocheleau. "No matter how well you build the car, if you have a flat tire, it's not going to drive down the street," says Hastings, "Controls are even more important to machines than tires are to cars. If they break down, nothing is going to work at all."

If you drink juice or milk, put sugar in your coffee, use household-cleaning products or are a user of personal-care products, you've probably used one of the



### Shorten the adoption curve

Figure 5: A store can produce a thousand dozen doughnuts per hour. Pump motor drive performance in the store can be seen through the Siemens TIA portal to diagnose, troubleshoot, maintain and prevent disruptions to production flow.

containers created on Rocheleau machines. And these containers are created incredibly fast, especially when they are created on Rocheleau's flagship machine, the RS-90 extrusion blow-molding machine ([www.controldesign.com/rocheleau](http://www.controldesign.com/rocheleau)).

### New generation of efficiency, power and speed

Rocheleau introduced its next-generation extrusion blow-molding machine at the same time we celebrated our 80th year in business. This first-ever six-head, 1-gallon blow-molding machine fills a need in high-volume packing applications. It tackles tubs and larger bottles at significantly faster cycle times.

How fast? It runs a six-cavity high-density polyethylene gallon in the mid-6-second range.

On a handful of occasions, a customer has asked Rocheleau to build a machine using a different brand of controls. Fortunately, in each case Kevin was able to talk them out of it. And the customers loved the machines and ordered more. The question of using different controls never came up again.

### Market Challenges

Customers were looking for a choice in the high-volume HDPE container production market. Major issues for customers included maximizing energy efficiency and increasing available floor space. In a niche market, it is imperative to develop new technology to provide customers a competitive advantage: to make more product faster and with less energy in a reduced footprint

## RS-90

Container	Gram weight	Estimated cycle time (seconds)	Cavitation	Bottles per hour	Bottles per 6,000 hour year (at 100% efficiency)
Lightweight					
Dairy gallon	62	6.5-7.5	6	3,085	18,510,000+
½ gallon	42	6.5-7.5	8	4,114	24,684,000+
Wide mouth gallon	90-110	10.5-11.5	6	1,964	11,784,000+
10 quart (water)	165	14.5-15.5	3	720	4,320,000+
Industrial					
Gallon	95-110	11.5-12.5	6	1,800	10,800,000+
	140	15-17	6	1,350	8,100,000+

## Production specs

Figure 6: The RS-90 is capable of six-cavity gallon or eight-cavity half-gallon for dairy and other industrial applications.

and with minimal direct labor input.

Rocheleau's Model RS-90, a 90-mm-diameter extrusion blow-molding machine addressed these issues. Its maximum high-density polyethylene (HDPE) processing output is 750 lb/hr. The RS-90 is capable of six-cavity gallon or eight-cavity half-gallon for dairy and other industrial applications (Figure 6).

We focused on our customer's challenges. Our engineering team developed the RS-90, beginning with a design for simple operation.

Our fresh approach directly addressed floor space required for the line. Our new clamp has 8-inch-thick solid steel platens, four working tie bars and a clamp frame with linear guide rails. This eliminated the need for center tie bars and allowed over 8

inches of machine width savings. Additionally, utilization of the hydraulic drive motor and two injection cylinders pulling the extruder carriage reduced machine length by several feet.

Our engineers developed a post-mold cooling station with a centrifugal blower to provide rapid cooling of scrap plastic prior to entering the integrated de-flash station, continuing to reduce overall machine size.

In addition to the RS-90's size and functionality, energy efficiency was another major focus of our approach. The design to utilize a hybrid extruder drive combined the energy efficiency of an electric motor using a variable-frequency drive (VFD), a fixed displacement hydraulic gear pump and a high-efficiency hydraulic motor.

Dual 10-gallon accumulators are charged for efficient injection speed and clamping force. And energy-efficiency tests show usage of less than 100 kW at competitive cycle.

Our customers have told us that the RS-90 contributes to cost savings due to energy efficiency, fast cycle time and less unscheduled downtime. The RS-90 has also resulted in more customers partnering with Rocheleau to receive factory-experienced technical staff for support. [CDI](#)

Steven R. Rocheleau is president of Rocheleau Tool and Die in Fitchburg, Massachusetts. He became the fourth president of the company in 2001, succeeding his father Roland, uncle Norman and grandfather Leopold. Working from youth, Steven has filled positions from maintenance, machine shop, assembly, processing technician, field service and sales. Sales have grown from \$2 million to \$15 million per year in that time. He helped lead the transformation from a custom molding focus to becoming a significant supplier to the packaging industry with customers in more than 35 countries, supporting both large multinational customers and smaller local customers. In 2014 Rocheleau started a second business producing plastic bottles and serving as a test facility and showroom for visiting machinery customers, as well as a production facility servicing the dairy industry in New England and Mid-Atlantic states. Steven earned a BSBA in management from Bucknell University in 1988, and he is a member of University of Massachusetts, Lowell, Plastics Engineering Advisory Board; Mount Wachusett CC Advanced Manufacturing Advisory Board; and Town of Westminster Capital Planning Committee. Contact him at [steve@rocheleautool.com](mailto:steve@rocheleautool.com).

Bobby Cole is president of Think-PLC in Winston-Salem, North Carolina. Contact him at [bcole@think-plc.com](mailto:bcole@think-plc.com).

# Motion and safety easier to build

Motors, vision, robots, I/O and bar code readers communicate with the controller via EtherCAT and Ethernet/IP networks

by Raymond Antalek, Inventek Engineering

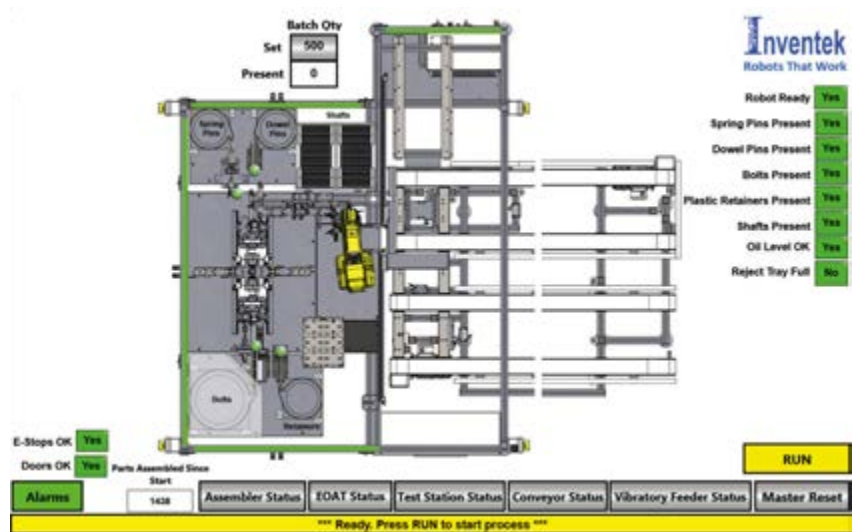
**INVENTEK ENGINEERING (WWW.INVENTEKENGINEERING.COM)** is a Santa Ana, California-based automation services company and systems integrator. Inventek's experts provide creative and cost-effective turnkey solutions using industrial robotics, vision and sophisticated control systems. Its diverse applications include automated assembly systems, flexible bottling equipment and material packaging and handling.

For the past 30 years, Inventek has utilized the expertise from the engineers at Valin ([www.valin.com](http://www.valin.com)) to better understand and master the technology it needs to best serve its customer base.

Inventek prides itself on attention to detail. By monitoring and controlling all the key elements in an automated system, it provides customers with a greatly improved and efficient process.

This in turn leads to higher productivity and lower overall production costs. Additionally, Inventek delivers systems that are streamlined and highly reliable, often the two qualities that customers desire most in an automation system.

In order for Inventek to continue delivering systems that meet its customers' high standards, it needed to find a more intuitive, easily understood PLC technology and be trained on its use and features. For this, Inventek turned to its long-time partner Valin, which has kept



## Automotive HMI

Figure 1: In a recent automotive application, Inventek needed controls to interface with a six-axis robot, machine vision and pneumatic manifolds.

up to date with the latest technology for the past 45 years.

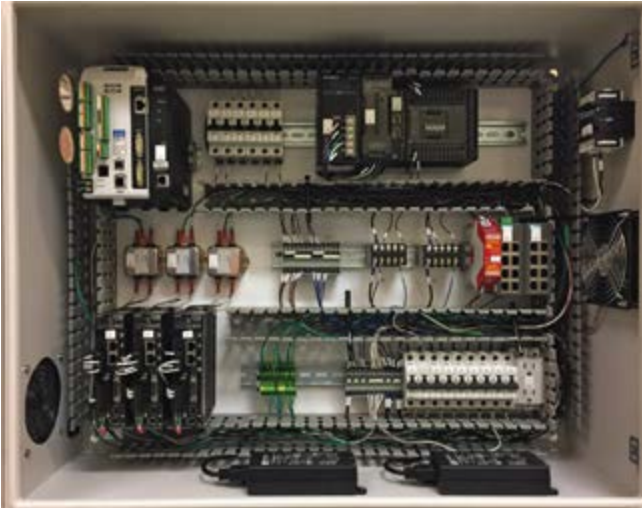
Valin knows how to help design control systems and train customers on both hardware and software to shorten the learning curve. This allowed Inventek to focus on what it does best.

Valin's engineers are essentially an extension of Inventek's engineering department. They've worked side by side with Inventek on many projects over

the past 30 years, both domestically and internationally, to solve a large number of challenges that ensured the projects were implemented successfully.

Inventek has had a number of projects in the automotive, life science and packaging industries.

In a recent automotive application, Inventek needed controls to interface with a six-axis robot, machine vision and pneumatic manifolds (Figure 1).



### In the cabinet

Figure 2: In the life-science application, the machine needed to have motion coordinated with the machine-vision system.



### Remote robotics

Figure 3: The secure connection would allow Inventek engineers to connect to the controls over the Internet and modify or troubleshoot programs and configurations without travel time or expenses.

The robot and machine-vision system performed assembly functions. The initial design assessment showed that controls with both EtherCAT and Ethernet/IP capabilities would be advantageous.

In the life-science application, the machine needed to have motion coordinated with the machine-vision system (Figure 2). After performing the inspection, the vision system would communicate the inspection results to the machine automation controller, which then calculated the required offset automatically after each cycle. The equipment design also required the integration of different safety devices, such as light curtains, safety door interlocks and e-stops throughout the machine. It required two human-machine interfaces (HMIs) so that operators could access them at different working locations on the same machine. This machine was designed using a lot of remote I/O. The end customer used many process recipes and needed to log data for FDA requirements, so a bar code reader with serial communication was introduced to select the correct recipe automatically.

In a packaging application, the customer wanted to control stepper motors for the precise rotation of a part before the robot inserted another part into it. The customer also wanted the

ability for Inventek to service the machine remotely without compromising the company network. The secure connection would allow Inventek engineers to connect to the controls over the Internet and modify or troubleshoot programs and configurations without travel time or expenses.

Inventek was looking for a way to better integrate all the motion, robotics and machine vision in the systems they design and deliver to their manufacturing customers. The solution needed to have simplified wiring and setup of industrial networks and limit the number of programming/configuration software packages needed. Motion, I/O, machine-vision, machine safety and HMIs should all integrate cohesively. Plus, Inventek did not want to be left to learn it all on its own, and it needed the learning curve to be as short as possible. The bottom line is that Inventek needed a simpler way of integrating everything together.

The team at Valin came up with an effective solution for the integrators at Inventek. First, it suggested utilizing the Omron NX1P, a modernized PLC/machine automation controller that has Ethernet, Ethernet/IP and EtherCAT built into it. This alone would make development easier because, in the past, Inventek would need three different software programs to deploy the

motion, industrial networking (Ethernet/IP and EtherCAT) and HMI. It had been a very cumbersome process. However, with the new platform, Inventek could use updated software for everything in a fully integrated development environment, Sysmac Studio. The improved software allowed Inventek to create variables (tags) and use the same tags in the PLC and HMI as opposed to making a new tag for each device, like in the older system. Sysmac Studio program/configuration software made building the EtherCAT network of Omron I/O, motion and machine safety devices much easier than controllers it had used in the past. With this control solution, stepper motors, servo motors, machine-vision systems, robots, I/O and

bar code readers could all communicate with the NX machine automation controller (MAC) using the EtherCAT and Ethernet/IP networks, as well as multiple serial communications interfaces.

The final piece of most automation controls puzzles is data logging. The NX MAC allows the option to log process and operation data to an SD card or to act as an FTP server or FTP client so that log and history data can be transferred as needed.

The Inventek team was brought up to speed and trained on the new control platform, as well as on updated HMI and Sysmac Studio software. In addition, an MB Connect Line secure router would be used to provide secure remote access to all the controls in the system.

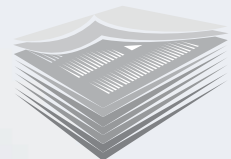
This led to savings both in terms of initial cost and engineering efforts on Inventek's part. The new hardware and software, combined with Valin's ability to provide training and bring them up to speed, saved Inventek significant software development and installation time. In addition, Inventek gained experience using a controller that had the flexibility to meet all current, plus future application requirements. [CD](#)



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# Keep the signal

All the components for interfacing and terminating connections safely

## Cable entry systems

The updated Murrplastik KDL/D Mono series cable entry system provides the same benefits as the existing KDL/D series in a round frame form. This series allows a cable to be installed through an enclosure or other bulkhead surfaces, and pre-



made, terminated cables can be installed without disassembling the connectors. The KDP/X cable entry system allows for a high density of nonterminated cables to be installed through a small area of an enclosure or other bulkhead surfaces. The KDL/D

Mono series is available in three frame sizes; the KDL/D series is available in four frame sizes; and the KDP/X is available in one frame size, with bolt-in or snap-on mounting.

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## EtherCAT terminal for direct connection of inductive displacement sensors

The EL5072 EtherCAT terminal enables direct connection of up to two inductive displacement sensors, including transducers in LVDT and half-bridge designs or inductive angular position sensors in the RVDT version. This means that precise position and distance measurements, such as in process control or the control of joining processes, are possible in a compact, finely scalable format. The terminal measures 12 mm wide for space-saving installation in the standard EtherCAT I/O system. With the terminal, all commercially available inductive measuring probes can be integrated into the standard control platform and evaluated. The integrated excitation source provides a range of parameterizable excitation frequencies and voltages.



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## Compact, customizable I/O modules

Axioline Smart Elements (SE) make it easy to create a cus-

tomized I/O station that occupies minimal DIN rail space. In addition to their compact size, the modules are easy to configure. With a footprint of 15 x 62 mm, a single Axioline SE module can provide 16 digital or four analog I/O points.



The Smart Elements then are stacked two high in the base units, making it possible to achieve 32 digital I/O on 15 mm of DIN rail. They feature push-in technology for easy, tool-free installation. The digital and analog modules require no configuration.

**Phoenix Contact** / 800-322-3225 / [www.phoenixcontact.com](http://www.phoenixcontact.com)

## Interface module

This interface module offers signal, power distribution and relay type modules, with connection types that include D-Sub, IDC and Fuji. The module is compatible with many PLCs to convert industry-specific connectors to field wiring connectors. It is designed with push-in design terminal blocks to save space and time and ensure long-term connection stability.



**Dinkle** / [www.dinkle.com](http://www.dinkle.com)

## Terminal block interfaces for pin terminals

This interface terminal block is a wiring connection component that combines a connector and a terminal block. There are several types of terminal block clamps: spring, clamp and a ferrule-processed bar-type crimp terminal that allows for push-in connections by simply inserting a wire. Mounting methods include direct, DIN rail and dual-use mounting variations. The number of poles, the pitch between terminals and the type of connector vary and must be selected depending on the PLC.



**Misumi** / [misumiusa.com](http://misumiusa.com)

# product roundup

## Terminal blocks

PTFIX 10 six-position terminal blocks from Phoenix Contact provide simple and fast distribution solutions in hundreds of variations. The line features compact size and modularity in a variety of colors, sizes and configurations. The blocks are 10 mm<sup>2</sup> contacts designed for situations in which a larger wire size is needed for multiple contacts and include easy direct, DIN rail and adhesive mounting flexibility for tight spaces.



Digi-Key Electronics / [www.digikey.com](http://www.digikey.com)

## Measuring transformer terminals

The Klippon Connect measuring transformer terminals of the TTB series enable simple and safe wiring, even within complex circuits. They feature a disconnect lever mechanism—"close-before-open" contact for as many as four connections, increasing system availability, extending the life cycle of the entire switch-gear and carrying IEC 60947-7-1 Annex D approval. They have been developed especially for use in secondary circuits of measuring transformers. For safe application when disconnecting or isolating protection and measuring devices, the terminal short-circuits the current transformer and thus prevents high voltages from occurring in the secondary winding.



Weidmuller / [www.weidmuller.com](http://www.weidmuller.com)

## EtherCAT slice I/O and controller

The AMAX-5000 series of EtherCAT slice I/O and controller is designed with the smallest programmable automation controller (PAC) in the Core i class, modular I/O and PCIe communication interface. With this series, equipment manufacturers can set EtherCAT I/O modules to perform tasks such as data acquisition, detection and machine control. It also offers a cloud platform and IT/OT integration from the PAC's open architecture. The controller features compact size, high-speed processing, flexible expansion and integration.



The series includes an AMAX-5580 embedded controller, the EtherCAT I/O module AMAX-50xx series and PCIe module AMAX-54xx series.

Advantech / [www.advantech.com](http://www.advantech.com)

## Terminal block series

The TopJob S mini terminal block series features push-in Cage Clamp connection technology. This series is 60% smaller than the company's standard terminal blocks and is well-suited where space is limited or use of DIN rail is not possible. These blocks are available in open tool slot or the easy-to-identify orange push buttons that can be actuated with any standard tool and have various mounting options.



Wago / 800-346-7245 / [www.wago.us](http://www.wago.us)

## Digital interface adapter

The SeaDAC Lite 8112 digital interface adapter control and monitors four optically isolated inputs and four Form C (SPDT) relay outputs via any USB connection. Inputs can range from 5-30 Vdc and provide 3,500 Vdc (2,500 Vac RMS) isolation to ground, while the high-current Form C relays can switch up to 6 A loads at 250 Vac and up to 5 A at 60 Vdc. Form C relays can be wired for either normally open or normally closed operation. Each Form C relay has a discrete common, and each pair of inputs shares a common. Status LEDs display I/O activity and field wiring is simplified via 3.5-mm removable terminal blocks.



Sealevel Systems / [www.sealevel.com](http://www.sealevel.com)

## PLC family with additional I/O CPUs

The MicroSmart FC6A all-in-one PLC family has been expanded to include three 12-Vdc CPUs. The 16 I/O CPUs allow the PLCs to handle more than 100 I/O points. Features include Ethernet, USB and serial connectivity; SD memory slot; replaceable battery; HMI module; up to three I/O expansion modules with removable terminal blocks; other available digital and analog expansion modules; and easy expansion of communication ports.



The rugged form factor can withstand -25 to 65 °C operating temperatures and Class I, Div. 2 environments. Users can configure and monitor the PLC using the WindEdit app for iOS and Android over Bluetooth and Ethernet.

idc / [www.idc.com](http://www.idc.com)

### IP67-rated I/O systems

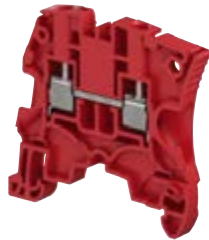
MVK Pro and Impact67 Pro are IP67-rated I/O systems. Available for the Profinet, EtherNet/IP and EtherCAT protocols, each is equipped with eight multifunctional Class A/B IO-Link master ports allowing one module to serve as 16DI, 16 DIO, 16 DO or 8 IOL. Two L-coded M12 ports (four- or five-pole options) allow for daisy-chaining and provide up to 2 x 16 A power. These blocks use IO-Link to get input and output data from machines and systems. Users can add the IO-Link hubs and analog converters to connect digital and analog signals to this IO-Link master using a standard sensor cable.



**Murrelektronik** / 770-497-9292 / murrinc.com

### Terminal blocks

The design of TE Connectivity's PI-Spring can be used as a push-in or traditional spring connection. The push-in mode allows a direct one-step insertion of solid and flexible stranded wires with a ferrule, 50% faster than standard screw clamp technology. Using the spring mode, very little effort is required to open the spring clamp with a screwdriver and insert the wire, which does not need a ferrule. The screwdriver locks in the terminal block after insertion, freeing up hands to manipulate wires or circuit drawings.



**Newark** / www.newark.com

### Self-configuring I/O modules

These self-configuring I/O modules are available with four, eight and 16 digital signals that can be used bidirectionally as inputs or outputs. This allows many different applications to be implemented with the same module. The variant with 16



I/O is a suitable alternative to comparable Ethernet or IO-Link-based I/O solutions, and it includes channel-specific diagnostics that provide a detailed overview,

even if many inputs and outputs are present. Sensors and actuators can be connected in any combination, with a possibility of two signals per M12 port. An optional assignment of a fixed configuration of the inputs and outputs is possible via company software.

**Bihl+Wiedemann** / www.bihl-wiedemann.de/us

### Remote terminal

NXR terminals provide a rugged I/O solution for mounting and connecting I/O remotely. NXR IO-Link Masters provide additional diagnostics to identify failures as well as two-way communication to IO-Link devices. Setup time is reduced by 90%. Quantified EtherNet/IP and IO-Link communication statuses allow users to find network cabling errors before operation. During operation, the communication status can be monitored, making it possible to check the system before it stops suddenly. The remote terminal reports approximate locations of disconnections or short circuits in Ethernet cables and detects disconnections or short-circuits in I/O cables.



**Omron Automation** / 800-556-6766 / automation.omron.com

### Processor and I/O module with preinstalled edge software

The groov EPIC processor, GRV-EPIC-PR2 (PR2), and RIO edge I/O module, GRV-R7-MM2001-10 (MM2), both ship with Inductive Automation's Ignition Edge 8.1 preinstalled and include expanded memory and storage to support future versions. These releases target edge-oriented applications such as operational equipment effectiveness (OEE), predictive maintenance (PdM), remote condition-based monitoring (CbM) and digital transformation/IIoT.



The PR2 processor aims to support this and future releases with more than double the storage capacity of the original PR1 and almost double the RAM. It is fully compatible with existing EPIC I/O, power supply and chassis options. The RIO MM2 module introduces Ignition support to company's edge I/O family.

**Opto 22** / 951-695-3000 / www.opto22.com

## product roundup

### Medium-voltage motor control centers

Allen-Bradley Centerline 1500 medium-voltage motor control centers (MCCs) include an integrated protective maintenance grounding (IPMG) device that grounds all load-side connections and load cables. This UL-listed product eliminates the use of any temporary grounding device and seamlessly incorporates the MCC power cells.

It provides a method to ground all load-side connections, including the load cables, and provides the ability to ground the output (load-side connections) without opening the MCC power cell door. It also is available in MCCs with ArcShield arc-resistant controller designs.



Rockwell Automation /

[www.rockwellautomation.com](http://www.rockwellautomation.com)

### Ethernet remote I/O modules

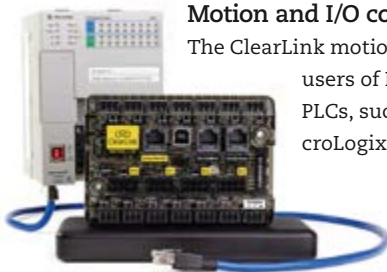
BusWorks NT series remote I/O modules provide an Ethernet interface for analog, discrete and temperature signals. NTE Ethernet I/O models have dual RJ45 ports and a Web server with Modbus TCP/IP communication to monitor or control the internal I/O channels. An integrated DIN rail bus allows connection of up to three NTX expansion I/O modules. Each I/O module adds up to 16 input or output signals, allowing a mix of voltage, current, temperature, TTL and relay control signals networked on one IP address. The space-saving design requires only 25 mm of DIN rail per module. The operating temperature range is -40 to 70 °C.



Acromag / 248-295-0866 / [www.acromag.com](http://www.acromag.com)

### Motion and I/O controller

The ClearLink motion and I/O controller offers users of EtherNet/IP-compatible PLCs, such as CompactLogix, MicroLogix and ControlLogix, a way to save space and wiring in their automated machinery. It provides four axes of motion control, a serial



port, 13 configurable digital and analog I/O points, expandable to 77 I/O points. It includes a licensed RSLogix/Studio5000-compatible EDS file with logical names and add-on profiles, which allows for easy mapping of I/O assemblies. Outputs can control a power-off brake or other inductive loads without a separate relay or clamping diode. Every I/O point has a dedicated LED for easy troubleshooting and diagnostics.

Teknic / 585-784-7454 / [www.teknic.com](http://www.teknic.com)

### Multifieldbus interface module

The ET 200SP multifieldbus interface module IM155-6MF HF with firmware version V5.0.3 can communicate to different controllers via three fieldbus protocols: Profinet, EtherNet/IP and Modbus TCP. It can be used by customers who, because of end user preference, occasionally use other Ethernet-based I/O systems in addition to Profinet; in applications for energy data acquisition via Modbus TCP, for example, via AI energy meter modules; and in customer segments that until now have used Modbus TCP or EtherNet/IP controllers exclusively. This firmware version can be used with MFCT Version V1.0.0.2 or higher. It is recommended to update the firmware of older interface modules to firmware version V5.0.3.



Siemens / [www.siemens.com](http://www.siemens.com)

### I/O with multipoint analog alarm option

The NET Concentrator System (NCS) has a versatile multipoint analog alarm (-MAA) option that allows users to set up simple or dynamic alarming schemes.

The option uses a built-in ISaGRAF program providing a flexible alarm configuration that is accessed via Web pages through the onboard Web server.

It allows users to configure as many as 32 alarms that can be assigned to any of the eight relay outputs on the relay output module (ROM). This enables each relay output to be driven by one input/alarm or multiple inputs/alarms. Each alarm can be configured as high or low with its own deadband setting.



Moore Industries / [www.miinet.com](http://www.miinet.com)

# PLC options for code documentation

**A CONTROL DESIGN** reader writes: When programming, what is the best approach for documentation of the code?

## Answers

### Follow the rabbit trail

You could say that proper program documentation is in the eye of the beholder. It is a rather subjective topic, but the overall goal is to communicate the intent of the machine level instructions used in programming environments. Well-written code can be self-documenting in some respects, but this usually requires familiarity with the programming language. The language of programming is built for efficiency, not necessarily easy readability, so it often becomes necessary to add documentation to provide more context or to communicate intent of code design. Revision control provides an historical documentation that is valuable to keep track of enhancements along the life of the code without polluting the code with too much text.

Program documentation can happen within the code itself using documentation features of the integrated development environment (IDE). For ladder logic, that might mean commenting rungs of code or headers for programs or tasks. For text-based code, it is simply 'commented out' lines within the code itself. The comments leave a rabbit trail of important functions within the actual code. It is useful to explain certain functions and help someone who is following the code to know how the code works. It is particularly useful to explain calculations that might not be apparent from the data points that are collected in the program. Naming conventions of data points and variables help to make the code easier to write and more efficient to read, as long as the naming convention is documented for the next reader.

Revision control is important to understand the history of the code. Major updates and revisions can be tracked to assist in troubleshooting if some problem is discovered later. A record of new feature additions can be recorded to see when new functions became available. GitHub is a popular website for managing version control using Git, an open-source software used in Linux since 2005. It is one of the most popular repositories of source code in the world and widely used in the software development community. As industrial controllers move more toward using the tools of modern, non-industrial software

development, revision control tools like GitHub are being integrated directly into industrial programming IDEs.

ALLEN TUBBS

product manager / **Bosch Rexroth** / [www.boschrexroth.com/en/us/](http://www.boschrexroth.com/en/us/)

### How input affects output

Proper documentation of code depends on the documentation's eventual use. If the purpose of the documentation is to help with troubleshooting, then I would first recommend investigating the type of code being used. Ladder code is great for troubleshooting because it easily helps engineers to see how inputs are affecting outputs. Sequential function charts are another great option for troubleshooting. They can provide intuitive visual cues to where the logic is at and what the code is waiting for to continue.

Documentation should be written in a way that clearly translates the code in plain language. Simplicity is the name of the game—the goal should be writing the documentation as if you were explaining to an elementary school student what the block of code does.

KRIS DORNAN

marketing manager, Logix controllers / **Rockwell Automation** / [www.rockwellautomation.com](http://www.rockwellautomation.com)

### Break the code

In general, if you can give very descriptive tag (variable) names and give your function instances descriptive names you have made very readable code. To get more specific, for PLC code I would place a rung comment on each significant rung. By this, I mean when you move from controlling one part of a system to a different part, document that change with rung comments. For more of a text or SFC type program, you have a lot more flexibility in your documentation. Here I would suggest that you break your code into chunks that are well described so that you can debug starting at where the problem is evident and work through the chunks that contain the source data. Really, as far as the best practices for program documentation go, as long as it is there and the variables are understandable any further tips inside the code is icing on the cake for the next programmer to enjoy.

MARK RUSSELL

tech application support manager / **Allied Electronics & Automation** / [www.alliedelec.com](http://www.alliedelec.com)

### Multiple programs and languages

System documentation should describe the overall architecture, configuration, I/O wiring diagrams and what the system does. Clearly defining the system also gives you a clear view on structuring the PLC program.

PLCs are very flexible and allow you to structure a PLC project as multiple programs, each of which can also be broken down into smaller units. For example, you can have an initialization program to load parameters on power-on, and a separate program for executing the main routine of the system. Clearly define the names of these programs and what each program does. Also define your variables. A table of variable definitions provides important context for anyone looking at code.

There are also some standards that exist to help provide standard structure and terminology. For example, Mitsubishi Electric is able to provide PackML sample projects with defined machine operation modes and state transitions.

During the design phase, you also have a choice of pro-

gramming languages between ladder diagram, function block diagram, structured text and sequential function chart. And it doesn't have to be only just one. A single PLC project can be comprised of multiple programs. When programming in ladder diagram, add rung comments. Function block diagram, structured text, and sequential function chart languages allow for comments to be written anywhere. Take advantage of this to clearly describe what the code is doing. The comments also stay with the code when downloaded to the PLC. This is a great benefit because even if the original project file is lost, you can retrieve the code and comments by uploading from the PLC.

In the end, the purpose of documenting PLC code is to make sure that the code can be maintained, so that programmers, technicians and customers can troubleshoot, modify or add to the program as desired. The easier it is to understand what the program is doing, the easier it is to support.

LEE CHEUNG, SR.

product marketing engineer / [Mitsubishi Electric](#) / [us.mitsubishielectric.com/en/](#) 

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### Servo system

SureServo2 servo systems, built from motor, drive, I/O breakout module and cable set components, are now available from AutomationDirect. The SureServo2 offering includes high-powered systems (up to 15kW), wide input power options (110VAC or 220VAC in single or three phase), and a host of additional hardware and software features. The built-in motion controller now includes routines for registration, electronic camming, rotary shear, flying shear and more. Option cards are available for EtherNet/IP and Modbus TCP network connectivity. The free, downloadable setup software now includes four tuning modes with the ability to auto-tune systems with up to 50:1 inertia mismatch and a built-in oscilloscope for super-exacting insight into system operation for development, troubleshooting and diagnostics.

**AutomationDirect** / 800-633-0405 / [www.automationdirect.com](http://www.automationdirect.com)



### Linear actuator with integrated encoder and temperature sensor

The compact SDLM-051-070-01-01 direct-drive linear actuator with integrated position and temperature sensors offers zero backlash, zero cogging, high acceleration, high speed and high resolution. This electric cylinder is 2 in (50.9 mm) in diameter with a housing length of 2.75 in (69.9 mm). The total length including the shaft is 4 in (101.6 mm). The linear optical quadrature encoder is protected inside the actuator housing and connected directly to the shaft. High throughputs are achieved when operating at peak efficiency by monitoring the data from the internal temperature sensor. The actuator also is available with a matching servo controller.

**Moticon** / 888-785-1804 / [www.moticon.com](http://www.moticon.com)



### Magnetic catches for panels and doors

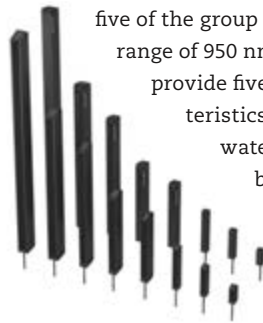
Constructed of corrosion-resistant stainless steel, the M5 magnetic catch combines a highly polished finish with the holding power of rare earth magnets to provide a solution for keeping doors and panels open or closed. The catches provide a reliable alternative to

door stays, are well-suited to high-vibration environments and can be configured to provide nominal holding powers from 50-118 N (11-26 lb) to accommodate multiple door sizes and weights with a tolerance for misalignment. They are available in a range of swivel catch height options that can be mounted horizontally or vertically and fixed catch options that mount flush to or directly on the surface.

**Southco** / 610-459-4000 / [www.southco.com](http://www.southco.com)

### Compact light bands with high repeat accuracy

These light bands offer high repeat accuracy and are available in eight lengths, from 10 to 300 mm. With their compact design, they can be integrated into tight mounting spaces. They offer a usable working distance of 10 to 500 mm, and five of the group use a higher than standard infrared range of 950 nm. This wavelength allows them to provide five times better absorption characteristics, meaning they can easily detect water and water-based liquids than can be difficult to detect with a standard visible light sensor. They are available with analog, switching and dynamic amplifiers.



**Balluff** / [www.balluff.com](http://www.balluff.com)

### CNC and robotics integration

These CNCs can control connected robots, providing machine tending or other assistance through the company's Quick and Simple Startup of Robotization (QSSR). The QSSR is a complete package designed to simplify the connection of a Fanuc robot to a Fanuc controlled machine tool. A QSSR G-code feature allows operators and machine tool builders to program robots through the CNC in ISO standard G-code format. Those unfamiliar with robotic programming language no longer will require additional training or specialists. A reliance on a separate teach pendant for the robot also is reduced with the capability of robotic programming and operation through the CNC user interface.

**Fanuc America** / 888-326-8287 / [www.fanucamerica.com](http://www.fanucamerica.com)



## product showcase

### Servo for low voltage

With a rated power of up to 1,000 W, the APBA80 series brushless dc motors offer a high-performance alternative to ac servos motors with the same flange size. The motors come standard with integrated encoder or with encoder and brake and are rated IP65. They have a peak torque of 9.6 Nm, a rated speed of 3,000 rpm and a rated voltage of 48 V. In addition to the standard version with keyway, individual shaft modifications also are possible as are customized windings. The control electronics can be tailored to specific applications, as well. The motors are well-suited for battery-powered applications such as AGVs or service robots.



[Nanotec Electronic](#) / [us.nanotec.com](#)

### Signal conditioner for new and legacy ac-LVDTs

The NTC-6000 Qwik-Cal LVDT signal conditioner provides the excitation and digital output many industrial automation and process control applications require. Without internal electronics, ac-LVDTs can operate in extreme environments but require the signal conditioner to convert position feedback into readable output for use by computers, PLCs, data acquisition systems and data loggers. Compatible with both new and legacy ac-LVDTs, RVDT or LVRT half-bridge sensors, this signal conditioner offers a variety of selectable excitation frequencies, analog output types and digital communications to a host computer via RS-485 output. The RS-485 port also supports the hot swapability of sensors by saving setup parameters and automatic excitation synchronization for multiple unit systems.



[NewTek Sensor Solutions](#) / [www.newteksensors.com](#)

### Amplifier modules for DAQ + real-time control system

Four amplifier modules have been added to the IOLite platform, which combines high-performance data acquisition with real-time control. The modules are 8xSTGS, an eight-channel strain gauge amplifier module; 16xLV, a 16-channel voltage amplifier module; 8xLA, an eight-channel current amplifier module; and 16xAO, a 16-channel analog output amplifier module. These

modules can be used in any IOLite main-frame chassis. The platform is equipped with two parallel EtherCAT buses. The primary bus is used for full-speed buffered data acquisition to a PC computer hard-drive. The secondary bus is used mainly for the real-time low-latency data feed to any third-party EtherCAT-based control system.

[Dewesoft](#) / 855-339-3669 / [dewesoft.com](#)



### Compact electrohydrostatic actuation

The Compact EAS is an electrohydrostatic actuation system intended for applications that require high dynamics and power density, use programmable cycles and demand high levels of accuracy and repeatability. These units comprise six elements: a servo motor, internal gear pump, compensation tank, valve block, stop valve and cylinder. Everything on the system is integrated; there are no pipes or hoses. The servo motor controls pump output and direction of rotation, eliminating the need for directional or proportional valves and resulting in a defined linear movement of the cylinder. Forces, speed and position on this linear actuation axis all are freely programmable.



[Moog](#) / [www.moog.com/industrial](#)

### PLCs for simple control

The Click Plus PLC series is designed for simple control. It is offered in wired-only, wireless-only and wireless/wired styles. All three CPUs offer USB programming and support the IIoT standard MQTT protocol as well as Modbus TCP. The modules with a built-in Ethernet port also support EtherNet/IP communication, and serial-capable models use Modbus RTU. WiFi-capable CPUs provide time-saving installations as no new network cabling is required. Each CPU has a slot for an optional I/O module so it can be configured as a stand-alone PLC with the user's preference of I/O.



[AutomationDirect](#) / 800-633-0405 / [www.automationdirect.com](#) 





**Anna Townshend**

managing editor  
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# The future of linear-motion technology

**LINEAR-MOTION** technology is the basis for many critical components used in industrial machinery. Learn more about product innovations from Hiwin ([www.hiwin.com](http://www.hiwin.com)), Aerotech ([www.aerotech.com](http://www.aerotech.com)), Nexen Group ([www.nexengroup.com](http://www.nexengroup.com)), Nippon Pulse ([www.nipponpulse.com](http://www.nipponpulse.com)), Ewellix ([www.ewellix.com](http://www.ewellix.com)) and Bosch Rexroth ([www.boschrexroth.com](http://www.boschrexroth.com)) in [www.controldesign.com/linearmotion](http://www.controldesign.com/linearmotion).

These same manufacturers discussed the overall market for linear-motion technology: what customer desires are driving the market; the biggest challenges facing technological advancement; and the future of linear-motion product design trends in the world of IIoT and Industry 4.0 and beyond.

## Compact components and power density

"In general, the precision control market is looking to solve space issues, especially in multi-axis applications where side-by-side motion is required," says Bob White, technical sales manager at Nippon Pulse. The ability to get smaller-diameter motors with higher force capabilities can drive higher density systems, he explains.

"Miniaturization trends are forcing manufacturers to increase the power density of their products or develop new solutions to offer more power in less space," says Will Morris, category manager at Allied Electronics & Automation. "That is required to reduce the machine footprint and optimize the overall layout to get lighter equipment that requires less energy to be utilized."

## Intuitive tools to expedite design

"Once a design is solidified, the products within should seamlessly transfer to the quote and ordering process with minimal effort on both the customer's and the supplier's side. This speeds up the process and eliminates errors," says Richard Vaughn, automation engineering manager at Bosch Rexroth.

"Designs which offer a complete axis solution bring more value to the marketplace versus individual components," says Justin Hillukka, lead engineer for power transmission and custom products at Nexen Group. "Engineering capacity is limited

in many organizations, so offering solutions that make the design cycle more efficient adds value."

## End-user delivery

Speed to deliver automation equipment to the end users is becoming an ever-increasing priority in these markets, says Bosch Rexroth's Vaughn. "Rapidly changing technology in all areas of manufacturing requires that production facilities be able to incorporate new designs or change over to the next

generation of products at record pace," he explains.

"A key theme for linear-motion products is ease of use," says Brian Fink, product manager at Aerotech. "With ever-increasing pressure on delivery, both end users and machine

builders strive to get their products to market as quickly as possible. It is highly advantageous to select motion stages, controllers and other components that are easy to integrate and operate right out of the box."

## Reduced downtime and higher precision

"Developers of motion control and automation systems are being pushed to deliver higher throughput, reduced downtime—higher reliability and reduced maintenance—and better quality, in terms of increased precision, all at the same time," says Art Holzknacht, engineering manager at Hiwin.

"Indeed, the underlying theme of smart products affects linear motion products, as well. In order to reach complete control of the equipment and implement advanced features, such as predictive maintenance or real-time performance optimization, sensors and electronics need to be integrated on linear-motion systems," says Morris of Allied.

## Less maintenance means increased production

"Maintenance-free operation is also becoming a clear need across many industries, as end users need to reduce the maintenance costs and related downtime to improve their productivity and bottom-line results," says Morris of Allied.

"Innovative motion-system engineers are responding by bringing down the cost of direct-drive linear-motor systems

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**Speed to deliver automation equipment to the end users is becoming an ever-increasing priority in these markets.**

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through highly optimized designs, incremental technology improvements and streamlined manufacturing,” says Holz-knecht of Hiwin.

## Market challenges

The desire for smaller, faster and more intuitive and accurate linear-motion products is driving new feature designs and technology innovations. What are some of the challenges facing this product market, and how is industry responding?

- Bringing new technology to a broader customer base: Without specialized knowledge in the system, it's more difficult for new markets to adopt new technology without a lot of education. “Advances in drive technology using advanced servo control algorithms and sophisticated software have taken the complexity out of the customer experience,” says Hiwin's Holz-knecht. “Setting up a direct drive is easier than ever, with smart tools that guide the user through every step.”
- Reaching delivery goals with slow order fulfillment: High demand and low supply have been exacerbated by the pandemic. “Increasing the adoption of more common and standard products by machine designers can allow motion suppliers to streamline and therefore increase their inventories, enabling greater control over product deliveries,” says Vaughn of Bosch Rexroth.
- Understanding design tradeoffs: Finding the right system for new customers and doing so on time and on budget means customizing each system by first understanding the system design objectives. “Machine builders and system integrators are often faced with difficult design tradeoffs,” says Fink of Aerotech. “It is crucial for motion control and stage suppliers to understand and appreciate these tradeoffs and the implications thereof. Only with this deep understanding is it possible for suppliers to design and manufacture motion control equipment that achieves as many needs of the target buyers as possible.”

## IIoT implications

The next industrial revolution is shaping every machine component, including linear-motion products, which are smarter, faster and more open. As with many components, it starts with data collection. “Capturing machine data offers big opportunities to gain knowledge,” explains Bosch Rexroth's Vaughn. “These new motion products enable ways to monitor, analyze and in turn improve like never before.”

For this data ultimately to be valuable, it needs to communicate quickly and efficiently with the controller. “These devices should work in harmony with the controller to deliver a higher

level of functionality to users,” says Fink of Aerotech. “Therefore, the design of the controller is at least as important, if not more so, than having a high-performing positioning device.”

IIoT and Industry 4.0 continue to put pressure on linear shaft designs, especially in the area of feedback devices used to close the servo loops, says Nippon Pulse's White. “These devices integrate with smart controllers that provide a wide array of data on motor health to upstream systems, along with key information about the mechanical elements that make up the machine axes,” he says.

Speed is still the name of the end game, whether designing, communicating, upgrading or troubleshooting. “Being able to connect to a motion control or servo drive remotely via an internet connection is key to fast troubleshooting. Expert engineers who are not on-site can respond quickly to machine faults, get diagnostic information and keep a motion control system running before a critical-line-down situation,” says Holz-knecht of Hiwin.

## 5 predictions for the future of linear motion

1. “More applications in microelectronics manufacturing, drug discovery/life sciences and precision automation will adopt linear-motion-driven systems to produce their products,” says Hiwin's Holz-knecht.
2. “Smart products and fit-for-purpose solutions are key themes that will guide new developments in linear motion. By adding onboard intelligence in the products, we can create new value that can bring innovation in traditional industries and applications,” says Morris of Allied Electronics & Automation.
3. “I see a trend toward fully automated and intuitive tools that enable motion-component customers to be completely self-sufficient. This includes online sizing and selection, CAD generation, quoting and ordering all from a website. Additionally, in the future the customer's equipment will be able to program their motion online with a virtual twin of the equipment, well ahead of the physical parts arriving to gain further advantage over short project timelines,” says Bosch Rexroth's Vaughn.
4. “I expect that the future will see more of a convergence on mechanical design optimization; but more important than that is the integration of the mechanics with advanced controller features and capabilities,” predicts Aerotech's Fink.
5. “Future trends include continued innovation on size reduction, improved magnetics, robust and lower cost feedback elements and a wider array of sealing options for different market requirements,” explains White from Nippon Pulse. [CD](#)

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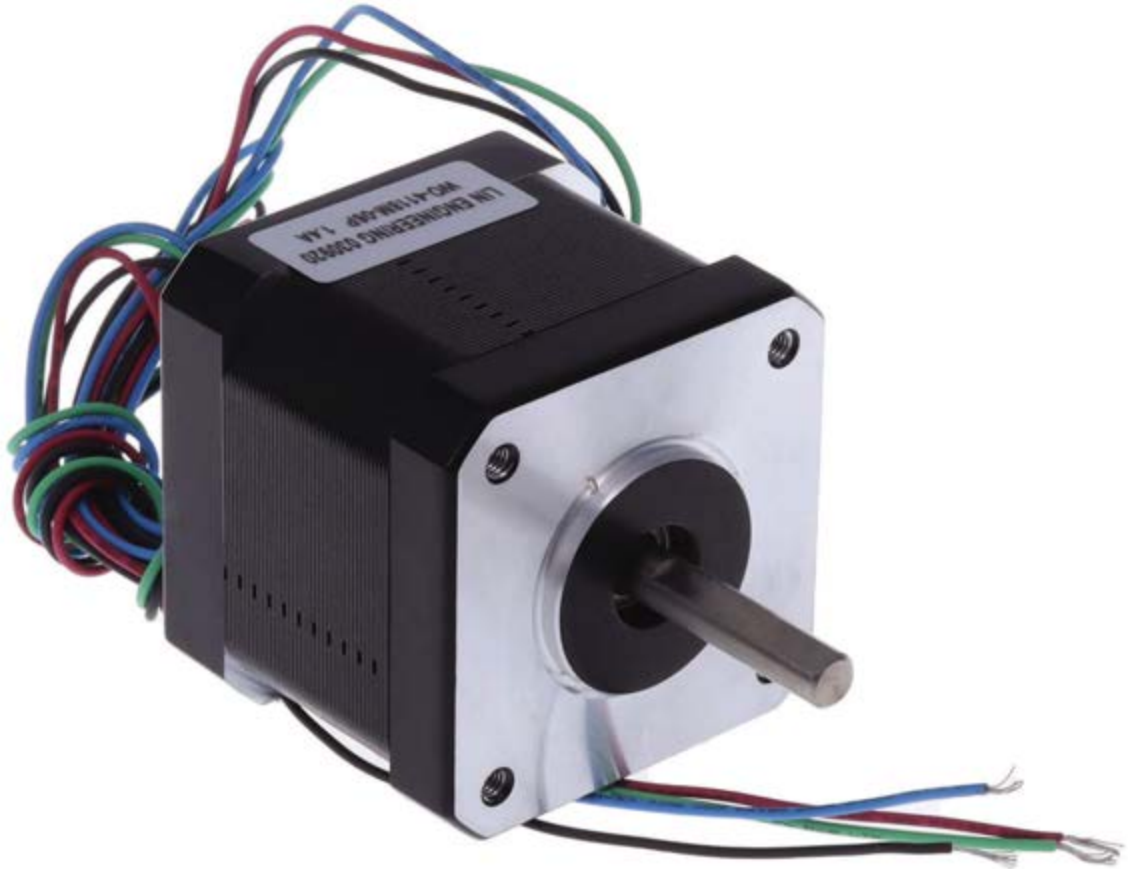
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