INNOVATORS IN Machine Design®

ACE CONTROLS

WEB | www.acecontrols.com
TEL | 800-521-3320

23435 Industrial Park Drive
Farmington Hills, MI 48335

CONTROL MOTION AND VIBRATION WITH ACE

ACE Controls Inc., located in Farmington Hills, Michigan, is a leading innovator in deceleration, vibration and motion control technology. For over a half century, ACE has manufactured superior deceleration products, including industrial shock absorbers, gas springs and vibration controls to meet your most demanding application requirements. We are committed to delivering the highest quality and the latest technology to meet your challenges.

ACE components can be used in a variety of applications and industries such as aerospace, aviation, machine building, marine, medical, oil & gas, packaging and robotics. From up in the air to under the sea, ACE products:

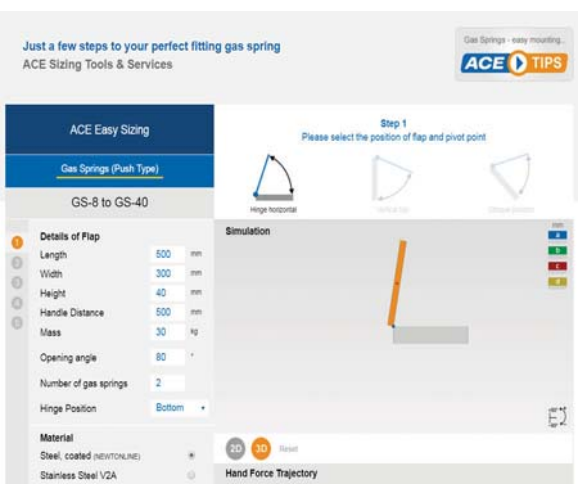
- Slow down moving loads
- Increase efficiency and throughput
- Reduce vibration and noise
- Protect against wear and tear
- Reduce downtime
- Increase throughput
- Increase safety

CUSTOM PRODUCT DESIGN & DEVELOPMENT

We offer a wide range of options to solve your motion and vibration challenges. Each product undergoes rigorous lab testing to ensure products are capable of meeting the most demanding conditions. Products are regularly evaluated for endurance, cycle life and material strength.

ACE specializes in custom engineering services, including working together with product engineers to prototype and develop patented components exclusive to your needs.

With over 250 distributors across the globe, there's always an ACE expert nearby. Visit our website to find your nearest supplier, *www.acecontrols.com.*



ENGINEERING TOOLS & RESOURCES

ACE has simple solutions to make your job easy, including a host of online resources and one-on-one assistance. Connect with ACE's application engineers who will work with you to calculate and select the right product for your needs. Or take advantage of our online tools:

- Size, Configure and Order Online
- CAD library
- YouTube
- Blog featuring case studies
- VibroChecker iPhone app

ACE
A STABILUS COMPANY

WHEN PERFORMANCE MATTERS

trust ACE Controls with your motion & vibration control challenges

Standard products available to buy online

- Industrial shock absorbers
- Industrial gas springs
- Vibration isolation

Online Tools

- Calculations & product selection
- Chat function for application assistance

Resources

- ACE CAD database
- ACETips video tutorials
- Technical blog & case studies

ACE
A STABILUS COMPANY

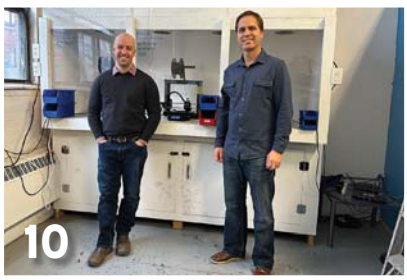
800-521-3320 · www.acecontrols.com · Farmington Hills, Michigan

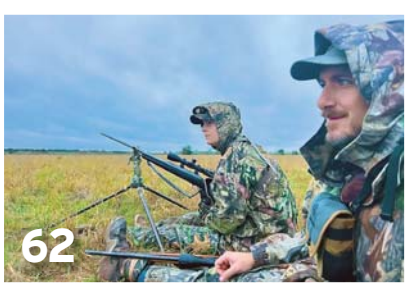
INSIDE

2025 INNOVATORS IN MachineDesign

FEATURES

Cover Photo Credit: 349759630 © Iryna Kushnarova | Dreamstime.com





Ad Index

From the Editor

By Rehana Begg, Editor-in-Chief

Laser-Focused Leadership: Driving Impact with Purpose

LET'S FACE IT—meaningful change is more likely to succeed when the charge is led from the top. And in a world where engineers shape the future, competent leadership is about driving collaboration, sparking creativity and turning bold ideas into reality.

Nowhere was this emphasized more than during a conference fireside chat featuring AVEVA CEO Caspar Herzberg and Amal Clooney, a British lawyer and international human rights advocate.

On the surface, inviting a human rights advocate to a technology conference seems like an interesting choice. But keep in mind that Clooney co-founded the Clooney Foundation for Justice (CFJ) with her husband, George Clooney, and has developed a speech-to-text translation app to enable trial monitors to document cases and distill information needed to assess the fairness of a trial.

The conversation between Herzberg and Clooney centered on sustained, meaningful corporate involvement in social and environmental issues, rather than reactive measures. Herzberg probed whether tech companies are increasingly aware of the responsibility they carry for their technology. "There are tech companies now that have their in-house human rights lawyers advising them, which is a sign of the relevance," said Clooney. "I remember going to Davos, for example, 10 years ago, and a group of corporate leaders said, 'Oh, your world is really interesting, but nothing to do with us.' The conversation has shifted, I think, because customers, employees and others have all shifted expectations as well as where businesses should stand on issues."

Without missing a step, Clooney redirected the question to Herzberg. "Do you agree? Do you think that tech companies know their power and use it responsibly?"

Herzberg replied: "I think that tech companies do know their power. I think what is increasingly clear to us is the importance of putting the power within frameworks. That's where ESG comes in...Our big focus is sustainability. So, foremost is our role and the one that we bring to our customers. And that means, at times, very intrusive rules that we have to follow. It's not always pleasant to execute against your ESG framework."

I'm convinced that the organizations that generate the most impact are the ones that combine the right technology with the right skill sets. The innovators highlighted in this issue have demonstrated that success and, ultimately, their impact, depends on the grit to keep feeding their curiosity while keeping up with technological advancements. They stay attuned to trends that shape industrial transformation, and they support their organizations in pursuit of their strategic goals.

Also central to the themes we covered in *Machine Design* this past year is the ability to use technology to transform enterprise-wide collaboration and to find ways to be more efficient, inclusive and dynamic. To ignite meaningful progress, we need top leaders who are equipped and inspired to lead the charge.

On another note: *Machine Design* is working on its own digital transformation. As of January 2025, the publication will be switching to a digital business model to more fully explore its online presence. This approach enables us to respect data privacy, review engagement statistics and publish high quality articles swiftly. Let me know what you think. Reach me at rbegg@endeavorb2b.com. ■

MachineDesign

EDITORIAL

Group Content Director: **Michelle Kopier**
mkopier@endeavorb2b.com

Editor-in-Chief: **Rehana Begg**
rbegg@endeavorb2b.com

Managing Editor: **Jeremy Cohen**
jcohen@endeavorb2b.com

Technical Editor: **Sharon Spielman**
sspielman@endeavorb2b.com

Contributing Editor: **Sara Jensen**
sjensen@endeavorb2b.com

VP/Market Leader - Engineering Design & Automation Group: **Keith Larson**

ART DEPARTMENT

Group Design Director: **Anthony Vitolo**
tvitolo@endeavorb2b.com

Art Director: **Jocelyn Hartzog**
jhartzog@endeavorb2b.com

PRODUCTION

Production Manager: **Sam Schulenberg**
sschulenberg@endeavorb2b.com

Ad Services Manager: **Deanna O'Byrne**
dobyrne@endeavorb2b.com

AUDIENCE MARKETING

User Marketing Manager: **Debbie Bouley**
dbouley@endeavorb2b.com

Article Reprints: reprints@endeavorb2b.com

LIST RENTAL

Smartreach Client Services Manager: **Kelli Berry**
kberry@endeavorb2b.com

SUBSCRIPTION SERVICES

OMEDA: machinedesign@omeda.com
847-559-7598 or 877-382-9187

DIGITAL

VP of Digital & Data Innovation: **Ryan Malec**
rmalec@endeavorb2b.com

SALES & MARKETING

Patrick Carmody
pcarmody@endeavorb2b.com
AK, AR, AZ, CA, CO, HI, IA, ID, IL, IN, KS, KY, LA, MI, MN, MS, MO, MT, ND, NE, NM, NV, Western OH, OK, OR, SD, TN, TX, UT, WA, WI, WY, Western Canada

Rebecca Ward
rward@endeavorb2b.com
DE, MD, NC, NJ, NY, Eastern OH, PA, SC, VA, WV

Liz Stott
lstott@endeavorb2b.com
AL, CT, FL, GA, MA, ME, NH, RI, VT, Eastern Canada

Holger Gerisch
hgerisch@endeavorb2b.com
UK, Europe (not Italy)

Diego Casiraghi
diego@casiraghi-adv.com
Italy

Helen Lai or Charles Liu
helen@twoway-com.com or liu@twoway-com.com
Pan-Asia

ENDEAVOR BUSINESS MEDIA

Endeavor Business Media, LLC
30 Burton Hills Blvd, Ste. 185, Nashville, TN 37215
www.endeavorbusinessmedia.com

CEO: **Chris Ferrell**

COO: **Patrick Rains**

CRO: **Paul Andrews**

Chief Digital Officer: **Jacquie Niemiec**

Chief Administrative and Legal Officer: **Tracy Kane**

Chief Marketing Officer: **Amanda Landsaw**

EVP, Design & Engineering Group: **Tracy Smith**

Sponsored Content

ABTech inc. Pride In Precision

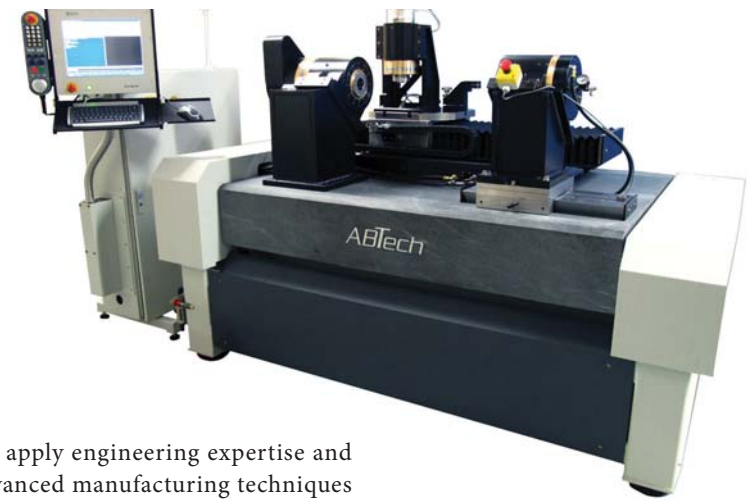
WEB | www.abtechmfg.com
TEL | 603-585-7106

126 Route 12 North
Fitzwilliam, NH 03447
Chief Operations Officer, Chris Abbott

ABTech is a global leader in delivering precision motion solutions, renowned for achieving sub-micron accuracy levels that meet the most demanding standards. Our expertise lies in creating robust, reliable systems that rely on air-bearing technology, setting benchmarks for precision and consistency across various industries.

For over 25 years, we have built a reputation for excellence by serving customers in the aerospace, optics, semiconductor, and advanced manufacturing industries. Companies worldwide rely on ABTech for solutions that ensure the highest levels of precision, enabling innovations in turbine engine assembly, high-resolution imaging, lens manufacturing, and semiconductor wafer inspection.

At the core of ABTech's success is our proven process. From consultation to delivery, we prioritize customer requirements and strive for unmatched performance. Our process begins with a comprehensive understanding of each application, followed by developing precision motion systems that are rigorously tested to meet stringent specifications.



We apply engineering expertise and advanced manufacturing techniques to ensure the reliability, ease of use, and longevity of our products. Every step is backed by a commitment to quality, ensuring that each product surpasses industry standards.

Every product we sell exemplifies our company-wide commitment to "Pride in Precision" craftsmanship. ABTech solutions are used in a range of industries across the globe, but all of our products are designed, manufactured, and tested exclusively by ABTech in our New Hampshire facility.

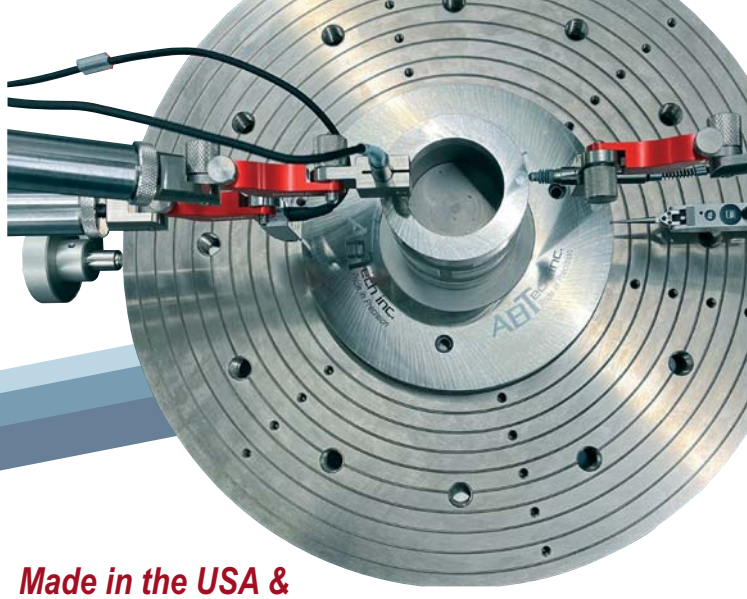
Our proprietary air-bearing designs are the cornerstone of our technology, eliminating friction and delivering motion solutions capable of sub-micron resolution and repeatability. These systems enable smoother operation, less wear, and optimal performance. By addressing critical challenges in precision engineering, ABTech enables customers to achieve the accuracy necessary for their operations.

As a trusted partner to industry leaders, ABTech's solutions power advanced manufacturing processes and research across the globe. Our commitment to innovation ensures we provide systems that serve evolving industry challenges. With a focus on excellence, collaboration, and precision, ABTech stands at the forefront of precision motion technology, enabling success for businesses pushing the boundaries of possibility.

At ABTech, precision isn't just a goal—it's our standard. When the application calls for air-bearing levels of accuracy, companies worldwide turn to us for proven solutions that meet their most exacting demands.

ABTech inc.
Pride In Precision

PRECISION IN MOTION.



The Precision Difference

ABTech specializes in motion systems for applications requiring air-bearing level precision. Our air-bearing technology provides the highest accuracy and nearly absolute repeatability with no contacting parts to wear over time, therefore delivering years of reliable and maintenance-free operation.

At ABTech, we believe our proven process of discovery, collaboration, quotation, execution, implementation and follow-up gives us the precision difference. Our solutions range from a simple single-axis air-bearing all the way up to a complete turn-key motion system consisting of a multi-axis controller.

If you have a process that requires ultra-high precision and sub-micron accuracies, reach out to us today. Discover the precision difference.

Made in the USA & Serving Industries Worldwide

All our products are designed, manufactured, and tested in our New Hampshire facility. ABTech solutions are used in a range of industries across the globe.

AEROSPACE
AUTOMOTIVE
AVIATION
ENERGY
MARINE
MANUFACTURING
OPTICS
SEMICONDUCTOR

ABTech, Inc.
126 Route 12 North
Fitzwilliam, NH 03447
(603) 585-7106
www.abtechmfg.com

WEB | www.amci.com
TEL | 860-585-1254

20 Gear Drive
Terryville, CT 06786

ADVANCED MICRO CONTROLS INC. (AMCI)

SINCE ESTABLISHED IN 1985, ADVANCED MICRO CONTROLS, INC. (AMCI) has been committed to bringing reliability, simplification, and unmatched performance to the automation industry. AMCI is a leading US based manufacturer with a global presence. Our focus has been to improve PLC-based automation systems with specialized position sensing and motion control technology. All of our products are designed and manufactured in house, enabling superior quality and innovation. We offer the best PLC integration available in the market.

AMCI's products have a unique design that delivers superior performance. Our specialty I/O products not only expand functionality but introduce capabilities such as position sensing, motion control, stamping press automation, and packaging control solutions. Whether linear or rotary, our PLC-based interface products ensure user-friendliness, setting a new standard in the industry.

Furthermore, AMCI offers a comprehensive range of heavy-duty rotary shaft sensors tailored for the industry's most demanding applications. Our product line offers a broad selection of heavy-duty resolver transducers, featuring single-turn, multi-turn, and redundant versions for precise absolute position sensing in harsh environments. Our stepper and servo motion control products provide optional network connectivity or seamless integration into existing systems, offering improved performance and reliability.

WARRANTY/GUARANTEE:

AMCI stands by the quality of our products and warrants that all manufactured products will be free from defects under normal use in materials and workmanship for a period of 18 months from date of shipment to distributor/customer. Within this period, AMCI shall repair or replace, free of charge, any products covered by this warranty.

SERVICE, SUPPORT & SPARE PARTS:

Dedication to the customer does not end with an invoice. AMCI is trusted across a spectrum of applications and our Technical Support group delivers maximum performance for every customer. Our resource library is available at no cost on our website and our technical support team is available 24/7.

TRAINING:

Our experienced Sales Department is more than happy to set up a training session for you and your team, virtual or in person. We offer demo products at cost and promotional materials so that you and your team can get the most out of our extensive product line. Our customer service representatives work hard to ensure that our customers are completely satisfied. We are happy to assist you in identifying the AMCI control products best suited to your application.

AMCI's commitment to the industrial automation industry runs deep throughout all aspects of the company. Our goal is complete customer satisfaction and seamless solutions for your industrial needs.

AMCI
ADVANCED MICRO CONTROLS INC.

H25

SINGLE-TURN RESOLVER TRANSDUCER

AMCI's H25 delivers unmatched versatility for precise feedback in demanding environments.

COMPACT **YET RUGGED**

- **IP67 rated**; superior durability in harsh environments
- Ideal for **high-shock** applications
- **Direct replacement** for AB Bulletin 846
- Variety of **mounting styles**
- **100% compatible** with AMCI's complete line of resolver interface products

AMCI.COM

AMCI ADVANCED MICRO CONTROLS INC.

RA Technology Partner
A ROCKWELL AUTOMATION PARTNER

Let Us Help You With Your Next Engineering Challenge

Atlas Technologies is a fully integrated US-based facility with on-site design, development, testing and manufacturing capabilities. We specialize in aluminum vacuum chambers and bimetal components to help solve engineering challenges everywhere—from space missions to particle colliders to semiconductor fabrication—as well as in simple, everyday applications.

AtlasUHV.com

Why Aluminum Vacuum?

Aluminum is the standout material for UHV and XHV chambers for these key reasons:

MINIMAL CARBON AND HYDROGEN CONTENT

With seven orders of magnitude less hydrogen and far less carbon than stainless steel, contamination is significantly reduced.

EFFICIENT BAKE OUTS AND UNMATCHED THERMAL PERFORMANCE

10x the thermal conductivity and 21x the thermal diffusivity of stainless steel makes aluminum ideal for vacuum. Bake-outs are quick and clean at 150°C.

HIGH RESISTANCE TO A VARIETY OF CHEMICALS

Aluminum is naturally resistant to many chemicals and can be anodized for additional management.

REDUCED RESIDUAL RADIATION

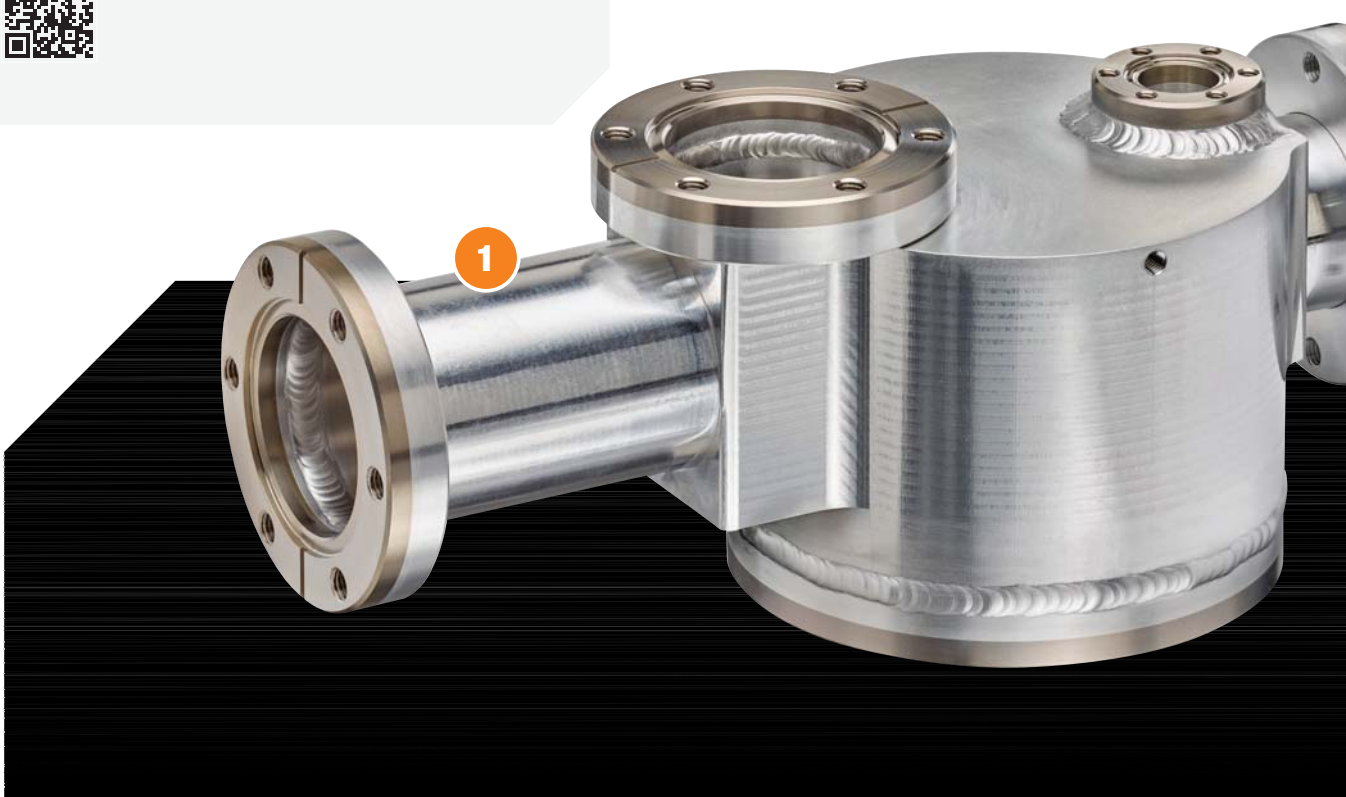
With a short neutron activated half-life, aluminum offers huge disposal savings and a priceless reduction in potential exposure to personnel.

COMPLETELY NON-MAGNETIC

Aluminum vacuum chambers offer no measurable disruption to electron and ion optics.

IMPROVED BOTTOM LINE

Lighter in weight and less expensive than stainless, aluminum is also easier to manage, less costly to ship and faster to machine.



Why Bimetal?

Bimetal flanges, fittings, and transitions support aluminum and titanium UHV and other demanding applications. Here's why you might want to choose bimetal for your next challenging project:

TWO OR MORE METAL PROPERTIES IN ONE COMPONENT

Metallurgically bonded dissimilar metals can be designed and manufactured to exploit varied properties all in one component.

RELIABLE, LONG-LASTING SOLID-STATE BONDS

Bonded dissimilar metals feature a molecular bond capable of withstanding extreme temperatures, corrosive environments and wrenching forces.

STRONGER AND MORE HEAT AND CORROSION RESISTANT

A welded or glued transition at a critical connection may allow caustic liquids into the seam between dissimilar metals. Bonded metals effectively eliminate the seam thus preventing incursion and resulting corrosion. These bimetal transitions also manage extreme temperatures more effectively.

REDUCED OVERALL COSTS

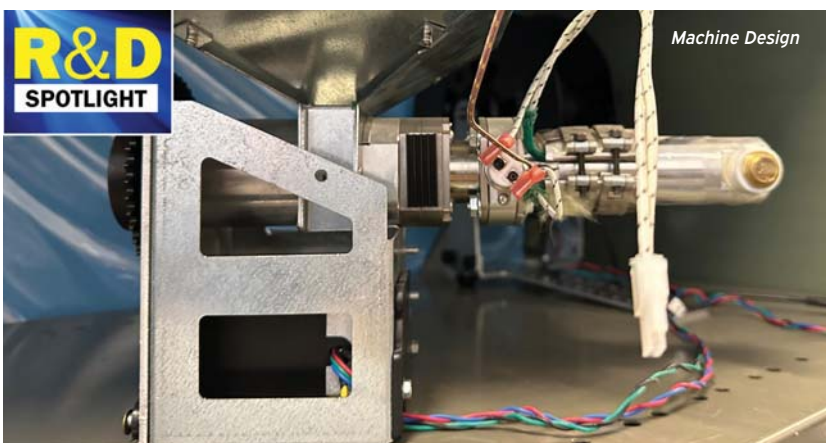
By using expensive metals only where required, then transitioning to lower cost materials via a bimetal connection, project costs can be lowered. Improved manufacturability also reduces costs.

1. **Al Vacuum Chambers**
   UHV, Semiconductor, Quantum, Aerospace, Cryogenics, Research
2. **Ti + Al Fittings and Flanges**
   Aerospace, Energy, UHV, Semiconductor, Quantum
3. **Al + SS Transitions**
   Aerospace, Energy, Research
4. **Al + SS Flanges**
   UHV, Semiconductor, Quantum, Research
5. **Cu + SS Transitions**
   Cryogenics, Energy, Semiconductor
6. **Ti + SS Fittings and Flanges**
   Aerospace, Energy, UHV, Semiconductor, Quantum
7. **Nb + SS Transitions**
   Aerospace, Energy, Optics, Cryogenics, Medical

Atlas TECHNOLOGIES

High-Risk, High-Reward:
Investing in Game-Changing Plastics Extrusion Technology

ReDeTec's patented solution for extruding materials could transform the plastics industry. R&D tests show it could use 50% less energy than competing systems. But what will it take to reach full adoption?



by Rehana Begg, Editor-in-Chief

ANGEL INVESTORS UNDERSTAND the high stakes of funding new technologies. The journey is fraught with financial, technical and market risks—but when a groundbreaking, well-designed innovation meets the right market, the rewards can be nothing short of legendary.

For Braam Meij, one technology has the makings of such an opportunity. ReDeTec, a Toronto-based small business, has developed MixFlow, a filament extrusion system that promises a new way to melt plastics. Whereas traditional systems churn a screw through molten plastic, ReDeTec's novel filament extrusion design separates the drive section and melt section with a thermal isolator, allowing independent control of temperature and pressure, explained Meij, CEO of BM3 Ventures Ltd., and an early-stage investor in the plastics extrusion system.

ReDeTec's extrusion technology is game changing because it uses 50% less energy than competing systems and offers higher throughput and more automation, Meij said during a call to invite *Machine Design* to visit ReDeTec's R&D facility in Toronto. "The solution has disruptive potential," he touted.

What is the Difference Between Extrusion and Injection Molding?

Plastics extrusion is a high-efficiency, low-volume manufacturing process where raw plastic material is melted and shaped into a continuous profile by forcing it through an extrusion die. The process is widely used to produce continuous components or products, such as pipes, tubing, fencing, deck railings, window frames, plastic films, sheets, thermoplastic coatings and wire insulation.

Injection molding, by contrast, forms a part by injecting molten material into a mold. The process can handle a broader range of materials required to produce discrete products, such as automotive parts or bottle caps, and is associated with greater precision, complexity and tolerances than plastic extrusion processes.

ReDetec's MixFlow technology is not only a new way to melt plastics but also a step up from extrusion, said Dennon Oosterman, ReDeTec's founder and CEO. "What it really does differently is that it allows one to melt plastic without viscous shear," he said.

In both cases, molten plastic is used to form an object. "In extrusion, parts are formed in a continuous profile; it goes forever," Oosterman explained. "Whereas, with injection molding, you form it in the

Dennon Oosterman, CEO and founder, ReDeTec, demonstrates a large and small prototype of the MixFlow system at ReDeTec's R&D lab in Toronto. ***Machine Design***

molds over and over and over again. Our technology provides the molten plastic that you then form. So, if you take our tech, you can either stick a die on it for the extrusion, or you can stick a clamp on it for injection molding. It is the portion of the machine that takes in room-temperature plastic and turns it into molten plastic to then be injected or extruded. That's what we do."

MixFlow is applicable to either industry, and it is ReDeTec's goal is to encourage companies that manufacture equipment for both extrusion and injection molding markets to adopt the MixFlow technology, said Oosterman.

Test, Develop, Validate, Scale

With traditional plastic parts production processes, molten plastic is mixed around a long screw. The advantage of this method is that it ensures a consistent flow of molten plastic, which is needed for producing high-quality extruded products. The main drawback from an energy efficiency perspective is the system's limited adaptability and control capabilities.

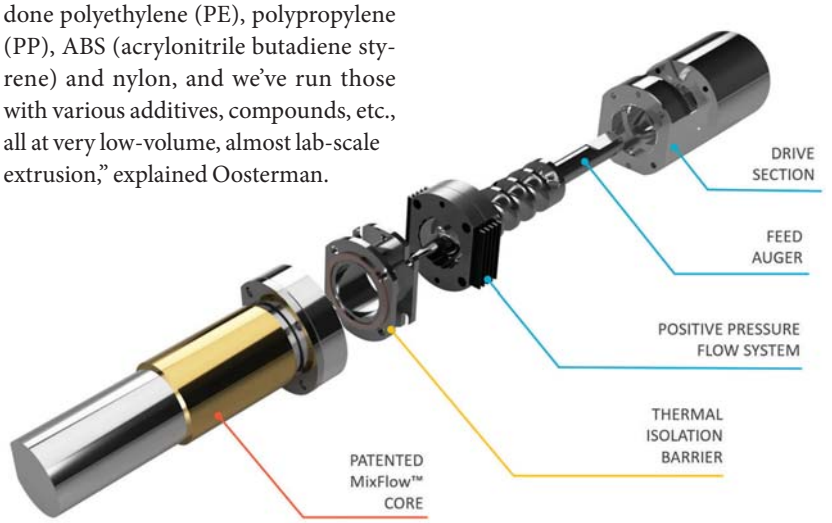
"You need full-time trained operators to run these machines," Oosterman explained. "It's a relatively intensive task. What MixFlow does differently is that it completely separates the screw or the feed auger from the plastic, and this allows us to have significant benefits in energy efficiency. [Add to that] the level of automation we're able to achieve. And the quality of the plastic itself is notably higher. There's less degradation from thermal and mechanical stress."

ReDeTec's extrusion of plastic materials patent covers a system where the auger feeds room-temperature plastic into a separate melting chamber that melts and mixes plastic uniformly without any interaction from the screw. The melting largely occurs through polymer shear or friction heating.

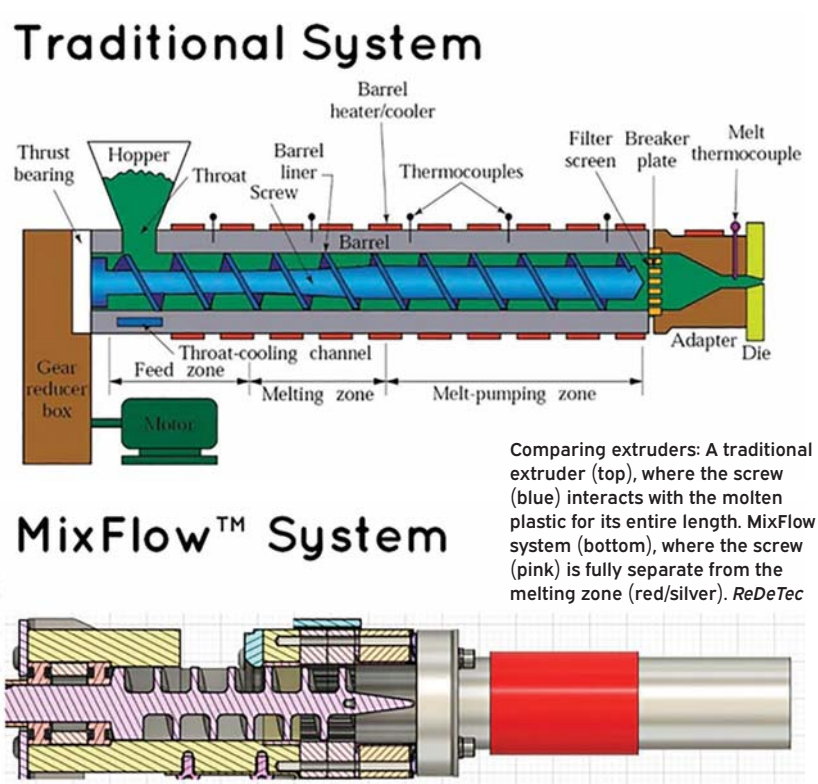
"Of course, there's much more to the proprietary process to make it work," said Oosterman. "We figured the best IP protection strategy was both—we have the patent, and we have all the other techniques you'd have to figure out as well. So, you'd need to both crack the code and violate the patent to copy it."

In ReDeTec's first pilot using a large extruder, their engineers ran four different polymers through the machine. Tests were confined to low-volume extrusion and focused on compounding. "We've done polyethylene (PE), polypropylene (PP), ABS (acrylonitrile butadiene styrene) and nylon, and we've run those with various additives, compounds, etc., all at very low-volume, almost lab-scale extrusion," explained Oosterman.

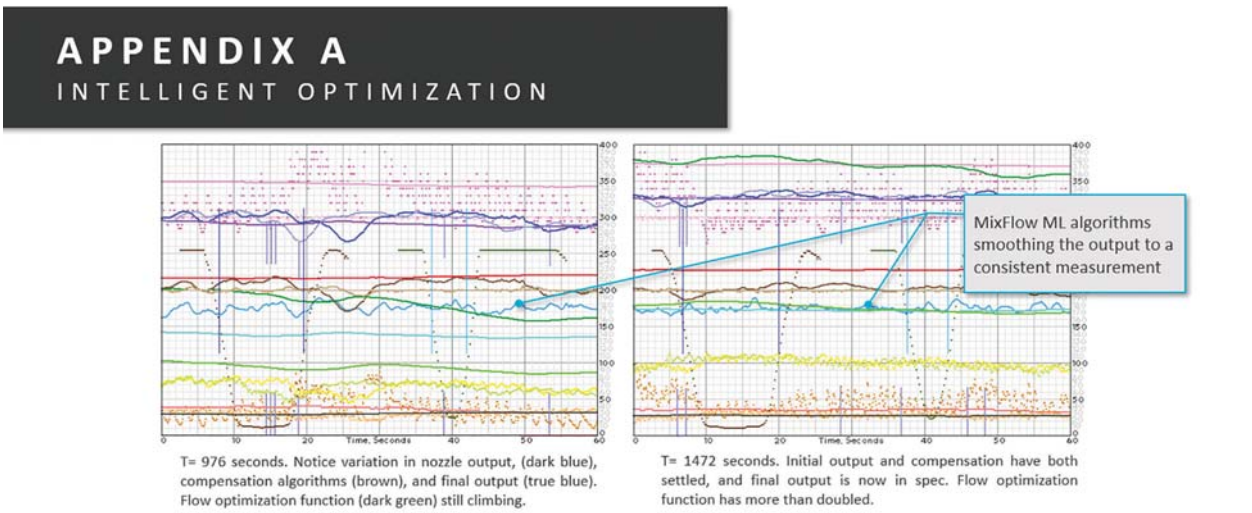
> *"People say, 'hardware is hard,' but it's also exceptionally rewarding."*
>
> *— Dennon Oosterman, CEO & Founder, ReDeTec*



An "exploded view" of a MixFlow extruder, with the drive section in blue, the thermal insulator in yellow and the melt section in red. *ReDeTec*



Comparing extruders: A traditional extruder (top), where the screw (blue) interacts with the molten plastic for its entire length. MixFlow system (bottom), where the screw (pink) is fully separate from the melting zone (red/silver). *ReDeTec*



ReDeTec's software "learns" a new plastic in real time. In this case, engineers provided ABS settings as a baseline, but the actual plastic being processed was HIPS. The green lines (dark green represents flow quality, and light green throughput). Both increase significantly as the system stabilizes and optimizes various settings for the new plastic. ***ReDeTec***

Tests have ranged from 200 grams (0.44 lb.) of filament using a small extruder to about 2 kilograms (4.4 lb.) an hour, or 10 times the throughput in a scaled-up extruder. "We're looking to scale that up to 20 kilograms (40.092 lb.) and then 200 kilograms (440.0925 lb.) an hour," Oosterman said. "The initial pilot was to show that the technology works with a variety of both commodity plastics as well as engineering grade. It works in extrusion, and it works for compounding."

Championing Circularity in Plastics

As industries become more conscientious of environmental issues, sustainability has become a crucial consideration in designing and processing parts. Accordingly, ReDeTec focuses on maximizing material use through plastics recycling and waste reduction, offering eco-friendly and cost-effective solutions that outperform current industry standards.

Whereas conventional systems degrade plastic every time it is extruded, MixFlow uses less energy and preserves plastic quality, reducing degradation to 1% or less and yields stronger filament, according to Oosterman.

In one study, ReDeTec's R&D engineers 3D-printed plastic samples, conducted mechanical tests and then recycled the samples into filament using their Proto-Cycler V3 filament extruder equipped with MixFlow extrusion technology. The engineers found that after three recycling cycles, the ultimate tensile strength and elastic modulus of thermoplastic samples (polylactide [PLA], ABS, HIPS [high

Redetec's MixFlow system builds on traditional extrusion processes. The proprietary solution separates the screw or the feed auger from the plastic and offers significant benefits in energy efficiency. ***Machine Design***

impact polystyrene] and PP) remained relatively unchanged when recycled using the MixFlow technology.

ReDeTec has effectively demonstrated an approach that from an environmental standpoint reduces energy consumption, minimizes waste and decreases downtime, said Oosterman. "We really care about sustainability and the environment," he said. Being able to slash the energy bills in an industry that consumes a huge amount of energy...is an important driver for us, and seeing intelligent mechanical systems perform incredible feats of engineering is something that gets the whole team out every morning. It's a really exciting thing."

Still, Oosterman recognizes that what he perceives as his company's greatest strength and what others care about are not necessarily aligned. "Personally, I think it's great that we've done studies that show that we work better with recycled plastic than existing technology, but the industry doesn't want to recycle plastic, and we're not going to change that," he said. "There are maybe 10 different problems with recycling right now, and we're only solving one of them. The other nine are still there, so it's a moot point."

The plastics industry relies on energy to process raw materials into products. After raw materials, energy is typically the largest resource consumed in the industry, noted Oosterman. "We've reduced the amount of energy needed for these processes. Obviously, there are greenhouse gas benefits, but it's just a more efficient system," he said.

If increasing production is prioritized over reducing energy consumption, efforts to promote energy-saving initiatives could encounter resistance. Oosterman believes that the two approaches are not mutually exclusive. Because companies prioritize growing and building their business, ReDeTec's go-to-market strategy highlights the potential to increase productivity for a given cost. This model embraces goals for longer-term success and materially better outcomes than traditional models. The pitch for MixFlow is: "Keep everything the same and produce more, increase output, gain a competitive edge."

Dennon Oosterman, CEO, ReDeTec, and Braam Meij, CEO, BM3 Ventures Ltd., discuss the pros and cons of designing and developing a plastics extrusion system. Redetec's MixFlow system builds on traditional extrusion processes. The proprietary solution separates the screw or the feed auger from the plastic and offers significant benefits in energy efficiency. *Machine Design*

Despite improving the prototype's overall performance this year, the company hasn't had the resources to commercialize the technology. "We're at the stage right now where we've demonstrated the technology's worth and that it's scalable, but all we've ever made are prototypes," Oosterman said. "We could hit 100% perfect and hit the absolute limits of physics with it, but that doesn't make a difference if it's not in plants around the world."

What ReDeTec needs, he said, is to find partners who will "take a bit of a risk, for sure," and incorporate the technology into their manufacturing processes. The Catch-22 is that until they show evidence of traction in the industry, growth into industrial markets is likely to stall.

Staying Afloat with 3D Printing

ReDeTec, which bills itself online as an advanced plastics manufacturing company, started out as a 3D printing business about 11 years ago. The company has six employees, including four engineers and sales and marketing support. "We have an electrical engineer, a mechatronics engineer and a software control systems engineer," said Oosterman, an engineering physicist who studied at Canada's University of British Columbia. "What unites all of us in this business and in this drive is that we all really like seeing hands-on, tangible creation. People say, 'hardware is hard,' but it's also exceptionally rewarding."

As a small business, the company has had success with its flagship product, ProtoCycler V3, which empowered users to make their own filament for 3D printing,

developed methods to recycle 3D printing waste and enables experimentation with the making of novel plastic filaments. This system is supported by ReDeTec's automated software, which controls and monitors all extrusion parameters when working with polymers and additives.

For the most part, the 3D printing business is keeping the business afloat, and it wasn't until five years ago that the company grew into the industrial market. "We're an established small business in the printing space," Oosterman said. "We've been around for about a decade shipping product. We've kept profitability. We're not going to disappear, which means we're no longer a startup on the industrial side."

The ProtoCycler V3 is ReDeTec's flagship product.. *Machine Design*

Innovating on the Shoulders of Industrial Giants

I read somewhere that location and urbanization influences are an important factor in the development of startups. ReDeTec's R&D lab is located on Carlaw, a busy street in Toronto's bustling urban East End. A collection of former factories and warehouses were built in the vicinity during the early 20th Century. Many were subsidiaries of their American parent companies, including Wrigley's (chewing gum); Crown Cork and Seal (patented a machine for capping bottles and designed an aerosol can at this location); and the Jefferson Glass Co. (the factory made 35,000 glass lightbulbs a day by 1918, and was bought by The Acme Paper Box Co. in 1931).

Due to revitalization and redevelopment over the decades, the pedigree of the former industrial precinct is clinging to survival. The area is characterized by a mishmash of old and new architecture, all of which contribute to the now mixed-use developments where tenants are as likely to be accountants, artists, woodworkers and glass blowers as they are engineers and physicists.

ReDeTec is housed in a building that at one time was a toy factory and a munitions manufacturer at another. For Oosterman, however, future success depends much more on his long-term vision and mission and the value proposition of his team than the building in which it operates.

"We're less concerned with having affordable real estate because we don't have a huge factory pumping up massive equipment," said Oosterman. "We are very concerned with accessibility to the brightest talent we can find. You know, recent grads from U of T, Queens, etc., most of whom live downtown and don't own a car and take public transportation. Especially in our earlier years, when we were constantly meeting with different partners, business development groups, marketing agencies."

Iterate, Build Traction, Grow

Both Meij and Oosterman had cleared the decks for the afternoon, but it wasn't for *Machine Design*'s benefit alone. They had a scheduled board meeting later that afternoon.

During the early stages of development, regular meetings and feedback from board members are crucial for navigating business challenges and for soliciting support as the company proves out initial assumptions. Investors can choose to be hands-off or deeply involved through development.

That day, Meij was ready to be hands-on. "Having better opportunities to recycle plastic, reducing the energy consumption and demonstrating automation and control in a totally different way to what has been done in the past was what was exciting for us," Meij said. "Taking something that's small and working well and then trying to industrialize that is a challenge and comes with exciting hurdles to overcome."

By training an industrial engineer who shifted vocations after a 22-year career with a large industrial conglomerate, Meij fully appreciates the application potential of ReDeTec's MixFlow technology. "We have the prototype, and we've done some great testing with good results," he said. "There's some tweaking that needs to be done, and we want to go bigger and get to a substantial-sized extrusion unit...Dannon and his team are the right partners to take on the industry a bit." ■

Salary & Career Survey: Mechanical Engineering Talent is in Short Supply

Survey respondents agree that a successful engineering career path includes acquiring ongoing technical knowledge. Hard and soft skills are necessary to ensure growth.

Images courtesy Endeavor Business Media

by Rehana Begg, Editor-in-Chief

EACH YEAR, *Machine Design*'s Salary & Career Survey takes a pulse on what's keeping engineers up at night. This year's survey highlights engineers' perceptions about the overall value of their engineering careers. Respondents expressed overall satisfaction, but their comments played up a few key constraints.

Engineers have tangible skills sets that span industries and disciplines. They are problem-solvers and drive innovation by pushing boundaries. Despite these indispensable competencies, they jostle to stay grounded in the industry's practical realities.

What follows are just a few findings worth picking through.

Skills Requirements Evolve as Technology Expands

The survey asked: "Do you believe that a career path in engineering and the potential for salary advancement is as promising today as it was five years ago?" The majority (68%) of respondents said "yes" while 32% said "no."

While survey participants were universally bullish about their regard for their careers, their comments related to this query portrayed a more nuanced scenario when engineers' varying degrees of tenure and their experience inside their organizations are considered. Ranging from salary expectations and skills requirements to advancements in technologies and market demand, comments included a mix of both positive and negative feedback. Among the 311 survey participants, 219 provided a rationale for their answer.

Respondent No. 144 best captured recurring themes: "Five years ago, the development of the engineering field was relatively stable, and the speed of market demand and technological updating was relatively slow. Some traditional engineering fields, such as construction and machinery, have relatively fixed career patterns and salary growth mechanisms. However, today, with the rapid development of science and technology, emerging technologies such as artificial intelligence, big data, new energy and other applications in the field of engineering continue to expand. This provides more opportunities for innovation and development for engineering professionals and also brings more high-paying jobs. But at the same time, it also puts forward higher requirements for the knowledge updating and skill upgrading of engineering personnel. If you can't keep up with the pace of technological development, you may encounter bottlenecks in career development and salary growth. The career path and potential for salary increases in engineering are different today than they were five years ago and cannot be generalized to be just as promising."

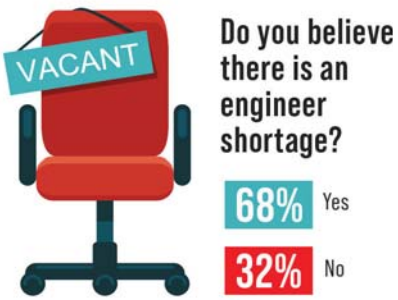
One respondent pinpointed the central issues of generational shifts and pay expectations relative to their skills sets: "I am retiring, my daughter has been in

engineering for 10 years. She has been laid off twice but continues to find work for better pay than the last job but still is not earning premium pay." Also identifying the generational divide and specialized skills, another respondent said: "Specialization. Willingness to relocate. My two sons make more than me after 10 years in the engineering field."

Yet another counseled on how the rapid advancement in technology requires continued learning if engineers are to stay relevant: "As system designs become more complicated, you must keep up with modern advancements by staying current in training and trends in your industry that make you more valuable."

Do You Believe There is an Engineer Shortage?

A shortage of engineering talent has been widely reported across the globe. An analysis of Bureau of Labor Statistics (BLS) data prepared by Boston Consulting Group showed that the U.S. alone will need about 400,000 new engineers and that nearly one in three engineering roles will remain unfilled each year through 2030.



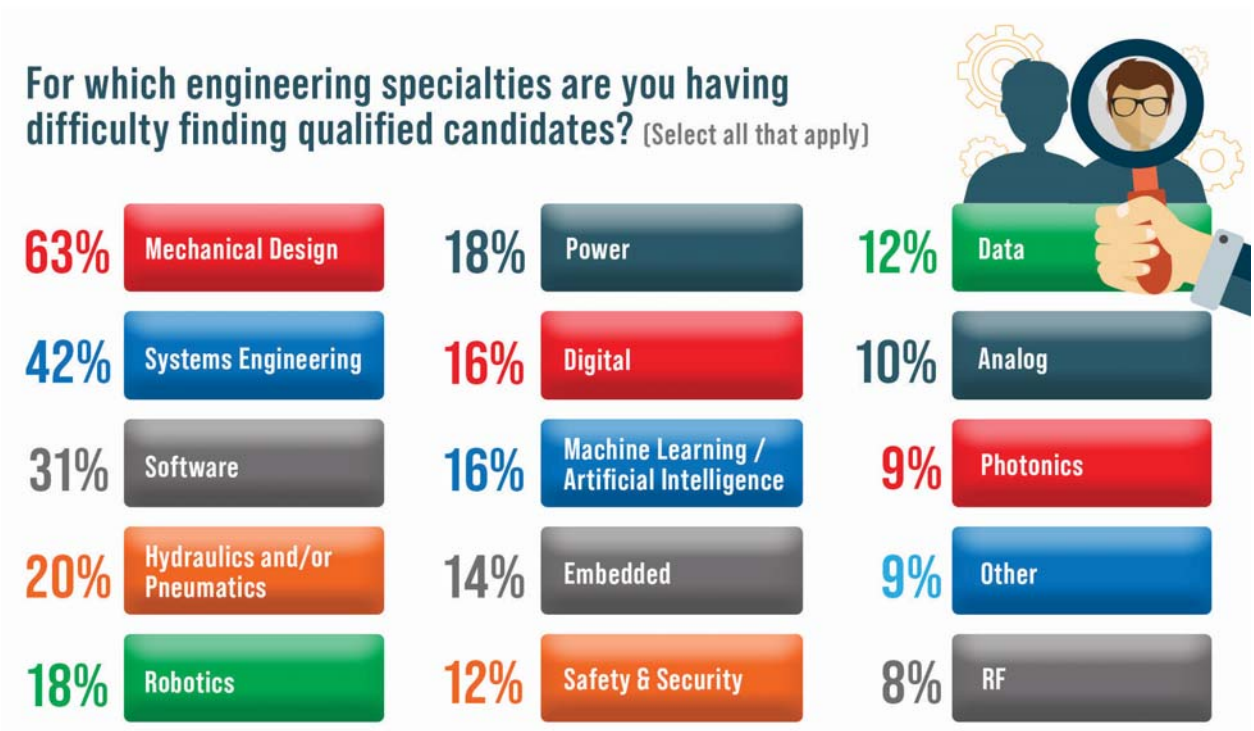
These statistics were shored up in the American Council of Engineering Companies (ACEC) Research Institute's quarterly engineering business sentiment study. In a letter to President Joe Biden in 2023, the ACEC expressed concerns that 49% of its member firms had turned down work specifically due to workforce shortages. The ACEC is a national federation of 51 state and regional organizations representing more than 5,500 engineering firms and nearly 600,000 engineers, surveyors, architects and other specialists nationwide.

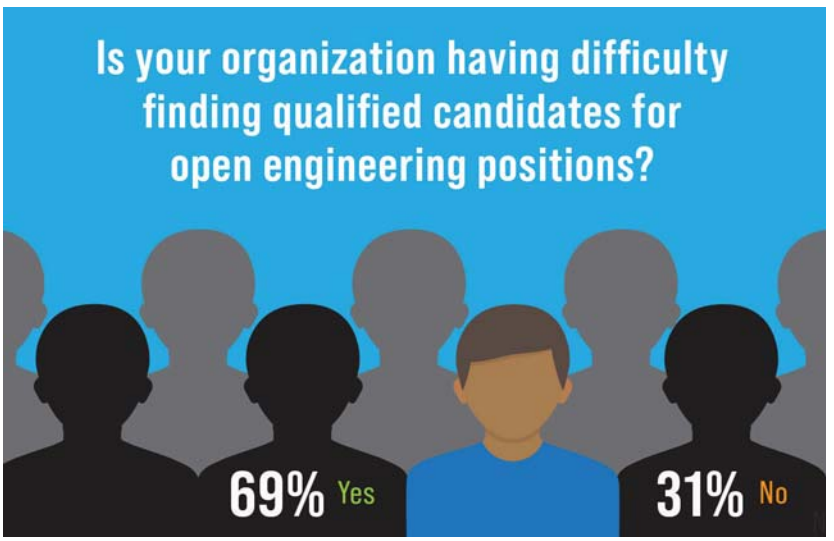
Respondents in *Machine Design*'s survey for the most part (68%) agreed that the U.S. is experiencing an engineering shortage. It is unclear why the remainder (30%) did not recognize the engineering shortage. Whether the issue lies in near-sightedness among this cohort of respondents—such as when a firm employs a full complement of engineers in in-demand disciplines or fills vacant roles with a steady stream of job applicants—it highlights a gap in the industry's skills shortfall and the broader implications for addressing workplace challenges.

Finding Qualified Candidates

Respondents were asked to list the average number of years of experience that their firms expect from new hires. Their answers were: three years (47.19%), five years (40.26%) and 10 years (10.39%), respectively. "Years of experience" refers to the amount of time an engineer has worked in a field. When listed on a job posting, this query not only helps to identify candidates with a specific level of professional experience but also helps employers gauge candidates' ability to execute.

Among the respondents' firms, 68.67% reported difficulty in finding qualified candidates to fill open positions. Mechanical design (62.75%) was at the top of the list of specialties firms were





struggling to find qualified candidates for. Other specialties facing notable challenges were systems engineering (41.83%); software (31.37%) and hydraulics & pneumatics (20.26%).

Consider the opportunities for mechanical design engineers. *Machine Design*'s survey data aligns with a generally high global demand for mechanical engineers who design and build machinery and other equipment. The latest U.S. Bureau of Labor Employment's Occupational Outlook Handbook, for example, noted that the job outlook for mechanical engineers is projected to grow 11% from 2023 to 2033, with about 19,800 openings projected each year over the decade. This rate of growth is much faster than the average for all occupations, according to the statisticians, who further stated that these openings are expected to arise from the need to replace workers who transfer to different occupations or retire.

A Big Thumbs Up to Engineering Careers

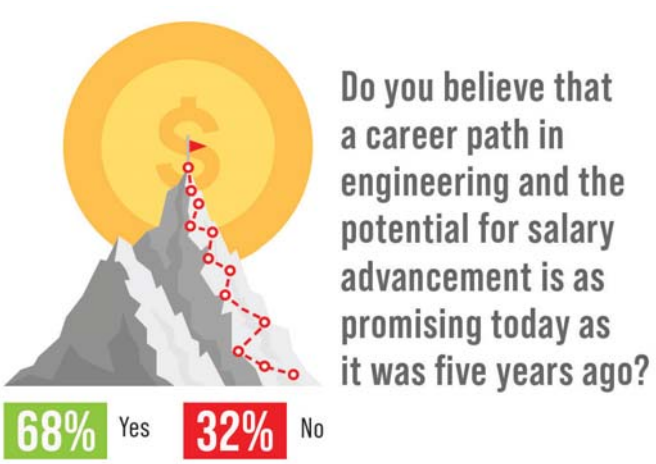
When asked whether respondents would recommend engineering as a career path to a young person looking to choose a profession, the response was resoundingly positive (89.41% said yes). Their reasons captured a sense of fulfillment and contentment, revolving around such words as income stability, purpose, meaning, flexibility, opportunity and job satisfaction. The wording reflected the various dimensions of the engineer's work experience and shed light on their priorities, values and how they perceive their career.

A Few Approving Comments

- "There's nothing more satisfying than the challenge associated with the advancement of new ideas."
- "It is the best way to learn how the world really works. And seeing your designs being built is extremely rewarding."
- "It's a great career path for those who enjoy problem solving and have the appropriate aptitude.
- "While AI may begin to encroach into our traditional roles, I think there will be plenty of opportunities to work with AI or to 'teach' the AI."
- "Engineering improves your perspective in life in so many ways."
- "Plenty of paths to go down depending on what your interest is."
- "Brains don't go out of style."

A Few Critical Points of View

- "The pay doesn't match the responsibility and there's no job security."
- "The industry has changed and is no longer fun to work in. It all changed in 2020 when companies changed and started mandating everything. No freedom to be you or be able to ask questions as management gets upset if you challenge anything. It's become a dictatorship, not a collaborative or team environment. They use 'Not a Team Player' if you try to bring up an issue that you see will not work."
- "Yes, but not yacht or boat design."
- "Well, it is not that I don't want to prevent anybody from choosing engineering and, for me, science and engineering are still the most important professions to shape our future. But I see that the work as an engineer is not really appreciated in companies. Sometimes you really have to do stupid work. Digitalization is used by the management as a buzzword and as soon as it comes with a price tag (investment) the enthusiasm of the management stops." ■



Sponsored Content

BAUMER

YOUR PARTNER FOR SMART SENSOR SOLUTIONS

WEB | www.baumer.com
EMAIL | sales.us@baumer.com
TEL | 800-937-9336

5 Century Drive
Bristol, CT 06010

The Baumer Group is one of the world's leading experts for high performing sensors and sensor systems in industrial automation. The unrivalled broad product portfolio, measuring precision and smart sensor functionalities provide intelligent solutions for digitalized production. With around 2,800 employees and 39 development centers, production sites and sales units in 19 countries, the Swiss family-owned Group is always close to the customers. As an innovation leader for more than 70 years, Baumer has been creating decisive market advantages and measurable added value with consistently high quality standards.

With many years of experience across the world, Baumer has partnered with a lot of renowned companies in all industries to solve tricky automation challenges.

Driven by its pioneering spirit, Baumer is always on the forefront of innovation, providing our customers and partners with the latest technology to improve their operations. It is not only customers who see the benefits of Baumer solutions but also the professional world of automation, constantly honoring Baumer innovations with awards. With a strong focus on quality, all sensors are manufactured in Europe and thoroughly tested in real-world settings prior to launch.

That's why our customers can always rely on receiving the highest quality from Baumer.

More than just providing the newest technology, we take pride in partnering with our customers to develop the best solutions for their needs and pave the way to smart production. Just a few examples: Baumer smart sensor solutions guide robots in a very efficient way, in beverage production they save huge amounts of energy and other resources, they push the limits of smart farming and make trains run smoothly.

You can also learn more about Baumer and our products at **Baumer.com/us/**

Baumer
Passion for Sensors

Baumer
Passion for Sensors

Your Partner For Sustainable Automation

Sensor Experts Driving Innovation

The Baumer Group is one of the world's leading experts for high performing sensors and sensor systems in industrial automation. Our broad and high-quality product portfolio paves the way to the smart factory with innovative and connected solutions focused on the future.

Facts and Figures

- **2800** employees
- **350** R&D engineers
- **19** countries
- **> 50,000** product portfolio

Learn more at baumer.com/us
or contact us at sales.us@baumer.com

Sponsored Content

CONTEMPORARY CONTROL SYSTEMS

WEB | www.ccontrols.com
EMAIL | info@ccontrols.com
TEL | 630-963-7070

2431 Curtiss Street,
Downers Grove, IL 60515

INNOVATIVE MACHINE INTEGRATION SOLUTIONS

Celebrating 50 years! Since 1975, Contemporary Controls has been focused on innovative solutions for industrial automation.

RUGGED ETHERNET SWITCHES

CTRLink products provide Ethernet infrastructure solutions. For simple systems, plug-and-play unmanaged switches provide a cost-effective method for expanding Ethernet networks. For troubleshooting, diagnostic switches allow a network sniffer to attach to an unused port on a switch and observe all traffic on the network. Designed for unattended operation in environments not conducive to office-grade equipment, CTRLink products provide convenient DIN-rail mounting in control panels, 24 VAC/DC power, UL 508, improved EMC compliance and reliability.

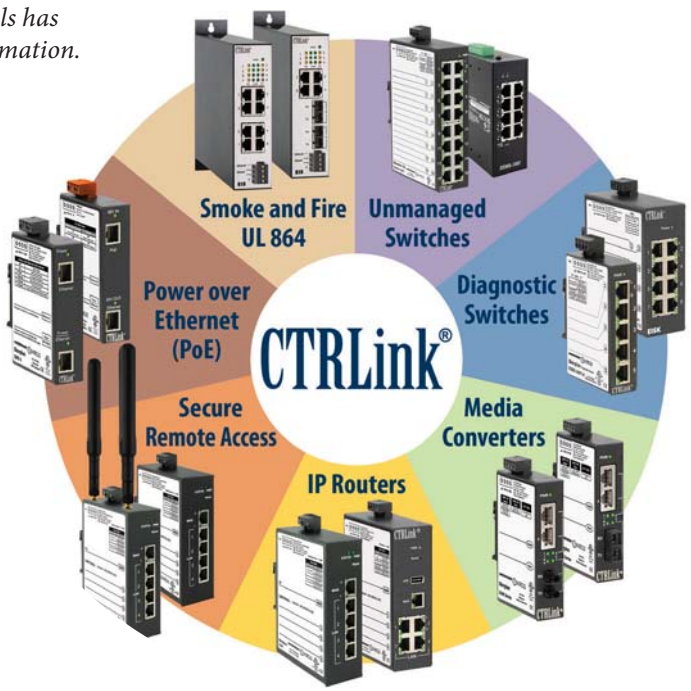
COST-EFFECTIVE, TRUSTED IP ROUTERS

Contemporary Controls' Skorpion series of IP routers eases the integration of new machines into the existing network. Each machine consisting of multiple IP devices connects to the LAN side while keeping the same IP settings for the devices and the application, lowering installation cost and eliminating troubleshooting. VPN models of the routers can provide secure remote access with the use of the RemoteVPN service from Contemporary Controls. Cellular routers with available data plans for hassle-free device activation provide quick and easy commissioning of the devices on the remote jobsite. Skorpion routers have been successfully used in Robotics, Automated Guided Vehicles (AGVs), Packaging, Scientific Equipment, and more.

SIMPLIFIED, SECURE REMOTE COMMUNICATION

A virtual private network (VPN) can provide secure access to remote job sites while giving systems integrators the flexibility to monitor and maintain systems from the convenience of their home or office.

Contemporary Controls offers three VPN solutions to meet your remote access needs – RemoteVPN subscription service, Self-HostedVPN and BridgeVPN.



PERFORMANCE YOU CAN DEPEND ON

Contemporary Controls' repeating hub, switches, media converters and IP routers adhere to IEEE 802.3 standards and more. Special regulatory needs, such as UL 864, are addressed in selected models.

Contemporary Controls' customers are systems integrators, contractors and OEMs seeking simple, reliable networking and control products from a dependable source. With headquarters based in the US, Contemporary Controls also has operations in the UK, Germany and China and is well suited to fulfil your application needs worldwide.

CONTEMPORARY CONTROLS® 50 years

Simplify Machine IP Integration

IP Routers

Maintain your factory-set IP addresses when integrating with the customer's IP network by using the Skorpion IP Router.

- Reduce installation time
- Eliminate IP conflicts
- Easily comply with your customer's IP requirements

Eliminate site visits with secure remote access using RemoteVPN , Self-HostedVPN or BridgeVPN.

- Quick troubleshooting of equipment and machines with real-time access
- Applicable to both permanent and temporary remote access
- Flexible man-machine and machine-machine applications
- Wired or wireless access

RemoteVPN Self-HostedVPN BridgeVPN

CONTEMPORARY CONTROLS® 50 years

Providing Solutions to Your Automation Needs

Learn more at www.ccontrols.com/machine

+1-630-963-7070 • info@ccontrols.com

Sponsored Content

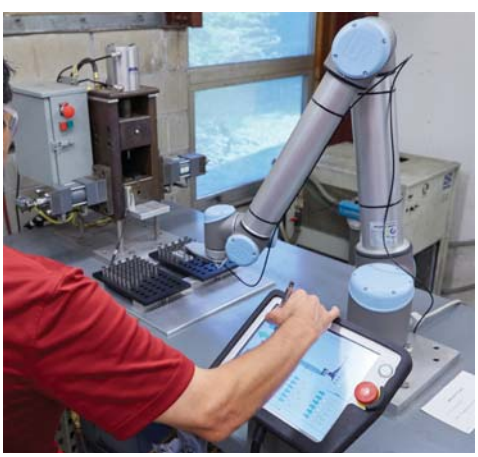
EAGLE STAINLESS

WEB | www.eagletube.com
TEL | 800-528-8650

STAINLESS STEEL TUBING IS THE MOST VERSATILE METAL ALLOY USED IN MANUFACTURING

Supplying Stainless steel tubing and other metals to the stringent demands of the medical, aerospace, energy and industrial industries. Eagle has been supplying stainless steel solutions since 1982. The multitude of benefits offered by stainless steel not only enhance its quality and durability but also contribute to its sustainability. The exceptional strength, corrosion resistance, and longevity contribute to the sustainability by minimizing the need for frequent replacements and reducing environmental impact through its long lasting performance.

Our mission is to provide our customers with top-notch stainless steel tubing and services that meet their unique needs, all while maintaining the highest quality and professionalism.



ISO 9001 AND ISO 13485 QUALITY MANAGEMENT CERTIFICATIONS IN PLACE

ISO Certifications play a crucial role in ensuring the quality and reliability of stainless steel tubing, making them indispensable for industries where precision, safety and consistency are paramount. The certifications not only assure product quality but also instill confidence in clients and regulatory bodies, contributing to enhanced performance and reduced risks.

SERVICES OFFERED

- **Distribution.** Eagle ships products from inventory, including tubing, bar stock, hollow bar, wire. Stocking both seamless and welded tubing, from an extensive inventory.

- **Precision Cut-to-length.** Eagle's manufacturing facilities enable the cutting and deburring of up to 2" diameter and quantity of fractional, metric, pipe, and hypodermic tubing.
- **Custom-fabricated components.** Working to customer specifications and specializing in Bending, CNC and EDM/ ECG machining and Laser machining. Eagle can produce close-tolerance parts for the medical industry as well as other industries.

Transforming a simple part into the part you need. Though thoughts of tubing may offer circular images, in fact, tubing comes in many shapes, sizes and thicknesses. Round, oval, rectangular or square, stainless steel tubing is versatile and popular. Secondary operations then tailor the tubing to the exact part needed.
Formed components are ideal for uses in surgical devices, heat exchangers, instrumentation and handling equipment.

ORDERING TUBING

Stainless steel tubing is generally ordered to outside diameter (OD) and wall thickness. Tubing has 3 dimensions: OD, inside diameter (ID) and wall thickness. Only two can be specified with tolerances. The 3rd is theoretical. Other things to keep in mind are alloy, temper or hardness, welded or seamless tubing, how long, surface finish, straightness, and how clean does it need to be. Additionally, consider factors such as alloy, temper or hardness, welded or seamless tubing, length, surface finish, straightness and cleanliness.

EAGLE STAINLESS

STAINLESS STEEL TUBING

The Most Versatile Metal Used in Manufacturing

Just as not all stainless steel grades are created equal, neither are stainless steel tubing suppliers. **Eagle Stainless Tube & Fabrication Inc.** has been supplying millions of feet of stainless steel tubing, nickel alloys, and aluminum to the medical, aerospace and industrial industries since 1982.

ISO 9001 | ISO 13485

HYPODERMIC TUBING SELECTION GUIDE

The tubing below is available in 10 foot lengths. Eagle can cut your order to shorter lengths as required.

Full Hard #3 Temper • T304 • T316

Gauge Size	O.D. Range (Inches)	Nominal Wall (In.)	I.D. Range (Inches)
3 STD	.258/.260	.015	.226/.232
4 STD	.236/.240	.020	.195/.201
5 STD	.218.220	.015	.187/.191
5 TW	.218/.220	.010	.196/.200
6 STD	.202/.204	.015	.170/.1765
6TW	.202/.204	.010	.180/.186
6V	.187/.189	.010	.165/.171
7 STD	.179/.181	.015	.147/.153
7TW	.179/.181	.010	.158/.162
7V	.171/.173	.011	.147/.153
8 STD	.164/.166	.015	.132/.138
8TW	.164/.166	.010	.143/.147
8XTW	.164/.166	.009	.145/.149
8V	.155/.157	.010	.133/.139
9 STD	.147/.149	.015	.115/.121
9TW	.147/.149	.010	.126/.130
9XTW	.147/.149	.006	.134/.138
9V	.140/.142	.011	.117/.121
10 STD	.133/.135	.014	.104/.108
10 TW	.133.135	.010	.112/.116
10XTW	.133/.135	.008	.1165/.120
10 V	.125/.127	.010	.104/.108
11 STD	.119/.121	.013	.092/.096
11 TW	.119/.121	.010	.098/.102
11XTW	.119/.121	.007	.104/.108
11 V	.114/.116	.010	.092/.096
12 STD	.108/.110	.012	.083/.087
12 TW	.108/.110	.009	.089/.093
12 XTW	.108/.110	.0045	.098/.102
12 V	.099/.101	.008	.080/.083
13 STD	.094/.096	.012	.069/.073
13TW	.094/.096	.009	.075/.079
13 XTW	.094/.096	.005	.083/.087
14 STD	.082/.084	.010	.061/.065
14 SP	.082/.084	.008	.065/.069
14 TW	.082/.084	.0055	.071/.073
14 XTW	.082/.084	.003	.075/.079
14 V	.077/.079	.007	.062/.066
15 STD	.0715/.0725	.009	.0525/.0555
15 TW	.0715/.0725	.006	.0595/.0615
15 XTW	.0715/.0725	.004	.062/.066
15 V	.0675/.0685	.007	.0525/.0555
16 STD	.0645/.0655	.009	.0455/.0485
16 TW	.0645/.0655	.006	.0525/.0545
16XTW	.0645/.0655	.004	.055/.058
16 V	.0615/.0625	.005	.0505/.0535
17 STD	.0575/.0585	.008	.0405/.0435
17 TW	.0575/.0585	.005	.0465/.0485
17 XTW	.0575/.0585	.003	.051/.053
17 V	.0555/.0565	.005	.045/.047
18 STD	.0495/.0505	.0085	.0315/.0345
18 SP	.0495/.0505	.006	.0375/.0395
18 TW	.0495/.0505	.004	.041/.043
18 V	.0455/.0465	.0065	.0315/.0345
19 STD	.0415/.0425	.0075	.0255/.0285
19 TW	.0415/.0425	.005	.0315/.0335
19 XTW	.0415/.0425	.0035	.034/.036
19 V	.0385/.0395	.006	.0255/.0285
20 STD	.0355/.036	.006	.023/.0245
20 TW	.0355/.036	.005	.025/.027
20XTW	.0355/.036	.004	.026/.0285
20V	.034/.0345	.004	.0255/.0275
20STD	.032/.0325	.006	.0195/.021
21 TW	.032/.0325	.005	.022/.024
21XTW	.032/.0325	.002	.0280/.0295
21 V	.030/.0305	.0035	.023/.0245
22 STD	.028/.0285	.006	.0155/.017
22 TW	.028/.0285	.004	.019/.0205
22 XTW	.028/.0285	.0025	.0225/.024
22 V	.026/.027	.003	.0195/.021
23 STD	.025/.0255	.006	.0125/.014
23 TW	.025/.0255	.004	.0165/.018
23 XTW	.025/.0255	.002	.0185/.020
23V	.023/.0235	.003	.0165/.018
24 STD	.022/.0225	.005	.0115/.013
24XTW	.022/.0225	.003	.0155/.017
24V	.021/.0215	.002	.0155/.017
25 STD	.020/.0205	.005	.0095/.011
25 TW	.020/.0205	.004	.0115/.013
25XTW	.020/.0205	.002	.0155/.017
25V	.019/.0195	.002	.0135/.015
26 STD	.018/.0185	.004	.0095/.011
27 STD	.016/.0165	.004	.0075/.009
27 TW	.016/.0165	.003	.0095/.011
27 SP	.016/.0165	.002	.0115/.0125
28 STD	.014/.0145	.0035	.0065/.008
29 STD	.013/.0135	.003	.0065/.008
30 STD	.012/.0125	.003	.0055/.007
30TW	.012/.0125	.002	.0065/.008
31 STD	.010/.0105	.0025	.0045/.006
32 STD	.009/.0095	.0025	.0035/.005
33 STD	.008/.0085	.002	.0035/.005

Note: Special sizes available on request!

CONTACT US TODAY

800-528-8650

Franklin, Massachusetts

info@eagletube.com

www.eagletube.com

EAGLE STAINLESS

My father started Eagle in 1982 with a vision for delivering top-quality products, and we proudly carry on that legacy today. At Eagle, we specialize in precision stainless steel tubing for demanding applications where performance and accuracy are critical. Our commitment to quality ensures that every product we deliver meets the high standards our customers expect and deserve.

Robert Bubencik Jr
PRESIDENT

EMERSON DISCRETE AUTOMATION

www.emerson.com

Emerson is a leader in the automation industry, providing solutions designed to optimize manufacturing processes and boost operational efficiency. Focused on innovation, Emerson's Discrete Automation business offers advanced technologies for various industrial applications, helping manufacturers achieve higher productivity, reliability, and sustainability.

Emerson advocates their customers adopt a "Floor to Cloud" approach to automation. This strategy integrates on-site operational technologies with cloud-based analytics, creating a seamless information flow from the factory floor to enterprise systems. This integration enables real-time monitoring, predictive maintenance, and data-driven decision-making, significantly reducing downtime and operational costs. The Floor to Cloud approach allows manufacturers to leverage the power of Industrial Internet of Things (IIoT) and Industry 4.0 for smarter, connected operations.

SOLUTIONS IN ACTION

Emerson's Compressed Air Manager and Energy Manager are two solutions that showcase the power of integrated, intelligent automation. The Compressed Air Manager optimizes compressed air systems, which are often inefficient components of manufacturing processes. By continuously monitoring air usage and system performance, it can identify leaks, inefficiencies, and potential failures, saving energy and reducing costs.

Similarly, the Energy Manager solution offers comprehensive energy monitoring. It tracks energy consumption across the entire facility, providing insights into energy use and optimization opportunities. By identifying patterns and anomalies, the Energy Manager helps manufacturers reduce energy waste, lower operational costs, and meet sustainability goals. Both solutions can be seamlessly used together within the same app, offering a unified platform for enhanced operational efficiency and energy management.

NEXT GENERATION DEVICES

Emerson's commitment to innovation is also evident in its smart devices, such as the AVENTICS XV Valve series. These valves deliver exceptional performance and reliability, with advanced features for precise control and easy integration into complex automation systems. The AVENTICS XV Valve series exemplifies Emerson's dedication to providing high-quality, advanced solutions for modern manufacturing needs.

INDUSTRY-LEADING EXPERTISE

Emerson's team of experts are dedicated to partnering with you to tackle any challenges or goals you may have. With a deep understanding of diverse industrial applications and a commitment to innovation, our specialists are equipped to develop customized solutions that address your unique needs. Whether you aim to enhance operational efficiency, reduce energy consumption, or achieve sustainability targets, Emerson will collaborate closely with you to design and implement the optimal strategy.

CONTACT US TODAY!

EMERSON

Go sustainability.
Go Boldly™

Emerson's IIoT solutions and analytics software detect compressed air leaks saving manufacturers over 20% in energy costs.

Learn more at **Emerson.com/Sustainable-Automation**

EMERSON™

Sponsored Content

WEB | https://exair.co/45lp
EMAIL | techelp@exair.com
TEL | 1-800-903-9247 or 513-671-3322

11510 Goldcoast Drive
Cincinnati, OH 45249

Manufacturing Intelligent Compressed Air Products Since 1983

EXAIR manufactures Intelligent Compressed Air® products that improve manufacturing processes which involve blowoff, drying, cooling, vacuum, lifting and static elimination. Since 1983, EXAIR products have been engineered to reduce compressed air use, reduce compressed air noise exposure and increase safety for personnel. Their staff of industrial process experts are familiar with a wide variety of manufacturing segments and offer help to individuals trying to find the most efficient and effective solution to their problem.

EXAIR's Engineered Air Knives offer a more efficient way to clean, dry or cool parts, webs or conveyors on your production lines. They deliver a uniform sheet of laminar airflow with hard-hitting force while remaining exceptionally quiet. Multiple lengths up to 108" and four materials are available. Super Air Knives are the most efficient compressed air knives on the market and provide the best performance with a 40:1 air amplification ratio. This amplification ratio allows it to have a low operating cost. Air Knives are available with everything you need to dramatically reduce your compressed air usage and lower noise levels when compared to other blowoffs.

Busy industrial environments often produce byproducts that can create troublesome messes. EXAIR offers a wide range of industrial housekeeping products to address this problem and keep your plant clean and running smoothly. The newest EXAIR vacuum, the **EasySwitch® Wet-Dry Vac**, simplifies the filter change process and is ideal for any application – wet, dry, light, or heavy. EXAIR industrial housekeeping products also include the Reversible Drum Vac, High Lift Reversible Drum Vac, Chip Trapper, High Lift Chip Trapper, Chip Vac, Heavy Duty HEPA Vac and Heavy Duty Dry Vac. These devices are engineered to quickly and quietly vacuum a wide variety of materials, easily transferring, filtering, and providing storage - all with no moving parts, low sound levels, and maintenance free operation.

Most of EXAIR's cataloged products ship the same day when ordered by 2 pm EDT. EXAIR products are made in Cincinnati, OH and can be modified to suit a specific application. All of the cataloged products have a 30 Day Unconditional Guarantee, a 5 Year Built to Last Warranty, and ship factory direct from stock.

Tech support is available by e-mail: techelp@exair.com, Phone: 1-800-903-9247 or (513) 671-3322, and Live Chat from our website **https://www.exair.com**.

HOME OF INTELLIGENT COMPRESSED AIR PRODUCTS

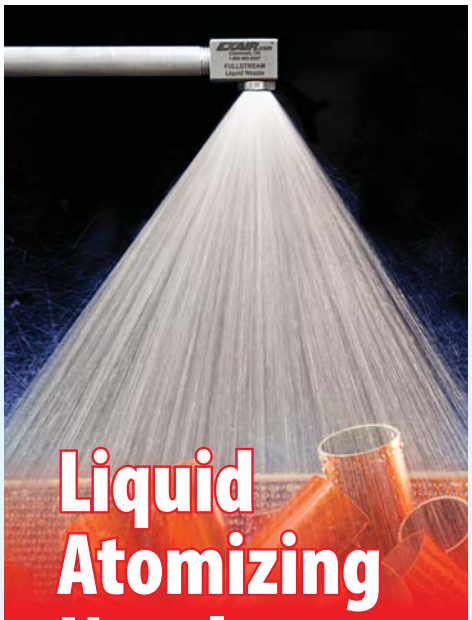
Broadest and deepest variety of engineered compressed air products to help you conserve energy & increase safety.

EasySwitch® Wet-Dry Vac

Makes the transition from a dry material vac to liquids with ease!

Benefits:

- Easy to switch from liquid to dry material
- Safe, no electricity. No motors to clog or wear out
- A quiet and powerful vacuum system (79 dBA)
- HEPA model available



Liquid Atomizing Nozzles

Pressurized FullStream Liquid Nozzles increase liquid flow for cooling, washing and rinsing!

Benefits:

- High liquid flow rates
- Increase liquid's surface area
- All stainless steel construction
- No compressed air required
- Compact footprint
- HollowStream also available

Cabinet Cooler® Systems

Stop electronic downtime due to heat, dirt and moisture A cleaner, more efficient way to cool!

Benefits:

- Low cost, compact and quiet
- No moving parts – maintenance free
- Stabilize enclosure temperature and humidity
- Class I, Class II and Class III Hazardous Location Models are also available

Contact EXAIR.com® today to keep your personnel safe, save money, and make your plant's compressed air efficient.

GOTO **www.exair.com/45/ourproducts.htm**

EXAIR® Manufacturing Intelligent Compressed Air® Products Since 1983

11510 Goldcoast Drive • Cincinnati, OH 45249-1621 • Phone (513) 671-3322 • FAX (513) 671-3363 • E-mail: techelp@exair.com • www.exair.com

CE

MEETS OR EXCEEDS OSHA REQUIREMENTS

blog.exair.com

Setting Standards for Mechanical Engineers

Machine Design's annual Salary & Career Survey puts forward a paradigm for the challenges facing engineering professionals. We interviewed Susan Ipri-Brown, president of the American Society of Mechanical Engineers (ASME), to gain deeper industry insights.

by Rehana Begg, Editor-in-Chief

MACHINE DESIGN regularly connects with industry associations to stay updated on career gaps and opportunities in engineering. This time, we reached out to Susan Ipri-Brown, president of the American Society of Mechanical Engineers (ASME), to discuss how ASME aligns its strategic plans with industry needs.

Our one-on-one with Ipri-Brown came at a perfect time. As we were in the throes of conducting *Machine Design*'s annual Salary & Career Survey, the conversation with Ipri-Brow touched on similar themes, allowing us to compare *Machine Design*'s survey findings with the insights that ASME gathers from its mechanical engineering members.

"ASME's mission is to advance engineering for the benefit of humanity, and our vision is really to be a premier resource for the engineering community globally," said Ipri-Brown, who stepped into the role of the society's 143rd president in June. "And to me, that means achieving a set of programs that empower engineers personally and professionally to create innovative solutions to today's challenges."

ASME started out by developing standards for the industry. "There were issues with boilers in manufacturing facilities, and they started by sitting down and writing the first boiler code," said Ipri-Brown.

Susan Ipri-Brown, President, American Society of Mechanical Engineers (ASME)

From those humble beginnings in creating safety and standards in 1880, ASME has grown to be a veritable professional convening space. The not-for-profit organization has more than 500 standards under its belt and more than 3,500 volunteers who are actively engaged in code operations and committee structures. The society has 85,000 members across the country and the world.

There was a strong synergy between Ipri-Brown's responses about ASME's members and *Machine Design*'s survey findings. Additionally, Ipri-Brown's perspective added much-needed context for some of the pressing issues that keep engineers up at night.

Read the full interview online at machinedesign.com/55249140.

Machine Design: **Can you talk more specifically about what ASME is doing to foster career development?**

Susan Ipri-Brown: Career development is vital. For engineers starting out, when we are in our engineering programs, we are taught to be problem-solvers and given that range of tools that hopefully will last us through the rest of our career. And as many of us are seeing now, jobs are continually changing. Students that are in school now are going to have job titles and areas that are not necessarily known at this point.

So, when we're talking career development, are we putting together learning and development programs? Are we convening our mechanical engineering department chairs to talk about what those skills are to give engineers, so that they are prepared for whatever their 30-, 40-, 50-year career is going to bring them?

One of our functions is convening. Part of the convening that the Society can do is to stay on that pulse of what's needed. What are the critical technology areas that we can then foster further collaboration or educational programs to?

The other thing that's happening in career development is looking at the range of skills needed. A lot of folks think of these societies, and they think of four-year degree folks, and that is certainly a strong area. But there's career development that's needed for technicians and engineers who are entering fields with a range of skills-development needs.

So we, too, are looking at community college programs and other training programs for reskilling engineers, so that there is a way to support this industry from a whole range of skills that are needed for industry to be successful in these critical technology areas.

MD: **Susan, I am recalling a stat from *Machine Design's* salary survey. We asked engineers whether or not there is a shortage of engineers, and the majority said, absolutely.**

SI-B: Yes, we're hearing similar things, and I think it goes back to the fact that careers are changing when new technologies come in. You see that a lot in the sustainability fields as we're leaning towards new, renewable energies. Not everyone, when we went through school, learned how to put together and work with solar panels or other types of services.

So, how are we putting together reskilling opportunities, learning and development opportunities so that engineers can say, "I want to move into a different field, but maybe I need to get myself up to speed on some skills." Additionally, there's a range of skills that are needed in industry right now, from technicians all the way through operators and engineers.

We are looking at our range of programs to make sure we're serving, starting in K-12, and making an awareness of these careers so that more people are interested in moving into the technical

fields. We're working within community colleges; are they resourced and understanding what industry needs are? As well as through four-year programs and graduate programs. We have to look at the entire pipeline and see what the training and reskilling needs are. And we need to be there at the forefront of those programs.

***MD:* One other observation from *Machine Design's* survey was that respondents expressed that their organizations were having difficulty finding qualified candidates. What new skills does industry need to seek out to fulfill that multidisciplinary approach that will allow engineers to be versatile?**

SI-B: I think you're exactly right in bringing up multidisciplinary because innovation is needed where there's a challenge for society. And it's not necessarily in that stovepipe of mechanical or electrical; things are interconnected. So, at a foundational level, yes, our engineering education needs to stay focused on: How do you problem solve? How do you understand these solutions? But what's really transforming it is digital transformation. It's data. Two of the key things that we're seeing are AI and the need to understand data analysis.

Right now, there's not necessarily a problem with getting enough data. The problem is too much data. There's data collected everywhere. And do engineers understand how to collect the right data? How do you analyze that to move forward to solve [specific] problems?

And with AI coming in, that is just going to be an amazing tool for engineers. It's going to transform the way that we do our jobs. And to understand what that tool can do is going to be important.

I think all these pieces about digital and data are where we need to make sure our engineers are ready to go in and use those tools, because that's going to be universal across so many different industries.

***MD:* I've been traveling to various trade shows and conferences. What I take away is a message that bubbles up: The future will be software-driven. How does a mechanical engineer define digital transformation? What impact does digitalization have on the fundamentals of component design?**

SI-B: I think the fundamental needs for an engineer to look at a challenge and need to come up with a product or a process to solve that challenge is still there. Innovation comes into how you are going to do that, how you are going to create something new that's going to solve that problem or create that new process. And when we look at what digital transformation means to do that, it is: how are we going to come up with that innovative solution? And how do we understand how AI can boost our productivity?

That again comes down to data. Do you know how to collect the data that you really need, and then use that data to improve your processes? Are you able to look at AI as a collaborative tool? Do you understand what it means to use AI? What is the data you want to put into that AI model? What is the data that you then want to get out?

And how do you work with the engineers on your team to say, what do I want that result to be? And in some cases, it may be, for example, on an industrial floor. Well, AI is going to let me find patterns in my repair schedule or help me find patterns in our testing, and jump you forward with an understanding of changes that you might need for your line to be more productive. Or to help jump forward in the levels of prototyping.

So, I think AI for engineers needs to be about where the points are in my design process and where I really could use a deeper understanding. Or in our manufacturing process, where are the points that we can better understand what's really happening, and use that to transform how we do our business. We're going to see digital twins and other models like that that are going to allow these systems to be back and forth with our designs and our processes and being able to react more on real-time data, make changes that we need to improve our production.

And engineers are not going to get replaced by that. They are going to be supported by that. I think the more that an engineer embraces that and sees how it's going to boost their productivity, the more integrated these tools are going to be able to bring success for us.

***MD:* ASME has made some DEI gains, specifically with your Board of Governors. Tell me about that.**

SI-B: ASME is committed to being a welcoming and inclusive society for all engineers. Diversity, equity, inclusion, access and belonging are to us not just visions. But they're imperatives. And we are developing programs around that for this fiscal year. Yes, we figured that has to start at the top. So, this is the first year that, on our Board of Governors, we have equity in men and women serving on the board. That's an exciting milestone to reach.

But for me, that is just the beginning. That is just the model of what's possible. Throughout the year we're doing a campaign on celebrating gender diversity but also looking at what are the pieces that we can do all the way through the Society to bring that gender equity, as well as inclusivity, in any different measures across all our conferences. There are several conferences that have a "women in engineering" session, so that when they're there you can start to have some mentoring and convening going on there.

We have a five-year $50 million-dollar fundraising campaign called the Campaign for Next Generation Engineers that is looking to double the number of women and minorities in engineering by 2030. Also, we are looking at mobilizing a global set of engineers to innovate in sustainability.

So many of the different pieces within engineering are designing for sustainability, then putting into place sustainable solutions as well as then recycling and other reuse type of efforts within the profession. For us, DEI is something that we are looking across everything that we're doing. And at the Board level, we're there to kick things off. But it doesn't end with just having the Board having gender equity at this point. ■

Sponsored Content

FLOYD BELL INC.

WEB | www.FloydBell.com
TEL | 888-FLOYD-BELL
FAX | 614-291-0823

720 Dearborn Park Ln.
Columbus, OH 43085

FLOYD BELL INC. is an American manufacturer of high-quality audible products. Known best for the Audiolarm line of piezoelectric alarms, our products are made to withstand harsh industrial environments and provide audible alerts in loud ambient noise environments. In addition to piezo buzzers, Floyd Bell also manufactures panel-mount LED indicators (Turbo Light) and Combination light & alarm products (Twin Turbo). Most recently, we have developed the Announcer line of products, which are pre-programmed speakers capable of storing and playing high-quality audio and voice alerts.

Floyd Bell Inc. has become the world's leading piezo electric audible alarm company. Our alarms are omnipresent. For example, they can be found on every ocean, lake, and river around the world. Our agriculture and farm machinery alarms help plant and harvest the planet's crops. Our recreational alarms can be heard on almost every golf course, amusement park, casino, and arcade. Our public utility alarms are found in most major power plants, as well as water and sewage treatment plants. Our public transportation alarms are found in most of the world's airports, as well as in bus, rail and subway terminals, and the vehicles that serve them.

Our restaurant equipment and foodservice alarms are found in most major hotels and restaurants. Our construction equipment alarms are found at most building sites. Our automotive and truck alarms are found on practically every highway. Our electronic telephone ringers are found in communications equipment, including that aboard Air Force One. The United States Air force, Army, Navy and Marines also use our alarms. And finally, our products have helped NASA explore beyond our world.

Customer satisfaction is our most important asset and the primary reason for our success.

Our staff is dedicated to extending our tradition of excellence to customer service, product design, and manufacturing.

Floyd Bell Inc
SOUND SOLUTIONS

GETTING YOUR ATTENTION is our job.

LOUD & BRIGHT attention-getting devices.

AN-454 Announcer

Floyd Bell offers an Extensive and Diverse Line of Products

Announcer	Programmable Speakers in both panel-mount and stand-alone styles. **Up to 115dB!**
NEW! ***CAN Alarm***	A large, super-loud intelligent alarm that can be controlled on any **CAN J1939** network.
Audiolarm	The most widely-used industrial piezo alarm in the world.
M-80	The original high-output piezo alarm in a **small footprint**.
Turbo	Small, front-mount panel alarm that is half-the-size and twice-as-loud as industry counterparts.
Turbo Light	High intensity panel LED indicator available in **5 different colors**.
Ultra	A rear-mount piezo alarm that is **12 dB louder** and **1000 Hz lower** than industry counterparts.
Twin Turbo	A panel mount lighted piezo alarm that combines **bright light** with **loud sound**.

For our complete line of products, visit **www.FloydBell.com** or call **1-888-FLOYD-BELL**

Floyd Bell Inc

Sponsored Content

HARMONIC DRIVE

WEB | www.harmonicdrive.net
EMAIL | sales@harmonicdrive.net
TEL | 978-532-1800

Beverly, MA Headquarters

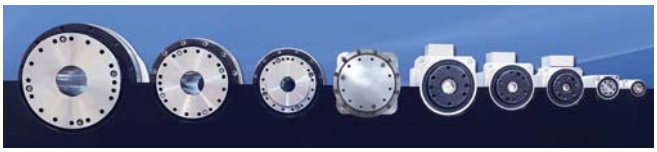
Mission Statement: Harmonic Drive's mission is to provide motion control solutions that give our customers a competitive advantage. To accomplish this, we continually invest in the growth of our employees and in our company's capabilities.

What we do: Harmonic Drive® is a market-leading provider of precision motion control solutions for OEMs, serving a variety of medical and advanced industrial markets. Harmonic Drive designs and manufactures an extensive selection of standard and custom engineered servo actuators, gearheads and gear component sets that help customers solve challenging motion-control problems.

With over 60 years of experience and innovation, Harmonic Drive developed and patented a break-through motion technology, ushering in a new breed of high precision, zero backlash strain wave gears. State of the art manufacturing facilities in the US, Japan and Germany enable us to serve the needs of our customers by providing high quality service and reliable support around the globe. Degreed sales engineers, who specialize in motion control, work closely with customers on their most ambitious projects, providing custom designed solutions that help to deliver their projects to market with confidence.

Global Manufacturing and Engineering: The Harmonic Drive Group Companies are comprised of Harmonic Drive LLC (United States/Canada), Harmonic Drive Systems, Inc. (Japan) and Harmonic Drive SE (Germany). Our shared core values, product portfolio and quality standards enable us to be consistent with keeping our product and service delivery standards exceptionally high. With state-of-the-art manufacturing facilities in the US, Japan and Germany, we are able to deliver high-capacity manufacturing, by leveraging regional supply chains and utilizing global time zones to optimize production capabilities.

NEW PRODUCT:



Integrated Actuators are now available with CANopen® and EtherCAT® communication protocols.

APPLICATIONS:

Medical: Surgical Robots, Medical Imaging – CT Scan, Therapeutic, Prosthetics, Laboratory Automation and Exoskeleton

Robotics: Industrial Automation, Service Robotics and Humanoids

Semiconductor: Wafer Handling, Flat Panel and Packaging

Aerospace: Satellites, Lunar and Interplanetary Rovers, Solar Array Panels, Antenna Pointing and Valve Actuators

Defense: Unmanned and Manned, Air and Land Vehicles, Weapon Systems, Antenna Pointing

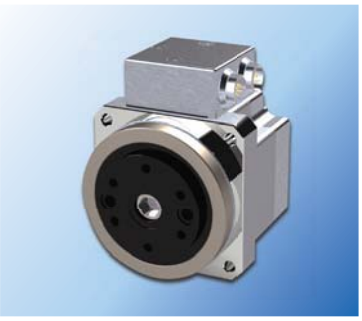
Machine Tools: Milling Head, Tool Changer, Rotary Table, Grinding, B&C Axis on a Variety of Machine Tools

NEW

Simplify.

Rotary Actuators with Integrated Servo Drive

Simplify your Design with our New, Innovative Family of Compact Rotary Actuators with Integrated Servo Drive!



The Servo Drive is Inside!

The Integrated Servo Drive Actuators (IDT) is a series of compact rotary actuators with an integrated servo drive with CANopen® or EtherCAT® communication. They deliver high torque with exceptional accuracy and repeatability, and feature Harmonic Drive® precision strain wave gears combined with a brushless servomotor. This innovative product line eliminates the need for an external drive, while simplifying cabling requirements, yet delivers high-positional accuracy and torsional stiffness in a compact form factor.

- Actuator with Integrated Servo Drive utilizing CANopen®
- 24 or 48 VDC nominal supply voltage
- A single cable with only 4 conductors is needed: CANH, CANL, +VDC, 0VDC
- Zero Backlash Harmonic Drive® Gearing
- Panel Mount Connectors or Pigtail Cables Available with Radial and Axial Options
- Control Modes include: Torque, Velocity, and Position Control, CSP, CSV, CST

All Integrated Actuators are CANopen Certified. Selected Sizes are EtherCAT Ready.

HD® HARMONIC DRIVE | HarmonicDrive®

42 Dunham Ridge, Beverly, MA 01915 | 800.921.3332 | www.HarmonicDrive.net

Q&A: AVEVA's Chief Product Officer on Tapping into 175 Zettabytes of Data

Rob McGreevy discusses AVEVA's radical collaboration approach for enabling industrial companies to rev up their intelligence.

by Rehana Begg, Editor-in-Chief

IF DATA IS the new currency, what makes a company stand out among the many industrial digital enterprises shaping the digital economy?

To answer this question, look carefully at how they go about building data connections between the people, businesses, devices, equipment and processes. For those that evangelize digitization, hyperconnectivity is the backbone. Their distinction and success, however, lie at the intersection of tracking, monitoring, listening, watching and continuously learning.

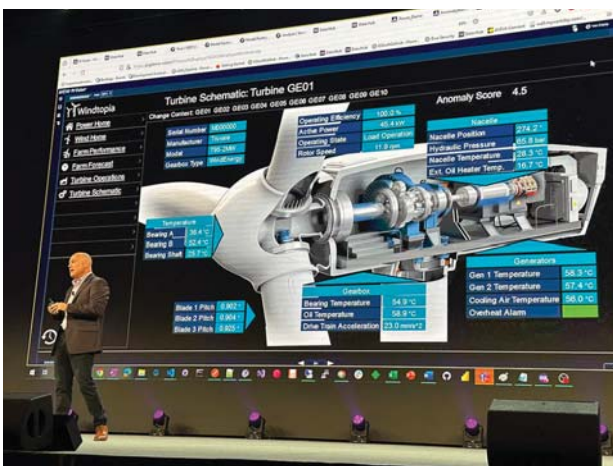
Integrating data is at the forefront of everything we do. The International Data Corporation (IDC) forecasts the amount of data created, captured, replicated and consumed will reach 175 zettabytes by 2025.

For software companies like AVEVA, capturing the opportunity means embracing digital platforms; investing in innovators, artificial intelligence and emerging technologies; and expanding its ever-growing ecosystem. The UK-based software company was acquired by global automation and energy management specialists Schneider Electric in 2023. To date AVEVA has preserved its business autonomy and strives to become the go-to SaaS provider of software and industrial information.

In the interview below, Rob McGreevy, AVEVA's chief product officer, explains the company's "radical collaboration" approach to data-centric physical asset management.

***Machine Design*: During your presentation at AVEVA World 2024 in Paris, you stressed that the global industrial sector increasingly relies on data to maximize business value. You also said that data as a resource only truly becomes useful when it is extracted, processed and delivered to the right people at the right time, securely and in context. Can you elaborate in more basic or practical terms?**

Rob McGreevy: We could take it down a level to machine building and equipment manufacturers. For example, all elements of how you decide to design the next generation of machinery, construct and build it, and then turn it over into operations are changing as a result of digital transformation. So, what does that actually mean? It means that all machine designs are built digitally. In this database, you will essentially simulate and model how this [machine] could behave based on certain outputs.



AVEVA's open digital platform spans the entire industrial lifecycle and is touted for enabling tasks such as real-time data acquisition, visualization, system reliability and performance optimization. *All images courtesy Machine Design*

That transitions into an actual design engineering environment—a CAD tool—where you create a model of the environment that you're using, or of the machine you're building. And then that digital twin, that digital definition, starts to make its way into the operating world, where the machine actually gets built and constructed and then ultimately turned over to a customer who's going to use it to produce finished goods, palletizers, case packers, whatever the machinery of choice is.

The other piece is that that digital twin continues. So now that the machine is producing finished goods, it's capturing telemetry and data, vibration, thermal, temperature—whatever it may. Ultimately, that information needs to make its way, not only to the customer because they use that to help produce finished goods, but that information can also make its way back to the machine builders to inform on future designs to improve the machinery as you get real-time information about how it performs in the field. This closes the design simulation loop for machine builders.

The other thing you can do is open avenues of growth for machine builders and OEMs and equipment manufacturers to create new business models, where you start to monitor and maintain the health and well-being of that machine on behalf of the customer. So those can become value-added services.

And in this case, the machine itself becomes a fully digitally defined, living (if I can use the term), piece of equipment that continues this constant loop of design, engineering and optimization. It is not just building machinery that you turn over to a customer. It becomes a collaboration between machine builders and customers to actually drive improvements to ultimately make and manufacture better products.

MD: **Referencing themes you unpacked during your presentation—about radical collaboration, advanced technology and responsible resources—how do these factors support AVEVA's conference theme of "Generating Impact?"**

RM: A lot of different themes to unpack there, across radical collaboration, across sustainability and the responsible use of resources to meet those demands. And, of course, advanced technology, which is largely what we're talking about.

Radical collaboration is about engaging the community at large in industrial manufacturing critical infrastructure to help solve these enormous problems we're all facing: the energy transition, the increasing demand for power, the need to manufacture goods at a rapid pace, distribute those in an interesting and sustainable way. So, the entire value chain of producing finished goods and manufacturing things requires this idea of radical collaboration.

And the "radical" just means that it's going to take basically all elements of that value chain working together to achieve the demands of the future. Energy is the easy one. It's daunting; the amount of energy that we need to meet the demands of the future is significant. At the same time, we're trying to decarbonize those things and create a more sustainable future. That again becomes a confluence of things.

The responsible use of resources—not only from the energy side…but water, air, steam, gas, electricity—these are all elements that the resources in many cases. Electricity, of course, is finite. It's expensive. We just talk about the demand for it. So better managing that in a responsible way is top of mind for manufacturers, and frankly, anybody in the world today.

Water is another one in a lot of places in the world. Water is a scarce resource, and so more effective use of the world's resources to manufacture finished goods, to operate infrastructure—such as data centers that use a lot of electricity, need water for cooling. That's what we mean by responsible use of the world's resources. Yes, to achieve radical collaboration and transform the industry and the markets that we serve, we need to do that in a responsible, sustainable way.

And the last point on that, the last pillar on that, is advanced technologies. How can technology help us meet these objectives, if you like, or these goals? And technology has a huge role in that. On the radical collaboration side, we use technology to bring people together, to collaborate, to capture tribal knowledge, as we were talking about a bit earlier in the day.

That is the expertise that's manifest in the workforce, the everaging workforce. And how do we digitally capture that using advanced technologies and synthesize that captured information and make it available for another generation, the newer, early careers generation that's going to take on the energy challenge and the manufacturing challenges.

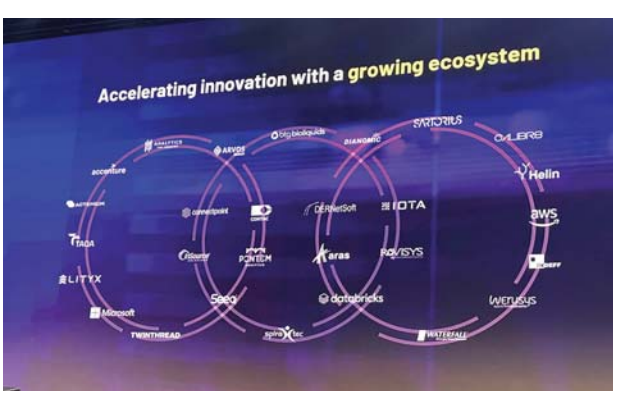
A lot of the other technologies that we talk about are enablers for this. So, enabling rapid collaboration is one thing, but using technologies like artificial intelligence (AI) and different permutations of that, like predictive and prescriptive analytics to help better guide and inform the workforce to better optimize machinery and productivity and throughput.

Visualization technologies like augmented reality, virtual reality, 1D and 2D information can help us envision the manufacturing infrastructure world around us and better interact with it, in a sense. And I think the concept of all this being backed by Big Data, 1D and 2D and 3D information, process, production information all come together, and we synthesize and use that data to drive all those different improvements. And so, those are maybe the highlights for those key pillars that we talked about earlier.

MD: **Talk about some of AVEVA's products that help facilitate those pillars.**

RM: We talked about digital transformation and what that means. We talked about some of the key tenets of these radical collaborations, responsible use [of] the world's resources and sustainability, and, of course, tech for us. That all comes together in CONNECT, AVEVA's industrial intelligence platform. It's a software capability, a platform. It's an open and neutral platform, and vehicle to enable all these amazing things that we're talking about.

It enables interoperability with lots of systems and sources across the value chain—that's design systems, planning systems,



AVEVA's industrial intelligence platform is built on Microsoft Azure and integrates with critical infrastructure and manufacturing assets.

simulation systems, production execution systems, maintenance and reliability systems. It amalgamates or integrates all these different pieces in the spirit of radical collaboration.

It's built upon the tenet that our partner ecosystem, which is made up of thousands of experts, ISVs [independent software makers], OEMs, system integrators, value-added resellers, all participate in this. They use CONNECT technology and applications to deliver the last mile of innovation, manufacturing and critical infrastructure.

CONNECT is really the embodiment of all these tools and technologies that transcend the design, build, operate and optimize lifecycle that exists amongst the critical infrastructure and manufacturing markets.

***MD:* What exactly is feeding the rise of open-source solutions?**

RM: There's a lot of talk about openness in general—open systems, open standards, open source, as far as code goes. And I would just say, open collaboration amongst the peer groups and sharing data and things like that. This openness concept is fueled by a number of things.

One is, I just think there's a realization that to solve these problems, what we face as an industry and as a species, if I could use that phrase. It's going to take a community; all the great minds that we have. And so, the way to fuse together the great minds and intellect is through sharing and collaboration of ideas.

So, open exchanges of ideas, exchanging information in our world about machines and equipment is about exchanging information about performance, of how machines perform. How do they consume electricity and water and steam and air and gas and resources?

That open mindset of sharing that information, those systems and those sources amongst a broader peer group, we think will enable rapid acceleration and progress for the industry and for the markets that we serve. And hopefully, leave the planet a better place than we found it one day.

***MD:* So, is cost no longer the main motivation for open systems, or for agnostic systems?**

RM: Yeah, I think it's more than cost. I mean, certainly, people look at open systems as being a cost-sensitive thing, but in the end, you still are going to pay for that technology in one way or another. But I don't think it's necessarily about cost. The focus is really on innovation and results, and the best way to make that happen is through open and collaborative approaches.

But it doesn't mean you can't monetize those things as a manufacturer, as a producer, as a machine builder. I think the openness is more about rapid innovation, exchanging data and ideas to help move things forward. But certainly, cost comes up quite a bit. I think cost reduction is almost a benefit of implementing these practices in the long run.

Rob McGreevy, chief product officer, AVEVA, announces the advancements in AVEVA's CONNECT data services at AVEVA World 2024 in Paris.

***MD:* To follow up on the limitations of open systems and agnostic/interoperable over closed-looped orchestration. Certainly, companies make the decision on going one way or the other. AVEVA proffers open systems. But that doesn't mean that open orientations don't have challenges.**

RM: Yeah, so we're talking about open systems. There is a huge challenge. Applying open systems to manufacturing critical infrastructure means participating in hundreds of different systems that make up manufacturing or utilities. These systems and sources have different brand heritages, different protocols, different rules for interoperability.

We've made a history of doing that. We've been an open and neutral software company for more than 30 years with hundreds of different devices and protocols and drivers that interoperate with these different systems and sources. We've got a long history of making these open systems neutral and agnostic.

One of the challenges that you face with that is it's quite expensive and costly to manage and maintain all these different protocols and systems. Because, if you're going to bring all these sources together, bring together the elements of that value chain, you must understand the protocols that exist between them and how those systems behave and interoperate. Another challenge is complexity. But we've been doing this for a long time, so we think we have a good sense of how to do that in the industrial and manufacturing markets.

The other challenge with open and neutral could sometimes be that you lack specificity. What I mean by that is, if you build one machine or one piece of equipment and you just focus on that, you can make that perform at incredible rates or very high rates or make it highly specialized. But again, machinery and equipment don't exist in a vacuum. They are participating in a production line, inside of a plant, inside of a network of plants, inside of a utility grid.

And so, I think it's interesting to note that in the world that we live in, everything is hyper-interconnected. The challenge is there about making sure that your systems are optimized with

specificity but remaining open to the outside world is going to become an increasing necessity. And so, the case for open and neutral is quite strong, and companies that create closed systems will find themselves probably not able to participate or compete as much in the future.

***MD:* What about AI as a tool? Is it something that is being bolted onto existing technologies? Or does AI become its own revenue stream in itself?**

RM: Great question. Is AI a standalone product or a bolt on? I don't think so. I think AI becomes infused in all the things that we do in everyday life and then in the industrial world and thinking about machine building or equipment. If you think about the design process, we'll infuse AI to help create better designs, better use of wiring systems and wiring guides, better use of piping, better use of different materials, for example, because AI can run scenarios and generate different sequences far faster than humans can.

AI won't replace humans. It'll just become a tool to help designers and engineers build better optimal configuration. AI, in that case, is infused in the design process. The same thing occurs in the construction process, when you start to procure materials and construct and build things. AI can also help there with managing schedules, looking at delays, looking at supplier management challenges and such.

Then on the operational side, AI also gets infused in the press practices to identify anomalies. "Hey, this vibration pattern doesn't look normal," or "Hey, this heat profile doesn't look right." Therefore, you might have a problem with this machinery, or begin to identify patterns of increased productivity, like, if we run these machines at this particular set of parameters, we know we can get better output.

AI becomes infused very much in all elements of life and in our world, all elements of our software, infusing the AI technologies to help empower the employees and the people that use our software every day.

***MD:* Consider AVEVA's latest announcements such as the partnerships with Vulcan Energy Resources, a lithium company with a carbon neutral footprint, and with Oxford Quantum Circuits on delivering quantum computing services. What do they mean for AVEVA's ecosystem? How do these relationships connect with AVEVA's ecosystem?**

RM: It all comes together through CONNECT. That's the easy way to think about it. CONNECT is the inflection point at which all these different pieces come together. It's built atop open technology standards and tech stacks and platforms like Microsoft. What we do with Microsoft Azure is add domain and industry specificity that doesn't exist in Microsoft.

What we do with partners, companies like Schneider Electric, for example, is extend the value of Schneider Electric's electrical capabilities, for example, or industrial controls capabilities into CONNECT. Customers that want to take advantage of Schneider's electrical tools capabilities and offers can do that through CONNECT.

And that extends to our partner ecosystem. All the other partners that have solutions, capabilities, delivery services, value added capabilities, all plug into CONNECT and offer their solutions. And it becomes this web, if you will, around CONNECT, this platform through which we bring together this community of experts and companies at large.

***MD:* Final question: You have an interesting background in journalism, communications and computer science. What skill sets should engineers and the future workforce focus on now to help kickstart their careers and secure a path to staying gainfully employed?**

RM: I guess my background is different from this industry, and the way I got into it was, I'm a career hobbyist. Curiosity is my specialty. I'm super-curious about all things in life. Technologies are one. From a very early age, I got involved in building computers and doing networking before the Internet existed. I'm afraid it ages me a little bit, but I've always managed to just pursue my interests with a voracious appetite and to constantly learn.

My background is atypical, but my hobbyist interest in technology and my ability to apply that to solve problems in the real world were what got me into this industry and helped me get to where I am today. What I would suggest to people is: Curiosity is No. 1. Be curious. Go after [your goal] by learning with relentless pursuit.

> *"If I had to give advice here, start with the foundation in STEM, finance, computer, wherever your interests lie. Follow your curiosities and just be relentless in continuing to learn how to learn, because the world moves at such a fast pace."*

My background, 20 or 30 years ago in school, was interesting, but in a lot of regards irrelevant. Think about artificial intelligence and all these [advancements]. Irrelevant is probably crude. Of course, my education was a building block for me. What mattered is what I learned over the last 10, 15, 20 and 30 years. In my experiences, I constantly learn the new trends, new technologies, new commercial business practices.

If I had to give advice here, start with the foundation in STEM, finance, computer, wherever your interests lie. Follow your curiosities and just be relentless in continuing to learn how to learn, because the world moves at such a fast pace. If you want to advance in the modern-day world you have to continue to keep updating your script, your skills. Be evergreen and updated. ■

Q&A: Joe White on Advancing Mobile Computing and Digitizing and Automating Operations

Joe White has three decades of product development experience. He talks about Zebra Technologies' adjacent market expansion.

by Rehana Begg, Editor-in-Chief

BEST KNOWN FOR its rugged label-making and tracking technology such as barcode readers and mobile scanning devices, Zebra Technologies has an expansive industrial workflow portfolio that spans software, innovations in robotics, machine vision, automation and digital decision-making.

If one asks Joe White about the company's go-to-market platform, he unwaveringly highlights three pillars: asset visibility (giving a digital voice to assets that are operating through the supply chain), connected frontline workers (recognizing the needs of the people) and intelligent automation (automating workflows).

These three areas are the culmination of a 55-year history, dating back to the days when it operated as Data Specialties Incorporated, a manufacturer of high-speed electromechanical products. A string of acquisitions has followed since and the company's ecosystem today extends to 10,000 partners across more than 100 countries, pointed out White when interviewed at Zebra Technologies' R&D facility in Mississauga, Ontario.

Deeply Embedded Knowledge

As chief products and solutions officer, White leads the adoption of new enterprise technologies, overseeing the strategy, investments and development of Zebra Technologies' expansive portfolio.

He comes by his role honestly. Despite graduating with a bachelor's degree in accounting from the University of Maryland, a deep personal interest steered him towards a technology-driven career. Through determination and grit, White honed his technical expertise by attending night school to master programming and by securing roles that fostered growth along the way. He taught himself to program when he was an accounting system analyst at a law binder company. Then, when the Internet was still in its nascent stages, he seized an opportunity at Digex, the first web hosting company in the world, effectively paving the way for his journey into the evolving digital landscape.

Joe White, Chief Products and Solutions Officer, Zebra Technolgies

"I studied to become a network engineer and to be able to program routers and networks," White said. "That was fun, because nobody knew that."

A move to an Internet company that deployed Wi-Fi and internet infrastructure at hotels across the globe was a bridging role to Matrics, whose founders were "really smart people from DARPA," and built some of the first RFID technology that eventually went to Walmart. "That company was eventually acquired by Symbol Technologies in 2004 and grew up through Motorola," White recalled. "They said, 'Hey, Joe, we need help building the silicon for RFID tags.' I said, 'I don't know anything about silicon, but I'm booksmart, so I'll go figure it out.'"

No matter who drew the other in, the succession of roles laid the foundation for the responsibility he now holds at Zebra Technologies.

***Machine Design:* With all the acquisitions over the years, what is the glue that holds the various technologies together?**

Joe White: Those three pillars are our five-year plan. That's how we're looking at making investments at a portfolio level. When you talk about product portfolio and how I allocate capital and how I invest in the portfolio, we have our core portfolio, which tends to be the anchor of what Zebra does. And by core portfolios, printing, barcode scanning and mobile computing tend to be the anchors. That's what we've known for over the past 55 years. So that tends to be the anchor point.

But you'll see we've looked at how to leverage that core portfolio, and how to expand—near and adjacent. I look at it from the lens of, "how do I deliver more value to our customers?" And by doing so, "how do I deliver technology and capability out of the portfolio?"

So, when you look at an adjacent market, think about tablets. We were the world's leader in rugged handheld mobile computers with over 50% share of the global market. And what we heard from our customers around the 2018 timeframe was not only do I want to collect information at the edge, but I also want to process it at the edge.

And where a handheld might be more about collecting data, a tablet form factor, how about: How do I give a manufacturing operator real-time visibility into what his machines are doing, and give them that data on a big enough real estate so that they can look at the operations and understand what's working well and what's not working? So, tablets became a good example of that near adjacency.

Another adjacency would be supplies and smart sensors. We've had a long supply business, but we look at expanding those into new categories of sensors and smart supplies. And, not just being an asset tracker, but also giving the condition, the temperature, the environment that you're seeing in that in that world. RFID fits in there. How do I place RFID technology and deliver real-time track and trace through my supply chain? Those would be good adjacencies that we've invested in over the years.

The third, if you think about a concentric horizon that I look at, is the expansion businesses. You see a lot around machine vision, robotic automation, software for the connected frontline worker.

Those are opportunities where we can deliver expanded value to our customers and grow. That's why, when I look at intelligent automation, it's really a growth pillar for the longer term. But that's how we think about portfolio investments as a whole.

***MD*: I wonder if you can expand on your "adjacent market" approach by walking me through one product and how it is being applied in warehousing and distribution, manufacturing, throughput or healthcare verticals?**

JW: Historically, we've always played in the supply chain side of manufacturing. So, as I receive components coming in the dock door, they're typically labeled with Zebra labels. They're scanned with either a mobile computer or a handheld scanner. And then they go into the factory line and the assembly. If you look at how we've added technology through that journey, how do I get replenishment into my factory lines? Well, I could use an AMR (autonomous mobile robot) to be able to take goods to the assembly line and prevent people from walking away from factory lines in real time. This is how we're deploying some of the robot technology.

When you think about how to get real-time quality inspection: We had an investor day a couple months ago, and I did a good example of the journey of a sneaker through its lifecycle all the way from factory floor to being delivered to your doorstep. And Zebra interacts with that product about 30 times during that journey. It really starts in that factory environment of receiving product but also doing 3D inspection to make sure it's the right product being shipped to the right person. It could be RFID tech to track and trace visibility; not only to the delivery point, but back through the return point if it ever got returned. So, you can see how in the factory environment we touch the product multiple times as we go through the manufacturing team, warehouse and distribution.

Zebra Technologies designs and manufactures small parts wearable scanners that give workers a productivity boost. Innovative back-of-hand design delivers a level of comfort and dexterity. *Zebra Technologies*

We've had a long history in warehouse distribution. If you look at our first mobile computer product, the MC 9000—which is probably the most iconic rugged mobile computer in the industry—it started in warehouse distribution. And, in fact, it really was a combination of technologies. Consider Wi-Fi technology. We created the Wi-Fi symbol back in the day. We gave it up by giving it to the Wi-Fi Alliance, which owns the critical patents for that and to enable the mobile computing market and create a market where you can mobilize compute power at the edge.

This enables receipt of goods in a warehouse environment. You could scan a pallet and know all the products coming into the dock door and where to put it away in the operations. And then we do vehicle-mount computers that sit on the forklifts, that actually take it from the dock door to the put away location and actually put it in a rack.

We do warehouse environment picking fulfillment. Our wearable technologies—we had the first wearable computer in the market. Our WT 6400 is our latest one. That product with ring scanners is used universally across warehouses for doing picking fulfillment operations, where if you have an order for company XYZ, it enables one to grab each item from all the different aisles and put it together on a pallet to ship to them. And that's often done using our technologies.

And then some of the latest. We're also using our machine vision capability and technologies to dimension those pallets and to understand what's being shipped out the door. Then, after you've received it, you're now staging it. You might be cross-stocking it. You might be taking it out to the dock door to ship to an end customer, or to a healthcare environment, where you're delivering products and goods into a healthcare environment.

In a healthcare environment, this is actually a good growth category for us overall, as we mobilize nurse clinicians to do patient-care work within a hospital. So, as a patient, when you check into a hospital, what is the first thing they do for you? They give you a wristband. That's a Zebra-printed wristband. It enables track and trace visibility through your entire journey at that hospital. When a nurse comes to your bedside to administer medications, what does she do? She takes our HC50 product, scans your wristband, verifies that you're the right patient. She scans the medicine, verifies the right medicine with the right dosage gets administered to the patient. That's what we do around patient care.

Zebra really plays a critical role—forget about manufacturing to your home—but manufacturing all the way to point of care. We play a critical role. I often tell people, "We're the technology that you see every day, that you don't know who it's from. ■

Sponsored Content

WEB | www.igus.com
EMAIL | sales@igus.com
TEL | 800-521-2747

257 Ferris Avenue
Rumford, RI 02916

HIGH-PERFORMANCE POLYMER SOLUTIONS & TECHNOLOGIES

igus® develops industry-leading plain, spherical, and linear bearings made from polymer materials along with plastic cable carrier systems and continuous-flex cables.

igus' tribologically optimized polymer blends consist of base materials for wear resistance, reinforcing fibers for high forces, and solid lubricants that eliminate the need for external oil and grease. In addition to being dry-running, igus' polymers are maintenance-free, lightweight, and resistant to dirt, dust and chemicals.

igus works with customers to find the best, most cost-effective solution for all applications via online chat, phone, email, or on-site. Online tools and lifetime calculation, custom part manufacturing, prototyping, testing, and more is available.

igus has been manufacturing engineered plastics for 60 years and develops all of the technology and materials behind their products. The family-owned company is committed to using its innovative materials to develop creative solutions and exceed customer expectations while delivering fast, accurate service.

igus centers their business around four main product lines focused on the idea of "motion plastics":

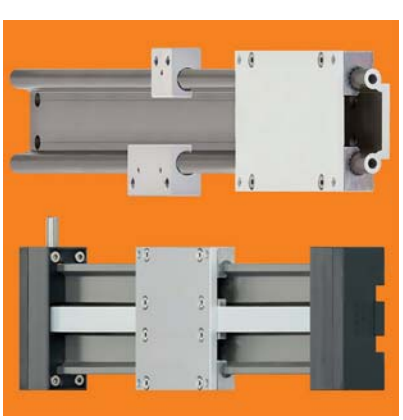
- e-chain® cable carriers
- chainflex® continuous-flex cables
- iglide® dry-running bearings
- drylin® linear bearings and guides

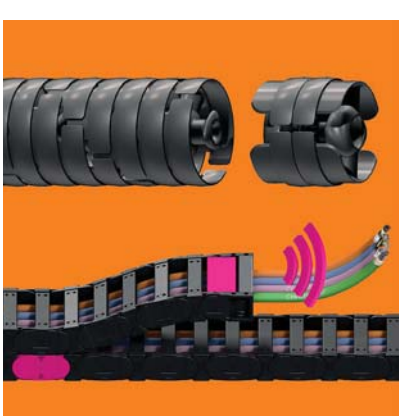
igus extensively tests all of their products under real-world conditions in a 41,000-square-foot testing facility in Cologne, Germany. Data from these tests power various online tools to help customers spec the best materials and parts for their application. With over 80,000 products in stock within their Rhode Island warehouse, igus is able to ship up to 96% of orders within 24 hours.

In an effort to make automation more accessible to small and medium-sized businesses, igus launched the RBTX marketplace, an online platform for automation components and complete solutions. Products from leading manufacturers can be mixed and matched with compatibility guaranteed, and free testing and consultations are available to make integration as simple as possible.

The igus team of sales engineers is available coast to coast from 8AM to 8PM ET, along with a dedicated team of technical sales experts located across North America for quick on-site assistance. igus also offers complimentary online CAD files and free products samples.

As a producer of plastic components, reducing environmental impact is a primary focus for igus. To that end, igus recycles and reuses 99% of their plastic waste and has also made the switch to green electrical and climate-neutral gas with plans to reach CO2 neutrality by 2025.





innovate **without** boundaries

With igus, you can set the standards of tomorrow. Our innovative polymer components have long been used to solve difficult design challenges and redefine what's possible. Now, we're taking the next step into the future – **and we want to bring you along with us.**

Discover ways to optimize your application with the AI-powered igusGo app. Configure parts, predict service life and instantly place your order with our range of tools. Request a visit in the iguverse with one of our experts. **Whatever your needs, we're here to foster your dream.**

igus.com

Sponsored Content

KEYSTONE ELECTRONICS CORP.

WEB | www.keyelco.com
EMAIL | kec@keyelco.com
TEL | 800-221-5510
FAX | 516-328-1080

QUALITY INTERCONNECT COMPONENTS AND ELECTRONIC HARDWARE

Leading-edge technology and precision manufacturing have defined Keystone's performance as a world-class manufacturer of precision electronic interconnect components and hardware since 1950.

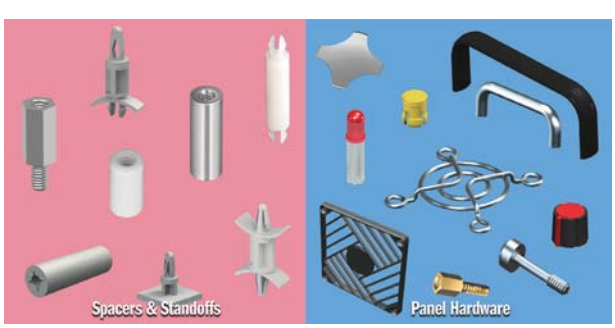
We manufacture precision stampings, in metallic or non-metallic materials for all industries, and are specialists in progressive dies, four slides, wire forming, in-die tapping, and high-speed blanking. Screw machine products are made with automatic machinery and support equipment to produce precision turnings from .020" to 1.00" diameters. Our assembly procedures include eyeleting, riveting, staking, swaging, inserting, crimping, and screw insertion, with automatic and semi-automatic operations assembling components into finished products.

Our **Product Design Guide M70** features products that are engineered specifically for use by OEM Designers and Engineers who create and develop state-of-the-art electronic products, instruments, and systems.

PRODUCT OVERVIEW

- **Battery Clips, Contacts and Holders**
- **Fuse Clips & Holders**
- **PCB Terminals and Test Points**
- **Spacers and Standoffs**
- **Panel & Computer Hardware**
- **Pins, Plugs Jacks and Sockets**
- **PC Board Hardware**
- **Multi-Purpose Hardware**
- **Terminal Boards and Strips**
- **LED Lens Caps and Holders**

While our catalog products meet most standard requirements, modifications as well as custom fabrications can be manufactured to meet customer-specific needs.



Keystone's design and engineering experts are fully integrated with our in-house precision tool and die shop. Utilizing the latest CAD/CAM and 3D modeling software, Keystone's Custom Manufacturing Division provides close tolerance Stamping, Machining, and Assembly services as part of their quality control and responsive customer service.

Our Quality System is ISO 9001:2015 certified by DNV Certification, Inc. Keystone is headquartered in the USA with offices in Canada, Europe, Australia and Asia.

For more details, contact Keystone Sales at 800-221-5510, Fax: 516-328-1080, Email: kec@keyelco.com. Visit *www.keyelco.com* for our Dynamic catalog of products or to request a copy of our **Product Design Guide M70.**

DESIGNERS & MANUFACTURERS
KEYSTONE ELECTRONICS CORP.
www.keyelco.com

THINK™

DESIGN SOLUTIONS

Design Solutions at your fingertips! Contact us for over 70 years of "in-house" design application and engineering expertise in:

• STAMPING • MACHINING • ASSEMBLY • CNC • INJECTION MOLDING

Designers & Manufacturers of Electronic Components and Hardware

Our team is just an email or phone call away.

IT'S WHAT'S ON THE INSIDE THAT COUNTS

KEYSTONE®
ELECTRONICS CORP.

View our Dynamic Catalog M70 at www.keyelco.com

(516) 328-7500 (800) 221-5510

Sponsored Content

KHK USA INC.

OVER 27,000 STOCK METRIC GEARS AVAILABLE FROM KHK USA

WEB | www.khkgears.us
EMAIL | info@khkgears.us
TEL | 516-248-3850
FAX | 516-248 4385
259 Elm Place
Mineola, NY 11501

KHK USA Inc. is a premier supplier of metric gearing, offering over 27,000 standardized metric dimensioned spur gears, helical gears, internal ring gears, gear racks, straight, spiral & zerol miter gears, screw gears, hypoid, zerol, straight & spiral bevel gears, screw gears, worms & wormwheels, ratchets & pawls and right-angle gearboxes, all designed for use in industrial automation applications. KHK's excellence in producing quality gearing for over 85 years has made them a world-renowned brand. All of the products produced by KHK USA's parent in Japan, are available in the North American marketplace from stock, direct from the factory. With 24/7 online shopping and free 3D CAD models, KHK USA offers the largest stock offering of metric gears in North America and is ready to support all metric gear requirements.

The 27,000 configurations of metric gearing are produced in various materials. KHK USA offers stainless steel & nylon racks, and stainless steel & nylon pinions for washdown applications. KHK USA has hardened CrMo alloy steel racks and pinions available for long life and rugged durability. Additionally, KHK USA offers wormwheels in cast iron, cast bronze, aluminum bronze, acetal, & cast nylon and mating worms in alloy steel, carbon steel and stainless steel.

KHK USA offers free 3D CAD model downloads for all products and details the technical specifications for all products at **www.khkgears.us**. The website also includes a shopping cart feature that permits current pricing and live inventory for 24/7/365 order placement. KHK USA's Factory Direct Shipping program allows for products to ship directly from the manufacturing warehouse and arrive at the customer's front door within 3 business days for a fee of only US$25 per order.

KHK-USA®

KHK Stock Gears

-Anytime, Anywhere, Ready to Use-

KHK USA can meet your gear needs with our abundant variety of over 200 styles and more than 27,000 configurations of stock metric gearing.
As these products are always in stock, they can be used anytime, anywhere, whenever you have a need for gears.

KHK-USA
259 Elm Place, Mineola, NY 11501
Phone: 516.248.3850 | Fax: 516.248.4385
Email: info@khkgears.us

A3 ASSOCIATION FOR ADVANCING AUTOMATION MEMBER

PTDA Member

Driving Sustainability with Open-Source Software Solutions

Mark Biagi is pioneering digitalization and sustainable practices. As senior director for Energy Industry Solutions at Bentley Systems, he drives digital transformation by leveraging advanced infrastructure engineering software.

by Rehana Begg, Editor-in-Chief

Mark Biagi, senior director for Energy Industry Solutions at Bentley Systems, said that design solutions have evolved to enable various engineering disciplines to work together effectively in multidisciplinary design environments. *Bentley Systems*

WHEN MARK BIAGI studied product design engineering at Glasgow University and Glasgow School of Art, mixing mechanical engineering and industrial design in an art-school setting seemed radical. But his undergraduate degree in product design engineering would prepare him for several roles, including stints at Schlumberger, ABB, Nokia and other design consultancies.

In hindsight, moving through various energy-related positions and combining those experiences with an MPhil in engineering for sustainable development from Cambridge University in 2004 equipped him with knowledge in environmental issues, economics and social development—the expertise he brought to his role when he first joined Bentley Systems in 2007.

Going Digital in Infrastructure Impacts Going Sustainable

Biagi said he joined the infrastructure software firm when "sustainability had not yet gained the industrial context in which we now understand it."

At best, the pursuit for sustainable development in engineering would have been in its incipient stages. The United Nations General Assembly defined sustainable development in 1987 as "an approach to growth and human development that aims to meet the needs of the present without compromising the ability of future generations to meet their own needs." And it wasn't until 2015 that the Paris Agreement became the first legally binding international treaty on climate change, requiring signatories to limit global warming to 1.5°C.

Sustainability has since erupted into the digital age and brought along new roles that espouse ESG-friendly practices. An analysis by McKinsey & Company, for instance, shows that companies that excel at profitability and growth while improving sustainability and ESG tend to outpace peers and exceed them in shareholder returns.

However, some firms adapt to this change more quickly than others. Those that do are thinking not just about the short-term costs associated with sustainability, but also the long-term benefits. Biagi's employer, for example, has created a way for customers to engage in their digital and sustainability transformation journey while also rewarding them through the Bentley Systems' Year in Infrastructure – Going Digital Awards.

Sustainable Practices in Process and Power Generation Infrastructure

Headquartered in Pennsylvania, Bentley Software helps engineers design, build and operate infrastructure products around the world. The firm's infrastructure awards program honors the innovative work that customers put into advancing infrastructure projects.

Project submissions are judged according to set criteria, including technical innovation, process/workflow improve-

ments, organization or regional impact, return on investment and environmental impact. Projects also need to demonstrate the use of digital delivery tools for improving asset performance and reducing operating costs—albeit with the use of Bentley's extensive infrastructure playbook, ranging from AssetWise, iTwin, iTwin Capture, PlantSight, OpenPlant, OpenBuildings and OpenWindPower to AutoPIPE, ProjectWise, MicroStation and SYNCHRO.

"We've grown and adapted the criteria by which we want to measure projects, but a lot of it now is very focused on sustainability, on environmentally sustainable governance and in those aspects leading towards the energy transition," said Biagi, whose portfolio fittingly includes presiding over the award program's process and power generation category.

Two out of the three finalists' submissions in the process and power generation category were metallurgy projects that sought to cut carbon emissions. "The third finalist related to development of an offshore wind farm and the very important renewable energy integration that [the implementation] was fulfilling," explained Biagi at the Year in Infrastructure 2024 Going Digital Awards (Oct. 9-10) in Vancouver, Canada.

The Bozhong Offshore Wind Farm was the 2024 category winner and is the first grid-parity offshore wind farm project located in China's Shandong province. Pioneering the intersection of submarine cables and oil and gas pipelines, the project presented complex hydrological and geological site conditions that required cost-efficient design solutions. Their project team leaned on Bentley for developing a full lifecycle digital twin and for achieving digital and intelligent construction control, facility operations and maintenance. Upon completion, the facility will provide 1.698 billion kilowatt-hours of clean electricity to the grid annually, reducing carbon emissions by 1.26 million tons.

What Digital Transformation Means Today

The digitalization of industrial value-added processes and its penetration across industries dates back at least half a century. That's when CAD (computer-aided drafting, or computer-aided design) entered the fray to streamline design, notably by replacing the drawing board with the computer screen. Today, vendors such as Autodesk, Bentley Systems, Dassault Systèmes, PTC and Siemens are the go-to software providers for supporting, speeding up and improving digital asset lifecycle management.

Those initial solutions, said Biagi, have "evolved into supporting different engineering and design disciplines, bringing together structural engineering and important analysis roles, hydrology and so on, and enabling those disciplines to work together effectively in multidisciplinary design environments."

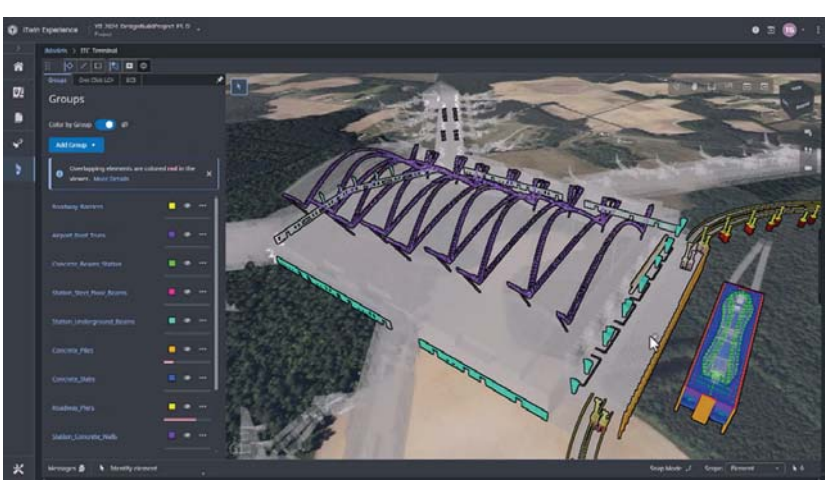
Biagi noted that many disciplines remain locked into their own silos and ways of thinking. In this respect, he said, Bentley excels at leveraging digital models from the design phase to drive better asset performance, reliability and asset integrity. "There are so many opportunities if we bring those disciplines together and are able to see in context the engineering models and the data they generate," Biagi said. "It allows new levels of insight, new levels of analysis."

And while digital transformation is the endgame, achieving this goal involves going digital through a progression of implementations. "From the earliest stages of generating data-centric models to fulfilling open ecosystems, these environments allow the data to be used in so many ways that were never originally imagined," he said.

Pioneering Open Data Ecosystems

Developing an open-source schema specifically for infrastructure is another cornerstone in Bentley's strategic digitalization play. Open-source business models revolve around an idea that more users mean more engagement, which means more user categories and more revenue opportunities. Bentley espouses the view that infrastructure organizations need open ecosystems that enable integration and interoperability across tools and platforms.

The internal challenge, according to Biagi, has been to have a diverse set of software covering a range of disciplines. Bentley's iTwin platform, for instance, was borne from an internal need to have software that communicates between the disciplines, he said. The platform provides APIs and services to help developers build digital twins for infrastructure assets (through developer.bentley.com) and handles back-end tasks such as security, infrastructure and data integration.



Bentley Systems' Carbon Analysis capabilities seamlessly integrate a user's design data with their chosen carbon assessment tool. *Bentley Systems*

"The secure flow of data is necessary to solve global infrastructure challenges, including the expansion of energy grids, modernization of transportation systems and retrofitting of existing assets to meet sustainable development goals."

Bentley's approach to open access in engineering virtualizes multiple data sources and provides a unified view without copying the raw data. Biagi maintained that data shouldn't be locked into proprietary formats; rather, it should be federated and brought together with other sources of information, which facilitate insights and the ability to be fully aware of everything that surrounds facilities. Moreover, data should be shared securely.

Simplifying Embodied Carbon Reporting with Added 3D Visualizations

A central message evangelized in Bentley Systems CEO Nicholas Cumins' keynote presentation encapsulates this thinking: "The secure flow of data is necessary to solve global infrastructure challenges, including the expansion of energy grids, modernization of transportation systems and retrofitting of existing assets to meet sustainable development goals."

This year, Bentley Systems solidified its investment in tools that simplify carbon reporting with the announcement of new Carbon Analysis capabilities in iTwin Experience (the company's version of a single pane for visualizing, analyzing, managing and sharing infrastructure digital twins). The carbon analysis tool features continuous reporting and carbon visualization functionality to allow engineers to streamline carbon calculations during the design process.

"Embodied carbon" is the carbon footprint of an asset before it is built, encompassing the greenhouse gases emitted during the construction process. The International Coalition for Sustainable Infrastructure (ICSI) estimates that embodied carbon from new infrastructure will be responsible for half of the world's carbon footprint released between now and 2050.

Nicolas Cumins, CEO, Bentley Systems, explains how carbon analysis tools can seamlessly integrate a user's design data with their chosen carbon assessment tool. *Bentley Systems*

Taking it One Step Further With AI

Using Bentley's carbon analysis means engineers can make "cradle-to-gate" assessments on a design's carbon footprint from the moment raw materials are extracted until it leaves the factory's gate, according to Biagi.

This year, Bentley Systems also delivered OpenSite+, the first engineering application leveraging generative AI for civil site design. The digital twin-native product integrates with Bentley's iTwin platform. Since it is built on large language models, users have instant AI-powered capabilities when they create, revise and interact with requirements documentation and 3D site models. In addition, the copilot handles layout optimization and automates drawing production in a fraction of time compared to traditional CAD software.

The integration of AI and machine learning for proactive asset management effectively ensures the company's acceleration to the next phase in digitally transforming critical infrastructure asset management.

According to Biagi, copilots for site design users bring together different sources of data. "With a few key prompts, it's able to generate scenarios, it's able to generate layouts and suggest context that can then be evaluated against lots of different other criteria—cost, carbon accounting, the land, remediation and so many other different disciplines," he said. "What it's allowing is for engineers to be able to evaluate concepts so much faster and to be able to get to a stage of a very mature design very, very quickly." ■

EDITOR'S NOTE: Rehana Begg served as a juror in Bentley Systems Year in Infrastructure 2024 Going Digital Awards.

Inspiring the **Next Generation of Engineers**

Tormach's 2024 Instructor of the Year, Danielle Ward, shares her approaches to STEM education, emphasizing hands-on learning and the integration of advanced technologies to prepare students for careers in engineering and manufacturing.

by Sharon Spielman, Technical Editor

IN THE WORLD of engineering and technology, the importance of skilled professionals cannot be overstated. Danielle Ward is an educator who stands at the forefront of transforming STEM education at Hilldale High School in Muskogee, Okla.

Awarded the 2024 Instructor of the Year by Tormach, Ward's initiative to integrate hands-on experiences with cutting-edge technology has not only equipped her students with essential machining skills but also prepared them for successful careers in engineering and manufacturing.

Danielle Ward, an educator at Hilldale High School in Muskogee, Okla., was awarded the 2024 Instructor of the Year by Tormach at NC3's Annual Leadership Summit. *Courtesy Tormach*

Since her journey began in 2011, when she introduced a robotics program to her school, Ward has consistently demonstrated a commitment to cultivating a robust learning environment that puts the emphasis on practical applications and machine design and engineering principles. From creating miniature putt-putt courses to using CNC technology for real-world projects, her curriculum aims to be a blend of creativity and technical training that resonates with students and fosters a passion for STEM fields.

Machine Design reached out to Ward to learn about her experiences and highlight her innovative teaching methods, the significance of partnerships with organizations like the National Coalition of Certification Centers (NC3), and her vision for the future of STEM education—especially in encouraging female participation in technical roles. Here's what she had to say.

Editor's note: Questions and answers may be edited for clarity.

***Machine Design:* How do you collaborate with industry professionals to ensure that your curriculum aligns with current practices and demands?**

Danielle Ward: Each year, I meet with different manufacturing companies in our area to hear their requirements for hiring future employees. I have local engineers come in and speak to our students, and we also hold career fairs in our building for our juniors and seniors to attend. Each one of these events allows me to remain current with the demands of our community.

***MD:* I know you use Tormach CNC routers and Dremel 3D printers in your classroom; what other tools or technologies do you integrate into your curriculum that are commonly used in engineering industries today?**

DW: I incorporate the following for my middle school students to learn coding skills:

- Ozobots
- LEGO Spike Prime Kits
- Code.org
- VEX V5 Block Coding
- VEX V5 Python Coding (HS only)

For my high school STEM lab, I incorporate the Dremel Laser Engraver and have a printer that allows students to make posters that promote special events, such as our annual Penny Drive that supports our special ed students who attend the State Games at Oklahoma State University. We also have a Roland printer that allows students to create decals.

MD: **How do you incorporate industry standards and best practices into your teaching? Are there specific frameworks of certifications you guide students to pursue?**

DW: Personal protective equipment (PPE) and safety tests are given over each machine before they can earn their certifications. Students must be able to read a tape measure, ruler and calipers with 80% accuracy and draw their projects out on graph paper and apply an appropriate scale for their projects. Students are also introduced to blueprints and must understand the angle at which they are drawn.

MD: **Have you received feedback from professionals in the field regarding the preparedness of your students? What insights have you gained from these interactions?**

DW: I had a student who graduated this past May and was accepted into the Engineering Department at Oklahoma State University. His mom reached out this past spring to let me know, "He was officially bumped out of pre-CEAT and into CEAT; he won't have any prerequisite to begin his engineering program." I will take that knowledge and pass it on to my students this year.

I have also had multiple students be able to use the makerspace labs at their college/university because they have their 3D45 certifications. One student's feedback was: "I actually used something I learned in high school at college."

MD: **Can you share any success stories of alumni who have transitioned into engineering roles? What aspects of your program do they credit with their success?**

DW: I am in my third year of teaching at the high school level. As of right now, I do not have any alumni who have transitioned into engineering roles. I do, however, have three alumni who are currently attending Oklahoma State University to become engineers. ■

Students observe their laser-engraved projects being created. Inset: Students show off their laser-engraved finished results.
Courtesy Danielle Ward

Innovation Through Collaboration in Manufacturing

With nearly 74% of manufacturers engaged in collaborative projects, the partnership between FloridaMakes and LIFT exemplifies how such collaborations drive innovation, elevate workforce development and support the manufacturing sector.

by Sharon Spielman, Technical Editor

INNOVATION HAS ALWAYS been the cornerstone of advancement in manufacturing, but it is not a solitary endeavor. The old cliché—two heads are better than one—holds true whether among team members, across departments or with external partners.

Machine Design's recently released 2024 Salary and Career Survey revealed that nearly 74% of respondents are engaged in projects that involve collaboration with other companies, which underscores the importance of partnerships in driving innovation. Furthermore, roughly 42% of organizations are leveraging cloud technologies to facilitate this collaboration, showcasing a trend toward digital integration and joint efforts.

A prime example of collaboration in action is the partnership between FloridaMakes and LIFT, two influential entities in the manufacturing sector. Kevin Carr, CEO, FloridaMakes and Joe Steele, vice president of communications and legislative affairs at LIFT, have come together to tackle the challenges and opportunities within Florida's manufacturing landscape, notably in advanced manufacturing and talent development.

FloridaMakes, the state's representative for the National Manufacturing Extension Partnership (MEP), was established in 2015 to bolster Florida's manufacturing economy through technological advancement, workforce development and growth strategies. Despite being less recognized as a manufacturing state, Florida boasts a robust network of approximately 27,000 manufacturing establishments, with a significant portion made up of small firms employing fewer than 20 employees.

LIFT, a public-private partnership between the Department of Defense and multiple industrial organizations and research institutions, as well as one of the DoD's National Manufacturing Innovation Institutes, is also celebrating its 10th anniversary. Based in Detroit, LIFT focuses on advanced materials and manufacturing processes, aiming to facilitate the transition of new technologies into practical applications, particularly within defense manufacturing.

322145785 © Yuri Arcurs | Dreamstime.com

Impact on Engineers and Small Manufacturers

The synergy between FloridaMakes and LIFT is expected to yield significant benefits for mechanical and design engineers in Florida. As noted by Steele, the partnership seeks to create a national ecosystem that aids manufacturers in the state by providing access to advanced technologies and commercialization pathways.

Carr said that small- to medium-size enterprises (SMEs) often face challenges in keeping abreast of technological advancements due to limited resources. This partnership offers critical support, helping these manufacturers improve their capabilities and integrate new technologies more effectively. By connecting local manufacturers with national resources and expertise, both organizations aim to foster innovation and accelerate growth in the manufacturing sector.

In outreach efforts, LIFT plans to leverage FloridaMakes' extensive network to host webinars and collaborative sessions that will bring together industry representatives, academia and governmental bodies; they aim to facilitate knowledge sharing and collaborative problem-solving. This proactive outreach will inform manufacturers about available resources and opportunities.

Carr said that outreach is essential for changing perceptions and increasing awareness of the support available through these organizations. Workshops, site visits to innovation centers and direct engagement with manufacturers are strategies that will help ensure even the smallest firms can access the tools and knowledge they need.

Expanding the Collaborative Network

The partnership's influence extends beyond Florida; it also has established a satellite facility in Puerto Rico, mirroring the efforts in the Sunshine State. This

Images courtesy FloridaMakes and LIFT

facility aims to bolster workforce development and technological innovation locally, ensuring benefits of the collaboration reach a broader audience.

LIFT's Steele highlighted how their facility serves as a "showcase and sandbox," demonstrating the future of manufacturing. Here, companies can observe the latest advancements and explore how digital technologies can improve their processes. The integration of computational materials engineering enables engineers to model and simulate new materials virtually, ensuring their suitability before physical production begins.

Additionally, there are plans to expand with a satellite facility in Florida's Panhandle region, further supporting local manufacturers by providing access to expertise and showcasing innovative manufacturing solutions.

Carr notes that while many collaborations are primarily focused on the aerospace and defense sectors, they also encompass a wide range of players, from small companies that specialize in materials technology to large original equipment manufacturers (OEMs).

Training Initiatives: Operation Next

Carr pointed out the importance of manufacturing knowledge for engineers entering the field and urged mechanical and electrical engineers to understand the process of bringing innovation to market. In the context of post-COVID recovery, a deeper comprehension of manufacturing processes can improve their ability to contribute effectively.

In response to the pressing need for a skilled workforce, LIFT introduced "Operation Next," a program aimed at providing certification opportunities in vital manufacturing skills such as welding, CNC machining and robotics. Funded by the Florida State Legislature, this initiative specifically targets veterans, active-duty military members and civilians, addressing the critical need for multi-skilled technicians on manufacturing floors. By ensuring that engineers and technicians work in concert, the goal is to streamline production processes and improve overall efficiency and manufacturing.

With a 10-year history focused on metallic materials at their Detroit headquarters, LIFT's Steele said they are now turning their attention to 10 new materials essential for advanced applications, particularly in hypersonics—technologies that operate at speeds exceeding 6,000 mph. These advancements necessitate the exploration of alternative materials, especially ceramics, which may hold the key to achieving the required performance standards. The influx of energy and expertise from the Florida region, with its proximity to the Space Coast and Redstone Arsenal, paves the way for innovative materials research and collaboration with local manufacturers.

The objective of the partnership is to integrate insights from Florida's manufacturing community, aiming to align ongoing projects with existing capabilities and accelerate progress into the marketplace. While the partnership has a vision, it remains adaptable, open to feedback and new ideas from manufacturers, Carr and Steele said.

A Future-Forward Vision

The partnership is committed to integrating insights from Florida's manufacturing community, aligning ongoing projects with existing capabilities to accelerate innovation. This adaptable approach invites feedback and new ideas from manufacturers, ensuring the partnership remains dynamic and responsive to industry needs.

Furthermore, the collaboration is actively addressing supply chain integration, particularly considering previous disruptions from natural disasters and the COVID-19 pandemic. FloridaMakes' introduction of the CONNEX Marketplace—a supplier capability database—facilitates connections between local suppliers and clients, bolstering regional manufacturing resilience.

The Role of Collaborative Networks

The partnership underscores the importance of collaboration across the manufacturing industrial base, connecting a range of suppliers critical to defense and broader manufacturing needs. By harnessing their collective strengths and knowledge, partners aim to uncover hidden resources and innovations within close proximity, promoting a culture of cooperation that can lead to significant advancements and efficiencies.

Embracing innovation through collaboration can help the manufacturing industry navigate the complexities of today's market while preparing for the challenges of tomorrow. ■

Courtesy AWS Foundation

Boosting Welding Education:
AWS Foundation Supports Schools to Train Skilled Welders

AWS Foundation grants funding to 14 schools, addressing the shortage of skilled welders in manufacturing and construction industries.

by **Sharon Spielman**,
Technical Editor

THE AMERICAN WELDING SOCIETY (AWS) Foundation aims to address the declining number of welding professionals by supporting education and workforce development in the welding industry. The foundation is providing financial assistance to educational institutions to train skilled welders for the growing manufacturing and construction industries, offering grants up to $25,000 per location for their welding education programs. The funding may be used on facility improvements, investing in welding or metalworking equipment and upgrading computer-based training systems.

The foundation announced in a press release that 14 schools across the country have been selected to receive these grants, which will help them elevate their training facilities and better equip students for the demands of the welding industry. Recipient schools include:

- Bristol Technical Education Center, Bristol, Conn.
- Capital Area Career Center, Springfield, Ill.
- Carrollton Area Career Center, Carrollton, Mo.
- Central Arizona College, Coolidge, Ariz.
- El Capitan High School, Merced, Calif.
- Indiana County Technology Center, Indiana, Pa.
- Lawrence, Nelson Community Schools, Nelson, Neb.
- Maple Mountain High School, Spanish Fork, Utah
- Milton High School, Milton, Wis.
- Rimrock Jr./Sr. High School, Bruneau, Idaho
- Santa Fe Independent School District, Santa Fe, Tex.
- The MILL National Training Center, Colorado Springs, Colo.
- Tidioute Community Charter School, Tidioute, Pa.
- Tourtellotte Memorial High School, North Grosvenordale, Conn.

"Graduates of welding schools are in high demand nationwide, yet many institutions struggle to train enough individuals to meet the local industry's needs," said Monica Pfarr, executive director of the AWS Foundation. "We are pleased to support these schools in expanding their welding programs and applaud their commitment and dedication to training the next generation of welding technicians and professionals."

Even though welding plays a vital role in modern society, the shortage of skilled welders continues. The AWS Foundation wants to buck this trend by backing programs that foster the welding sector through research, education and workforce development efforts. In 2023, the foundation allocated more than $3 million in grants and scholarships to propel welding education. ■

Sponsored Content

SEW-EURODRIVE, INC.

WEB | www.seweurodrive.com
TEL | 864-439-7537

220 Finch Rd.
Wellford, SC 29385

AS A WORLD LEADER in drive technology and a pioneer in drive-based automation, SEW-EURODRIVE has established a reputation for quickly solving the most difficult power transmission and motion control challenges. Since introducing the combined gearmotor in 1931, we have been bringing the best in drive technology to our customers worldwide.

More than just gearmotors

SEW-EURODRIVE offers much more than just components. We offer the expertise and expanded line of control components and software to drive them. Our team of automation experts understand the latest technology and can solve even the most complex motion control challenges.

Being a single-source automation partner radically sets us apart from others. Our team of automation engineers provides the expertise, project planning, software, commissioning, and worldwide support for your most challenging motion control projects. They can serve as a valuable extension of your engineering team, reducing the stress and demanding workload. Our experts provide a solution of perfectly matched SEW components that have been designed to work together seamlessly.

PRODUCT INNOVATION

MOVI-C® Modular Automation Platform

In addition to engineering excellence, SEW-EURODRIVE is also known for innovative new products. Our MOVI-C modular automation system is a flexible one-software, one-hardware automation platform that combines fully integrated drive components, control electronics and automation software – all from a single source. The key to the MOVI-C platform is that each of those components is designed to work together perfectly, taking the hassle out of machine design.

The MOVI-C platform utilizes the latest automation technologies – from AC motors and gear units to ultra-efficient permanent magnet servomotors, control electronics, and software. Machine builders will appreciate the seamless integration and prebuilt software modules tailored to the customer's application.

SEW EURODRIVE

What's the cost of a superior system?

A lot less than an inferior one.

At **SEW-EURODRIVE,** we engineer the finest drive automation solutions. What truly sets us apart is our unwavering commitment to customer support, long after the sale. We go above and beyond to ensure your business stays on the move with exceptional service at every turn. **Upgrade everything.**

SCAN TO START A CONVERSATION

SEW EURODRIVE

SEWEURODRIVE.COM \ INDUSTRIAL DRIVE AUTOMATION \ ENGINEERING \ SERVICE

Sponsored Content

SMALLEY®

THE ENGINEER'S CHOICE®

WEB | www.smalley.com
EMAIL | info@smalley.com
TEL | 847-719-5900

555 Oakwood Road
Lake Zurich, IL 60047

RING AND SPRING ENGINEERING EXPERTS

As the inventor of the edgewound wave spring and with over 100 years of manufacturing excellence, Smalley is the Engineer's Choice® in providing wave springs, retaining rings, and constant section rings for all of your application needs.

Smalley stocks over 11,000 standard parts across 30 configurations and 400 sizes, ready for delivery. If a standard part doesn't meet your requirements, you'll work with our team of over 30 industry-specialized engineers to quickly create an economical custom part in the material of your choice, all without new tooling. Prototype or production volume, our No-Tooling-Charges™ manufacturing process meets the design flexibility your application, budget, and timeline requires.

While all of our manufacturing is produced in our U.S. based 300,000 ft^2 facility, our global network of offices, engineers, and distribution partners allows you to quickly receive parts and support from anywhere in the world. Smalley's dedication to quality and manufacturing excellence has earned us multiple service and quality awards as well as the trust of OEMs worldwide.

CREATING APPLICATION-SPECIFIC SOLUTIONS

From everyday consumer products such as the smartwatch on your wrist to life-saving medical devices such as robotic surgical instruments, Smalley has helped tens of thousands of engineers and professionals create application-specific solutions across every industry.

Smalley has paved the way to become the world leader in rings and springs because of our personalized application-support, industry expertise, and customer-driven commitment.

FOR ALL OF YOUR DESIGN CHALLENGES

Retaining Rings

Unique configuration providing a low radial profile, reliability, and convenience.

- **No Ears to Interfere®** with undesired components
- **No lugs,** ideal for tight radial applications
- **No gap, providing 360° retaining surface for even load** distribution
- **Coiled, not stamped,** economical material options due to reduced scrap costs
- **Easy customization,** design around your application with No-Tooling-Charges™
- **Improved aesthetic appearance,** smoothly blending into your application
- **Safe and easy installation** requiring no special tools
- **Groove interchangeable** with stamped rings

Wave Springs

Optimize space by providing the same spring force as an ordinary compression spring at a reduced operating height.

- **Reduce spring height** by up to 50% when used to replace an ordinary compression spring
- **Compact design** fits tight radial and axial spaces, reducing spring cavity size
- **Light-weight assembly** that saves production time and material costs
- **Accurate and predictable load(s)** toleranced at specific working height(s)
- **Easy customization,** design around your application with No-Tooling-Charges™

Standard or custom, we are dedicated to delivering the right part in the right material for all of your applications.

SECURE YOUR SUCCESS WITH SMALLEY

SPACE
DESIGN
QUALITY
ASSEMBLY
BEARING
INNOVATI
CONNECT
SEALS
RELIABILI
GROWTH

As the inventor of the edgewound **wave spring** with 100+ years of innovation, here's why Smalley is *The Engineer's Choice®*:

- ✓ **11,000+ standard parts in stock**
- ✓ **Customizable with No-Tooling-Charges™**
- ✓ **Trusted performance in 25,000+ applications**
- ✓ **Award-winning quality backed by leading industry certification**

Smalley Wave Springs

- ✓ **Same Force, Same Travel as a coil spring**
- ✓ **Lightweight and compact**
- ✓ **Diameters from .118" to 120" in 40+ materials**

Buy Now or Request Samples at smalley.com or Call 847-719-5900

SMALLEY®
THE ENGINEER'S CHOICE®

Sponsored Content

SPIROL®

WEB | www.spirol.com
EMAIL | info@spirol.com
TEL | 860-774-8571

30 Rock Avenue
Danielson, CT 06239-1434

ABOUT US:

Since the invention of the Coiled Spring Pin in 1948, SPIROL has been a global leader and manufacturer of engineered fasteners and fastener installation equipment. Our core purpose is to help customers improve the quality of their product, simplify the assembly process and reduce the overall cost of assembly.

WHAT WE OFFER:

SPIROL continues to introduce new products and improve existing ones. Our diverse product line includes Coiled Spring Pins, Slotted Spring Pins, Solid Pins, Disc Springs, Alignment Dowels and Bushings, Spacers, Compression Limiters, Inserts for Plastics, and Precision Shims. You benefit from a choice of over 30,000 standard products, no tooling or development costs, less variability between production lots, and responsive delivery. SPIROL offers both the engineered fastener and a standard line of Fastener Installation Equipment and high-performance Vibratory Parts Feeding Systems. We are uniquely equipped to provide the total assembly solution!

In addition to high quality products, SPIROL has Application Engineers throughout the world to assist you in your designs, supported by state-of-the-art manufacturing centers and worldwide stocking facilities to simplify the logistics of delivering your product. Through partnering with companies early in the design stage, we not only help design the engineered fastener, but we also make the critical recommendations for the interface between our product and your assembly.

When you engage SPIROL as a design partner, you will shorten the design cycle time and get to market as quickly with a high quality, profitable product.

Visit our Resource Center at **SPIROL.com/Resources** to access:

- 2D/3D Drawings
- Case Studies
- Product Catalogs and Design Guides
- White Papers

WHERE TO FIND US:

SPIROL's products can be found in alternative energy / green technology applications, gas-powered automobiles, electric vehicles, airplanes & helicopters, agriculture / heavy equipment, tractor trailers, office furniture, consumer appliances, hand & power tools, lawn & garden equipment, medical devices / medical equipment - literally any assembly that can be mechanically fastened together! There are no engineering fees and all standard parts typically ship from stock!

SPIROL can be found on 4 continents within 13 countries: Brazil, Canada, China, Czech Republic, England, France, Germany, Korea, Mexico, Poland, Spain, United States, and Malaysia.

Involve SPIROL early in the design stage of your next project!

Learn more at SPIROL.com

SPIROL®

Since 1948!

Looking For a High Quality, Fastening Solution?

Partner with SPIROL - the experts in fastening, joining and assembly!

Benefits of Partnering with SPIROL include:

- Complimentary Application Engineering Support
- Responsive, World-Class Customer Service
- In-House Manufacturing / High Quality Products
- Expansive Product Offering / 30,000 Standard Items
  - Ready to Ship from Stock!
- Worldwide Production, Sales & Service Locations
  - We Are Where You Are!

Certified to:

IATF 16949 • ISO 9001 • AS9100
DFARS Compliant • ITAR Registered

Visit SPIROL.com!

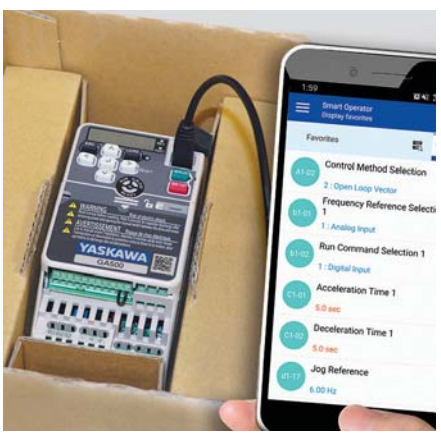
Sponsored Content

YASKAWA AMERICA, INC.

WEB | www.yaskawa.com
TEL | 1-800-YASKAWA
847-887-7000

2121 Norman Drive South
Waukegan, IL 60002

Whether you are a machine builder or equipment user, you know the daily struggle with limited resources and tight deadlines. You can't afford to settle for less than the right products and services to solve urgent problems, delivered with reassuring consistency and reliability you can trust.



Experience is often the difference between solving a problem the right way and settling for "good enough." Yaskawa's global expertise is unmatched and unquestioned, with 100+ Years of manufacturing excellence, 14,800+ worldwide associates, 30 countries with sales, service, and manufacturing locations, and $4.5 billion in global sales per year. Since 1915, Yaskawa has produced 25 million servo motors, 35 million variable frequency drives and 600,000 robots.

We provide both standard products and tailor-made solutions, all backed by proven quality and reliability. We're also continuously working to save you money, time, energy and headaches, because we believe your machine can always run faster, smoother and more productively. It's about making the correct diagnoses, creating the right automation machinery, and implementing it in the best way possible.

AC Drives: Yaskawa offers a variety of low and medium voltage AC drives that support every application in the industrial plant, offering size and performance options from fractional HP to 16,000 HP. Our latest variable frequency drives provide simple motor setup with highly flexible network communications, embedded functional safety, no-power programming, and easy-to-use tools featuring mobile device connectivity with our DriveWizard mobile app.

Servos and Controllers: Yaskawa AC Servo Systems come to a precise position with a speed and consistency that is unmatched in the automation industry. Connect our rotary, linear, and direct drive motors (outputs from 3W to 55kW) to an advanced Yaskawa iC9200 machine controller to manage motion, logic, kinematics, safety, security, and more from a single EtherCAT-based controller utilizing our iCube Control™ platform..

Robotics: Over 600,000 Yaskawa Robots are at work worldwide, with 150+ models to choose from and the strength of decades of application expertise. Our industrial robots increase efficiency, provide consistent quality, and boost productivity to deliver outstanding ROI. Our robotic portfolio ranges from 4 to 15-axis industrial robots with load capacities of 2 to 800 kg to special machines, devices, and turnkey robotic systems.

YASKAWA

STRENGTH IN NUMBERS

QUALITY, RELIABILITY, OPERATIONAL EXCELLENCE

100+ YEARS
MANUFACTURING EXCELLENCE

30
COUNTRIES WITH SALES, SERVICE, AND MANUFACTURING FACILITIES

14,800+
WORLDWIDE EMPLOYEES

$4.5B
*GLOBAL SALES
* Based on 2023 reported sales. For reference only

SINCE 1915, YASKAWA HAS PRODUCED...

- 25M SERVO MOTORS
- 35M AC DRIVES
- 600K ROBOTS


Edwards R. Deming Medal for Quality

Northface Scoreboard Award for Excellence in Technical Support

Interaction Metrics Superior Customer Experience Award

The quality of Yaskawa products is second to none, but Yaskawa Quality goes beyond that. **It's the total experience of purchasing Yaskawa products and working with people.**

- ✓ Global Expertise
- ✓ Proven Quality Management
- ✓ MTBF of up to 28 Years
- ✓ Award Winning Customer Service
- ✓ Product Lifetime Training
- ✓ Free 24/7/365 Technical Support

Want to have that working for you? Contact Yaskawa today.

FOR MORE INFORMATION:
https://www.yaskawa.com

IT'S PERSONAL

YASKAWA

Yaskawa America, Inc. 1-800-YASKAWA
Email: info@yaskawa.com | yaskawa.com

Connecting Ideas and Expertise Propels the Future Forward for These Innovators

Explore how the journeys of innovators Dr. Michelle Pantoya and Dr. John Granier illustrate the impact of mentorship, interest and shared purpose in driving advancements across their fields.

by Sharon Spielman,
Technical Editor

Dr. Michelle Pantoya says her students are a constant source of inspiration. Here, she works with a student in the combustion Lab at Texas Tech. *Courtesy Dr. Michelle Pantoya*

One of Dr. Michelle Pantoya's former students, Emily Hunt, is not only the Dean of engineering at West Texas A&M but the two co-authored a children's book. Here, they show off "Pride by Design," demonstrating that mentorship has an impact that propagates.
Courtesy Dr. Michelle Pantoya

WHEN DR. JOHN GRANIER, chief engineer of munitions and energetics at Element U.S. Space and Defense, and Dr. Michelle Pantoya from Texas Tech University's Combustion Lab spoke with *Machine Design* about their collaboration to understand the ignition processes in a range of ammunition systems—from small arms to large tank rounds—to improve the performance and safety of munitions, we knew we had to learn more about what makes these innovators tick.

In their respective journeys, Granier and Pantoya show how diverse backgrounds and insights converge to ignite creativity and drive change in their fields. Their collaboration shows the power of partnership in fostering innovation, and their individual stories illustrate how guidance, curiosity and cross-disciplinary thinking fuel their work and inspire others.

Pantoya's Path: Guided by Inspiration, Curiosity

Pantoya's journey to being an innovator began with profound guidance from her mother, who instilled in her a belief that anyone can achieve remarkable things.

Growing up in the 1970s amidst the excitement of NASA's space flights and the moon landing, her mother pointed out that successful individuals were not defined by their gender or ethnicity but rather by their passion for their work.

"She told me that 'people' were accomplishing all those exciting things, and since I am a 'person,' I could accomplish those things, too," Pantoya remembers. "She never drew attention to *who* those people were; she only ever focused on *where* they were educated, *what* their professions were and *why* they were so good at their jobs—because they loved what they did."

Her mother guided her toward the goal and not to the obstacles that were in her way, she said, "and I think that was all the direction I needed. She taught me to be focused and inspired me to follow the direction that excited me." This foundational belief became the cornerstone of Pantoya's pursuit of a career in engineering.

> *"Sometimes I have my best ideas when I'm walking my dogs—days after initially thinking about potential solutions to a technical problem."*

Motivation and Influences

For Pantoya, her students are a constant source of inspiration. Their intellectual curiosity and enthusiasm create an energizing atmosphere that fuels collaboration and creativity. "[The students'] enthusiasm is contagious, so the project itself becomes full of energy and everyone engaged in the project loves it," she said. "Self-motivated students not only learn a lot, but they also contribute significantly to the research. Often, they even introduce new ways of thinking that can be applied to other projects, thereby benefitting our whole research group."

A significant aspect of Pantoya's teaching philosophy is her commitment to instilling critical thinking in her students. She often provides them with resources such as Simon Sinek's *Start with Why*, encouraging them to question the underlying motives behind their scientific endeavors. By fostering an environment where asking "why" becomes second nature, she equips her students with the tools to tackle complex challenges and innovate confidently.

Her creative process is organic, often sparked by unexpected moments of clarity that arise when she allows her mind to wander. "New ideas generally come from making connections between different ideas that I've been exposed to either through readings, seminars or other project involvement," she said. "Creativity can't be forced, but it does tend to mature and develop over time. Sometimes I have my best ideas when I'm walking my dogs—days after initially thinking about potential solutions to a technical problem."

Dr. Michelle Pantoya says that some of her best ideas occur while walking her dogs—days after initially thinking about potential solutions to a technical problem. Here, Pantoya and her pups show each other appreciation. *Courtesy Dr. Michelle Pantoya*

Legacy and Positive Impact

When asked what advice she would give to aspiring innovators, Pantoya said it is important to keep focused on a vision for the innovation. "Remember your purpose for dedicating your time and energy to the innovation and do not become distracted by ancillary activities or tasks," she tells her students. "Also, do your best to keep a positive attitude along the way. There will always be obstacles in your path, but if you have an attitude that gets past the obstacles, you can accomplish anything."

Looking to the future, Pantoya is excited about the potential to harness energy from metal combustion in novel ways. Innovations that enable faster energy release from metal fuels could lead to unprecedented advancements in power generation, opening new avenues for exploration beyond our planet, she said.

"Because power is energy divided by time, greater energy release rates will lead to power generation in quantities never realized in the past," she explained. "Explosives have about as much energy as a stick of butter on your kitchen table. But they release that energy incredibly quickly, so they demonstrate great power. Metals have exceptionally high energy but release that energy slowly—so, limited power."

She said they are creating ways that make metals react at time scale more relevant to a detonation and gain energy faster, thereby creating power. "That level of power generation will fuel our way to other planets," she said. "The potential impact of harnessing metal power is transformative to the future of the human race. That's exciting!"

Above all, Pantoya hopes to be remembered for the positive impact she has on others' lives. Witnessing their successes fills her with immense pride and fulfillment.

"My hope is that my impact propagates and influences more lives in a positive way. Helping people make a strong professional start in their life is hugely rewarding for me. Then, watching as their successes build is even more rewarding," she said.

One of her students, Emily Hunt, is now the dean of Engineering at West Texas A&M. "When [Hunt] started working at WT, there was only a single degree offered in engineering. She created an entire College of Engineering that includes degrees in multiple engineering disciplines," Pantoya told *Machine Design*. "She has affected the lives of thousands of people in the West Texas region in a truly positive way by providing them with opportunities to pursue an engineering degree. I am

rewarded knowing that I played some role in helping her develop professionally and recognize that she is capable of achieving wonderful things. This is one example of what I mean by influencing an impact that propagates."

For Pantoya, the true measure of her success lies in the enduring influence she imparts to those she mentors—and another one of her former students and mentees is Dr. John Granier.

Granier's Gateway: Early Problem Solving to Pursuing Passion

Granier's early interest in problem-solving set the stage for his innovative career. An introduction to firearms during high school ignited a passion that intersected with his academic pursuits in engineering. "I was first introduced to firearms by a high-school mentor who taught me about hunting and shooting sports. We dove deep into reloading and practiced shooting often," he said.

This led Granier to explore the field further. "During my undergraduate studies, I was considering going to graduate school for mechanical engineering when I learned that I could dive even deeper into this field by studying nanothermites with an application in green percussion primer for small arms," noting this was when he knew he wanted to fully commit to this career path. "My graduate studies in reactive materials opened up all sorts of new doors and research areas that allowed me to grow my expertise in not only ballistics, but also in explosives and pyrotechnics."

> *"The potential impact of harnessing metal power is transformative to the future of the human race. That's exciting!"*

A significant turning point in Granier's career occurred during a conversation with a colleague. Faced with a daunting challenge, his colleague confidently asserted "if a human designed and built it, I can figure it out." This mindset resonated with Granier and instilled in him a belief that any problem could be approached with diligent research and collaboration, ultimately leading to breakthroughs in his field.

"This was a very confident statement," Granier said, "but it resonated with me, and I took my colleague's advice with me into several difficult projects. I felt that any problem that I came across, I could study the background research on that topic and collaborate with scientists in that field to get a thorough understanding of even 'state-of-the-art' technology," adding that once someone has mastered the state-of-the-art, usually there is a natural development of small creative steps to grow an understanding and the solve the next levels of whatever problem lies ahead.

Creative Process and Idea Generation

Granier says that true creativity is a gradual evolution rather than a series of sudden epiphanies. He draws parallels between seemingly unrelated fields, integrating knowledge from a range of disciplines to foster innovative solutions.

For instance, he said, "In physical arts such as painting or science, creativity is seeing the similarity or patterns in dis-

Dr. John Granier draws parallels between seemingly unrelated fields, integrating knowledge from a range of disciplines to foster innovative solutions, e.g., techniques in cooking food can cross over with adaptation to mixing and blending reactive materials. *Courtesy Dr. John Granier*

The metal sheet wall behind Dr. John Granier and his colleagues is a stationary fragmenting warhead test. High speed video records the time of arrival and pattern as fragments penetrate the metal wall. *Courtesy Dr. John Granier*

similar and nonrelated fields. For example, applying a new type of paint combined with UV (ultraviolet) lighting to create a new effect. Even in this example there was an evolution in the paint industry before the artist could paint, as a scientific thinker first had to have the idea to pulverize UV reflective particles and blend them into a slurry to generate the UV luminescent paint."

Granier strives to always be learning in hundreds of different interesting fields. "The more technology I can put in my mental database, the more links I can create to reference when I need to solve difficult problems," he said. "Techniques in cooking food can cross over with adaptation to mixing and blending reactive materials. Equipment that I see in medical imaging at the doctor's office can also be used to do a detailed inspection of sealed munitions. Sometimes, technology will mature and gain funding through one field, and when it gets well enough established, creative people will see unexplored uses and pull the technology to a totally new and unrelated application."

Trends and Innovation in Defense

When asked what trends are shaping his industry right now, Granier said that the defense industry is being rapidly pushed forward by additive manufacturing (AM) and artificial intelligence (AI). "I've seen many DoD (Department of Defense) research groups pushing the boundaries and materials of additive manufacturing to enable the creation of new materials with higher densities, materials with higher temperature ratings and even more reactive materials," he said. "These are stretch goals, but the defense community is making progress."

One DoD application that is close to home for Granier is utilizing AI processing with large amounts of data. "Our computer systems and software are amazingly capable of capturing tons of data," he said. With AI, humans can quickly find trends and create predictive models based on the data. "A few decades ago, these efforts would have taken so much time that it would have been too inefficient to even consider starting them. Now, we push sensors and diagnostics to the limit with confidence that our engineers (with AI assistance) can analyze it shortly after."

Dr. John Granier and a couple of colleagues pose in front of a warhead package on a rocket sled track at Hollomon AFB in New Mexico. The nose cone is a fixture just for making the test work to get the warhead to speed for dynamic explosive testing at the end of the track. *Courtesy Dr. John Granier*

As for the innovations that Granier is most excited about in his field, he mentioned the significant advancements in visual diagnostic technologies that utilize high-speed video coupled with sophisticated software. Specifically, he notes that scientists are pairing powerful post-processing software with high-speed video to achieve great new insights.

He offers a few examples, including:

- **Free-field explosively launched fragment tracking.** "Commercial companies are using multiple high-speed cameras in to track fragment velocity and distribution in open air tests," he said.
- **Digital image correlation.** "Commercial companies are employing stereoscopic high-speed cameras to measure 3D strain without touching the object of interest, which can sometimes interfere with the measurement," he explained.
- **Digital thermography.** "This is more at the research level," he noted. "Researchers are using special optical filters on conventional digital high-speed cameras. Then through calibration and post-processing software, they can compute 2D temperature maps for really fast events."

The Influence of Impactful Innovators

The stories of Pantoya and Granier offer great examples of innovation demonstrated by mentorship, curiosity and collaboration. Their dedication to advancing environments where inquiry reigns not only elevates their personal work but inspires the next generation of innovators.

As they continue to push boundaries and explore new frontiers, their insights are a great reminder that innovation is as much about the connections we make and the lives we influence as it is about the outcomes we achieve. Through their journeys, we learn that the path to innovation is not just a destination but an ongoing experience of growth, exploration and impact. ■

Industrial sensors

The eyes and ears of automation

DigiKey has a wide range of high-quality industrial sensors from leading suppliers that guarantee the perfect match for any application. Find the inventory, content, and expertise you need. We are your industrial sensor experts.

You'll find the sensors to fit your needs at digikey.com/industrial-sensors

DigiKey

we get technical