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THE VOTES ARE IN: 2021 IDEA! Awards Winners **17**

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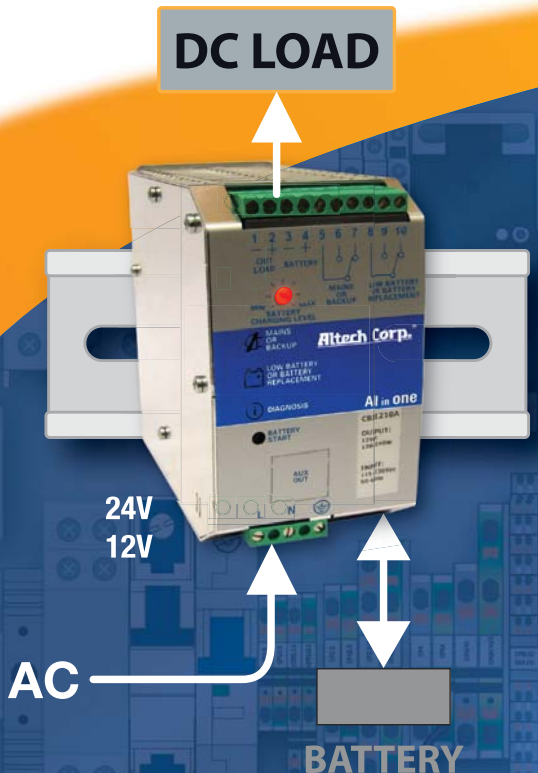

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MachineDesign

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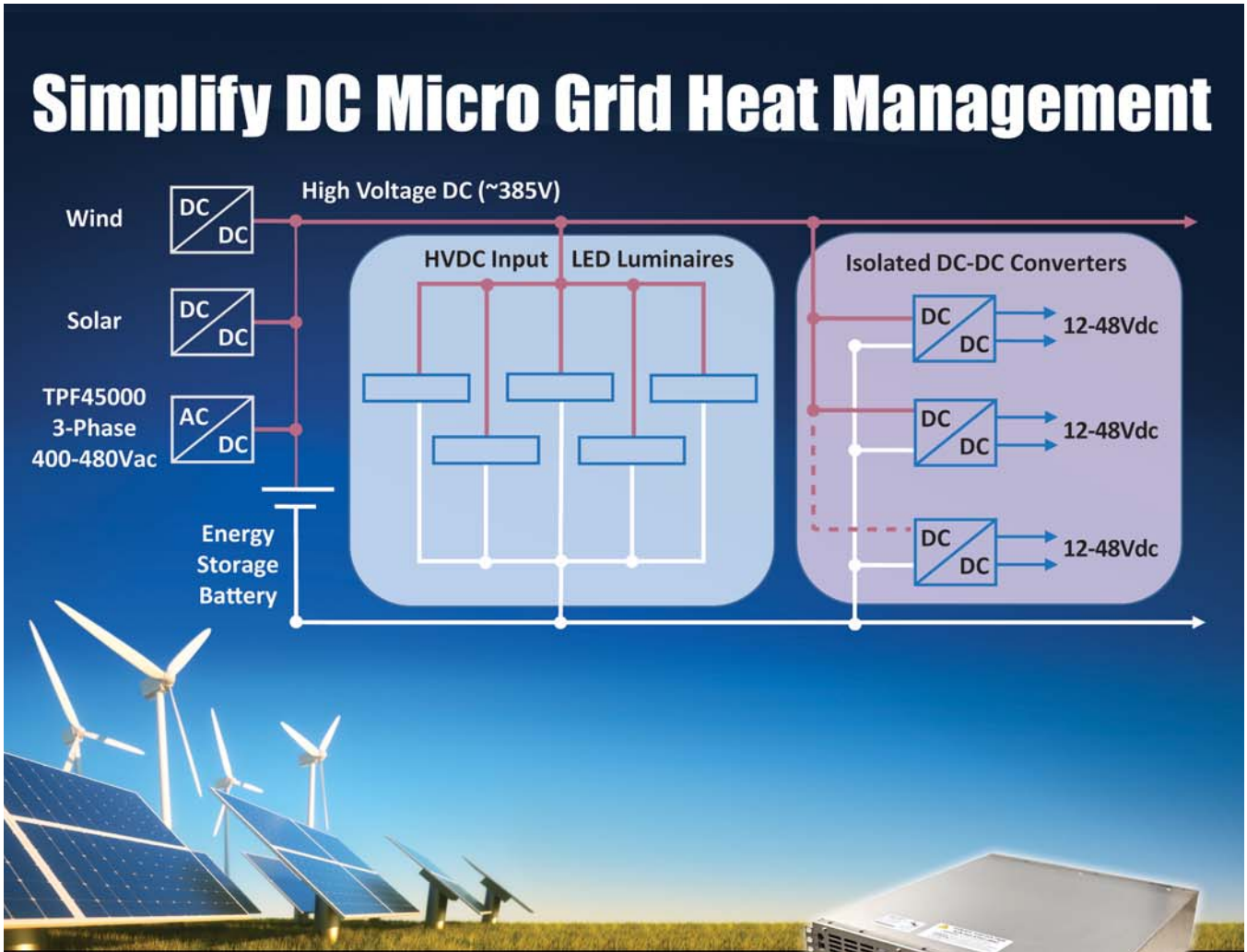

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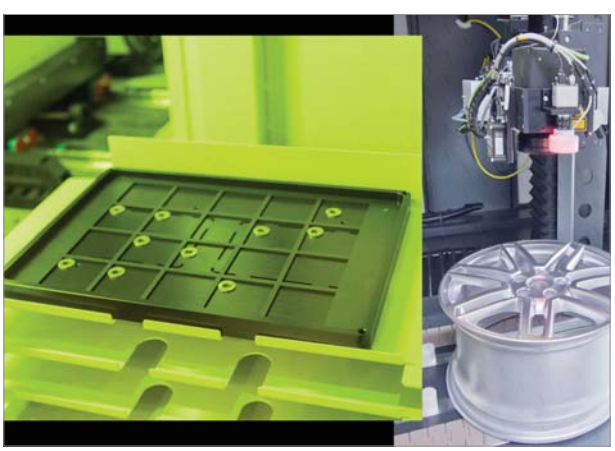

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FROM THE ARCHIVES

Non-Destructive Testing: Should You Invest in a System or Service Partner?

NDT is an important part of quality control for the automotive, aerospace and electronics industries. Here is a breakdown of both investment options.

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Editorial

BOB VAVRA | Senior Content Director

bvavra@endeavorb2b.com

Full Speed Ahead to **Plant Size One**

Manufacturers can ill-afford to sit on the sidelines while the sector works through its post-COVID recovery.

In a transformational time for the global manufacturing sector, the post-COVID recovery has been no less disruptive. While job openings are seemingly everywhere and supply chains are impacted as a result, the business of manufacturing has seldom been busier.

With manufacturing growing at a robust 20% above its baseline levels according to the Institute for Supply Management, it would be reasonable to conclude these dual concerns about supply chain disruptions and job openings have been overblown. It's also possible that the reverse is true—when the supply chain is reconnected and the jobs are filled, manufacturing is poised for a historic growth spurt.

Either way, too many manufacturers are sitting on the sidelines, waiting to see how it all works out. That is the least desirable of the outcomes.

The growth of the Internet of Things and the emergence of such concepts as artificial intelligence have gotten folks to imagine a world of Lot Size One—a place of singular manufacturing to specific consumer specifications in which a flexible, intuitive and dynamic production line can produce one of anything instead of thousands of one thing. That world already exists in many sectors, and as technology improves and evolves, that idea of Lot Size One becomes a more intriguing concept.

To accomplish this requires automation, skilled planning and a dynamic supply chain specifically configured to meet the needs of the end-user. It requires Plant Size One.

At Pack Expo in September in Las Vegas, I saw the potential around this concept played out in some unique ways. One manufacturer showed a conveyor system at his booth and noted a plant manager had asked to buy the system right off the show floor. Other vendors reported a similar appetite to upgrade systems and processes. Some of those who see the limitations of speed and personnel also are unwilling to wait for things just to get better. They are reimagining their own facility and tailoring it to meet their specific production needs.

The good news for such manufacturers—and for those who remain on the sideline—is that the technology exists to minimize disruptions and overcome the bottlenecks facing manufacturers today. The supply chain must be more reliable and more flexible. We must assess our hiring needs and develop an attractive pitch for those looking for longer-term security, not just transactional employment.

But even if we cannot solve either of those issues today, we can't wait for the solution to emerge. We must take full advantage of the technology to not just ride out this wave, but to catch the next one at full speed. md

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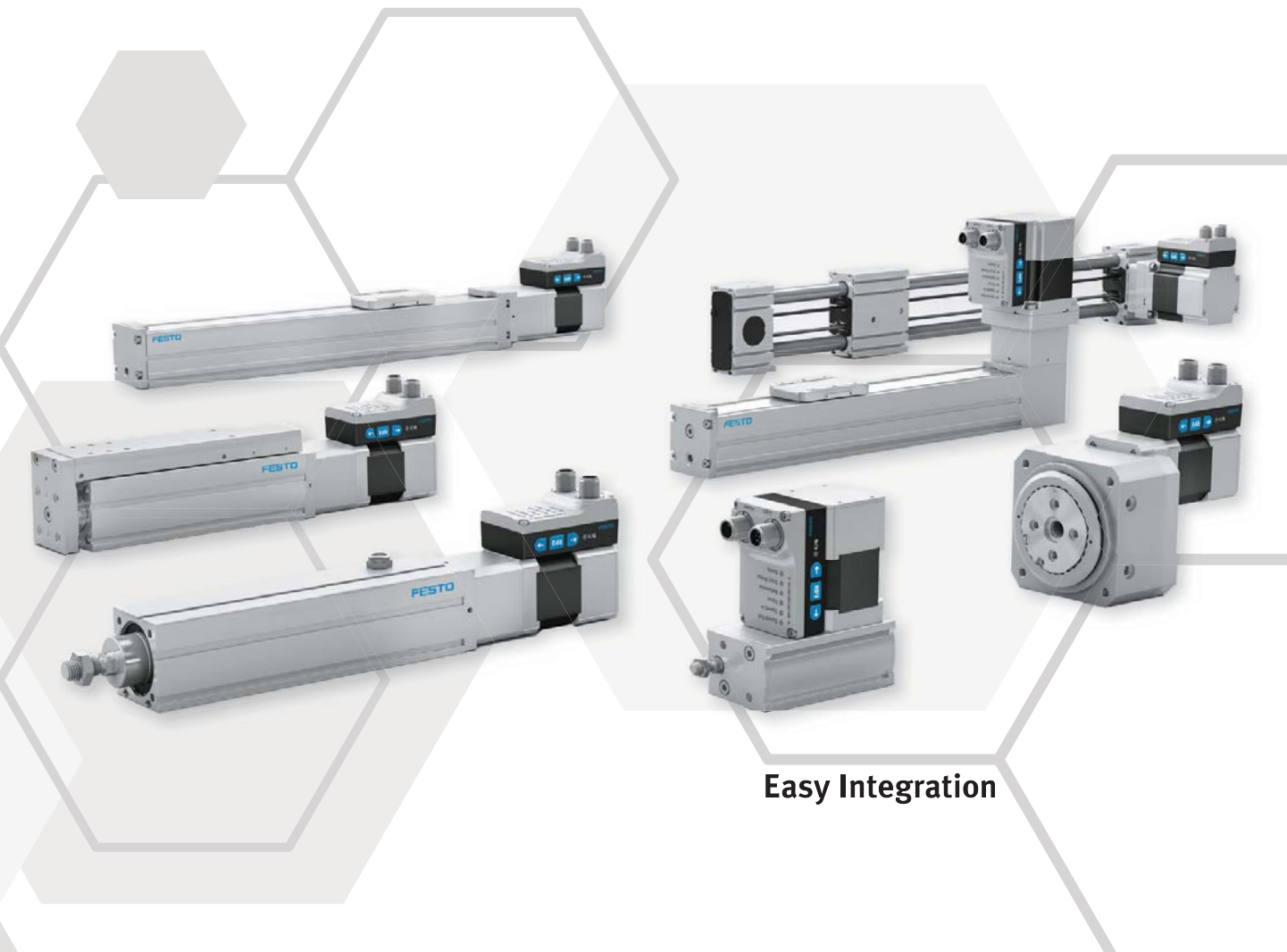

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News

THE ROAD AHEAD
Is Connected Wirelessly

Tektronix's Suchi Srinivasan discusses the latest developments and future trends.

ALIX PAULTRE | Editor, Evaluation Engineering

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From advanced wide-bandgap semiconductors to machine learning and cloud computing, every powered device is becoming smarter, better and more efficient.

Tektronix's recent 2021 Tektronix Innovation Forum provided an opportunity not only to learn about the latest developments and future trends in high technology, but give participants a chance to get a feel for how their peers are handling the latest technological developments.

We talked to Suchi Srinivasan, product line manager at Tektronix, about the event and some of the trends and technology she saw.

One of the aspects of electronic design is that it's a double-edged sword. The more advanced the technologies are, the more advanced the test technology has to be in order to evaluate and measure it. Right?

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or systems—that evolution has requirements in terms of signal characteristics, what needs to be measured, that definitely increases the complexity of the test solution. The fact is that the test solution has to be much better when it comes to resolution, speed and the ability to capture the right information and translate that into good data.

In test, the lines on your ruler always have to be closer together than the lines on their ruler. You could point your finger at any advanced developing technology, and it's a test and evaluation challenge too.

When it comes to characterizing these wide-bandgap components, or scale that to thinking about system-level solutions, we are building up technologies for probing, that can access these signals the right way, and translate the signals without losing that signal integrity. Our signal-acquisition systems within our scopes, it is important to have the right resolution in order to be able to capture those signals, and then the software being able to process these in the right way. Being able to capture the critical parametric and timing performance, and so on.

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So we can scale from IC-level testing all the way to module testing and system level testing, in order to help improve the time to market for our customers. There are similar examples of what's happening in other application areas like wireless—for example, 5G and 6G and IoT, and similarly, in the wired segment as well.

There are a lot of moving parts in all of those application spaces, and they all have to be monitored. One of the aspects of the expansion of smart everything is, eventually everything that draws electrical power will be connected in some fashion. What are your thoughts on that?

Absolutely right. So the connectivity space has definitely evolved. We're getting into times where our doorbell is able to communicate to our cell phones, our cell phones communicating to the lights in our homes. I've been able to talk to some

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of our smart speakers and essentially get things delivered at home. It's definitely true, we live in a world of convenience.

With that, the introduction of new technologies, whether that be, ultra-wide-band, the new generation of Wi-Fi 6, and so on. And with this connected technology comes complexity of handling the higher bandwidth requirements. And that's where again, innovation within Tek plays a big role, because as we're continuing to stretch the capability of our processing units, we keep some of these standards in mind.

Theoretically, you can be completely aware of a product from the moment you conceive of it, until the warranty runs out in the field. Today you can literally go to a product at any point in the chain, and know everything about it. A truck gets a flat tire with the parts on it, and you could see the numbers change on the spreadsheets. So now having said that huge setup, what are your thoughts on that concept of the ever-present awareness of product?

I think the big takeaway is, within the test and measurement industry, we have to stay on top of all this, and evolve quickly.

Typically, when I'm spending time with my team, we are doing these idea sessions in terms of what's next, and what are the big disruptors that are coming. The things that we always keep in mind are, how much do we understand the customer's pain point? What are they going through right now, that is preventing them from being able to debug faster and get validation of their solution?

I can think of a recent example, where we have these wide-bandgap semiconductors going in a big system, a generator board for one of our end customers. They were having problems with signal acquisition. Not only that, they were having overall system-level problems and they did not know what was causing it. So their mind directly went to, hey, it must be that wide-bandgap device, because that's the one thing that we changed on the board, and so on.

That's where, with Tek's help, given our probing solution, they were able to not only access those signals, but were also able to translate that with respect to the right requirements, voltage and current requirements. And our scopes were able to translate that into something that is visual. They were able to debug each part of their signal chain and figure it out where exactly the problem stood. So, that evolution in terms of understanding the customer needs, whether that be the debug methodology, or whether that be the software needs that they're looking for.

Even in terms of processing needs, we continue to see IC standards evolve. Multiple channels now are needed in terms of signal analysis, not just for the closing signals, but for the conditioning signals, the output signals and so on. So they had,

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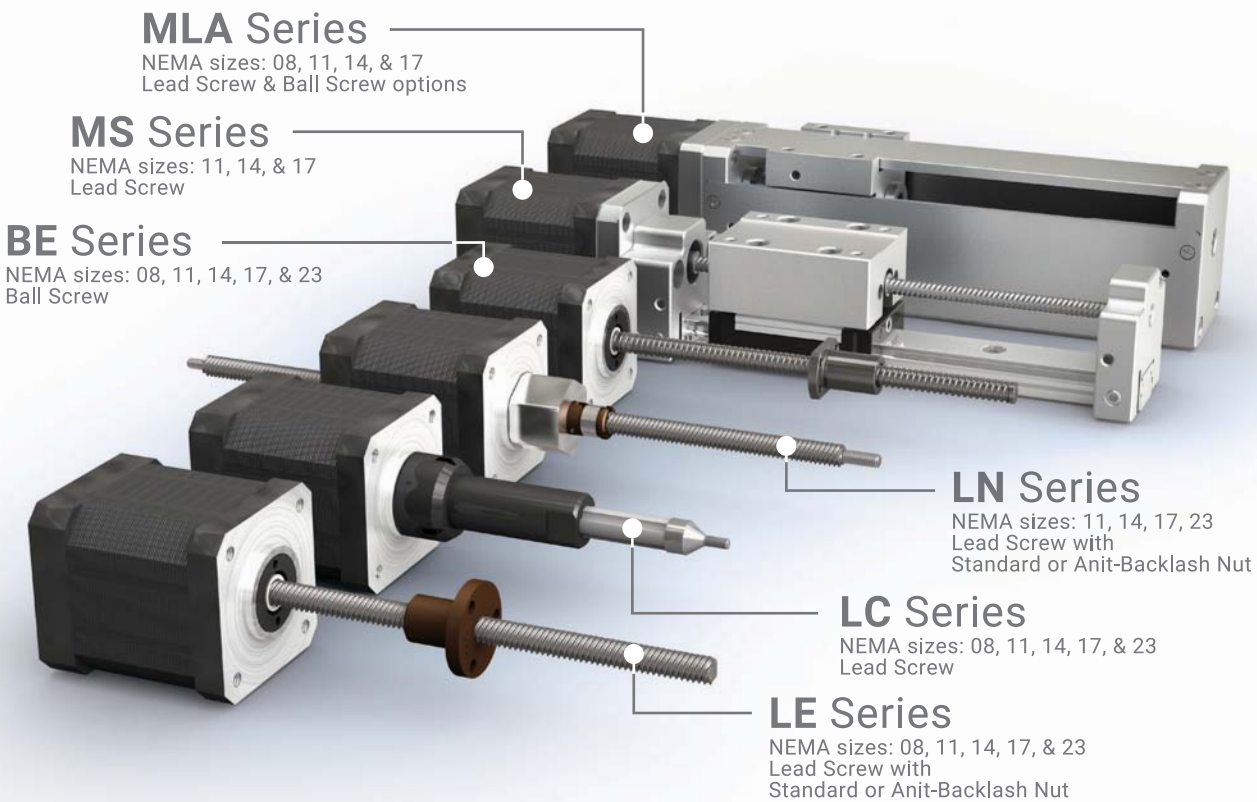

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Everything that we use in our daily life—mobile phones, computers and now, with autonomous driving as well, with cars starting to communicate to each other—there's a big need for the data.

again, another example with our evolution with the TekScope, where you can have four to five scopes, and synchronize all of these scopes, and look at multiple signals, all at the same time, in order to mix and match and analyze circuits.

Those are some examples of how Tek has been evolving quickly, given some of the needs that we see in the market and the acceleration that is naturally happening in the market space as well. Also, as part of these idea sessions, we think about some of the future problems. Data centers are a great example. We're all using tons of data: Everything that we use in our daily life—mobile phones, computers and now, with autonomous driving as well, with cars starting to communicate to each other—there's a big need for the data.

These data centers are going to be huge hubs of data transfer. And data throughput is going to become a big need. So they're again evolving in terms of AI or machine learning, in order to upgrade their algorithms, their software applications.

Now we're in the final stages as it were of ultimate connectivity, no wires, nothing.

Absolutely. No wires, lower power, smaller size and all these characteristics, kind of coming together to form the solution. Which has been an interesting transformation because we almost have to rethink the way we end up acquiring signals or processing the signals. And that actually brings me to a topic about sensing and sensors.

We know that everything in the world around us is analog and the sensors are going to play such a major role, in terms of acquiring signals from the real world, and then helping us translate into the digital world—which is where most of the processing happens, the communication happens and so on.

The one thing I see is the evolution of the sensors, whether that be for medical purposes, medical sensors, sensing in patient monitoring or sensing in the automotive application. Especially with all the safety requirements and so on. md

EDITOR'S NOTE: This is a video interview excerpt from *Machine Design's* sister publication, *Evaluation Engineering*. The full interview can be found at *www.evaluationengineering.com/21238167.*

2021 IDEA! AWARDS WINNERS

BOB VAVRA | Senior Content Director

AT A TIME when manufacturers are looking for innovative ways to improve productivity and better manage costs, the 2021 IDEA! Awards provided a variety of great new solutions to review.

The IDEA! Awards, presented by *Machine Design* and *Hydraulics & Pneumatics*, offered engineers from all over the world a chance to review the latest product advancement. They also got to vote on those products they felt best fulfilled the promise of greater operational effectiveness.

Gold, Silver and Bronze winners have been selected in six categories:

- **Automation & Software**
- **Fluid Power**
- **Machines & Components**
- **Motion Control**
- **Motors & Drives**
- **Sensors**

The Branson GMX-20DP ultrasonic metal welder from Emerson received the Big IDEA! Award, presented to the product that received the highest number of votes from all product categories. The formal announcement of the awards was made Nov. 10 at the 2021 IDEA! Conference, part of the Manufacturing & Technology Conference in Cleveland. The announcement also was made simultaneously at *machinedesign.com* and *hydraulicspneumatics.com*. md

BIG IDEA | MACHINES & COMPONENTS

GMX-20DP Ultrasonic Metal Welder

The Branson GMX-20DP ultrasonic metal welder joins thin, fragile nonferrous foils and films (approx. 5-10 µm) in assemblies of 100-plus layers using higher downforce and lower weld energy (weld amplitude). Its unique "direct press" actuator delivers direct vertical downforce on parts (unlike typical cantilever-type actuators) for more consistent, yet gentle joining of more "energy dense" many-layered battery structures, while virtually eliminating the film/foil tearing and cracking that compromises battery assembly quality. The Branson GMX-20DP welder directly enables the development of lighter, more "energy-dense" battery cells and packs, capable of delivering more watt-hours of energy per unit of battery weight.

Emerson
www.emerson.com

IDEA! AWARDS BIG IDEA

BIG IDEA!

Branson GMX-20DP Ultrasonic Metal Welder
Emerson

AUTOMATION & SOFTWARE

GOLD: Studio 5000 Design Software
Rockwell Automation

SILVER: Sitara AM2x MCU
Texas Instruments

BRONZE: OPTIME
Schaeffler Group USA Inc.

FLUID POWER

GOLD: SLV20 load-sensing proportional directional valve
Eaton

SILVER: MXT-XTP Hydraulic hose
The Gates Corporation

BRONZE: Cartridge Flow Transmitter (CFT)
DGD Fluid Power

MACHINES & COMPONENTS

GOLD: har-modular
HARTING

SILVER: Antimicrobial Food Grade Type LAFG
Electri-Flex Company

BRONZE: Four Outlet Gen4 Power Supply
EXAIR Corporation

MOTION CONTROL

GOLD: PGVA Pressure Vacuum Box
Festo

SILVER: SmartStage XY
Dover Motion

BRONZE: Electrak LL Electric Actuator
Thomson Industries, Inc.

MOTORS & DRIVES

GOLD: Hägglunds Atom
Bosch Rexroth

SILVER: Twin Multi-Drive
One Motion

BRONZE: DS2020 Digital Servo Drive
Moog Inc.

SENSORS

GOLD: AWR Antenna on Package Sensor
Texas Instruments

SILVER: Cordis Electronic Flow Controllers
Clippard

BRONZE: SBV-01
INXPECT

BRONZE: Tag-It Program
Regal Beloit

GOLD | AUTOMATION & SOFTWARE

Studio 5000 Design Software

Two new additions to the Studio 5000 design software allow for industrial engineers to design machines and processes more efficiently. The Simulation Interface tool transforms how users design, test, validate and commission systems using digital engineering. The tool connects a system's controller to advanced simulation and modeling tools. Users can then simulate how products or processes with dynamic properties will behave in production. The Application Code Manager (ACM) tool allows users to automatically generate documentation for projects after creating a template and placeholders for data. The ACM also allows users to import information from architect tools, which reduces rework.

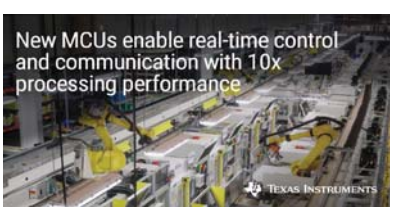
Rockwell Automation
www.rockwellautomation.com

SILVER | AUTOMATION & SOFTWARE

Sitara AM2x MCU

The Sitara AM2x microcontroller portfolio combines processor-level performance with MCU design simplicity to enable real-time control, networking and analytics applications at the edge. The portfolio enables 10 times the computing capability of traditional, flash-based MCUs. The Sitara AM243x device features up to four Arm Cortex-R5F cores running up to 800 MHz each, with integrated real-time control and industrial communications to simplify factory automation. Integrated stacks support common industrial protocols and gigabit Ethernet with TSN. The on-chip security features help engineers meet encryption requirements, while functional safety mechanisms and collateral can help achieve up to SIL 3 for industrial systems.

Texas Instruments
www.TI.com



BRONZE | AUTOMATION & SOFTWARE

OPTIME

OPTIME is an affordable and easily scalable condition monitoring system that consists of wireless, battery-powered vibration sensors, a cellular gateway and an app to visualize the resulting data. OPTIME provides 15,000 unique measurements per sensor per year to deliver advance warning of potential damage to machines such as electric motors, fans and pumps. OPTIME's sensors, which install in just minutes, can be put into operation without any prior condition monitoring expertise. OPTIME captures six different vibration measurements plus temperature at preset intervals, thereby adding value to the customer by providing timely information on machine condition status to avoid unplanned outages.

Schaeffler Group USA Inc.
www.schaeffler.us

GOLD | FLUID POWER

SLV20 Load-Sensing Proportional Directional Valve

Eaton's SLV20 load-sensing proportional valve is a priority flow-sharing solution for mini and micro machinery. Utilizing screw-in cartridge valves in aluminum sections, the SLV20 offers greater versatility and serviceability than cast iron valves, plus significant weight and space savings. A patent-pending multi-function logic element enables flow sharing and flow prioritization in the same valve bank, a feature previously available only on heavy traditional valves. Individual sections can be produced with additional functions, such as counterbalance valves, replacing remotely mounted ancillary valves. By reducing machine weight and providing flexible flow-control options, the SLV20 can increase efficiency, load-carrying capability and battery life.

Eaton
www.eaton.com

SILVER | FLUID POWER

MXT-XTP Hydraulic Hose

MXT-XTP is a hydraulic hose that combines patented wire braid technology that makes it lighter weight and more flexible while maintaining 600,000 impulse cycle performance, which is three times the industry standard. The abrasion and ozone resistance XtraTuff cover provides additional protection for the hose to stand up to the toughest of applications. Ozone is everywhere and impacting hose performance, so having a robust cover material to prevent hose breakdown and keep machine uptime high is of great benefit. MXT-XTP joins the Gates lineup of other industry leading products that include MXG4K-XTP and Multi Master GMV.

The Gates Corporation
www.gates.com

BRONZE | FLUID POWER

Cartridge Flow Transmitter (CFT)

DGD Fluid Power enters the hydraulic market with the CFT (Cartridge Flow Transmitter) with multiple output options provides a convenient digital solution to measure flows in hydraulic systems. The flow transmitter can be easily installed anywhere in the hydraulic circuit for continuous monitoring of all critical hydraulic functions, e.g., component performance, diagnostics, closed loop control and data acquisition for predictive maintenance and remote troubleshooting. Future models to be released include pressure and temperature sensors, combined with the CFT in a cartridge valve format.

DGD Fluid Power
www.dgdfluidpower.com

GOLD | MACHINES & COMPONENTS

har-modular

HARTING's har-modular series offers a unique and flexible solution for the connection of PCBs. A modular concept, based on the time-tested and reliable DIN 41 612 connector family, this product allows engineers to develop custom connectors using off-the-shelf components. In this way, customization can be achieved without the normal barriers of long lead times and development costs. This revolutionary PCB connector system offers over a billion combination possibilities for data, signal and power. It is configurable online and can be ordered in quantities of 1.

HARTING
www.harting.com

SILVER | MACHINES & COMPONENTS

Antimicrobial Food Grade Type LAFG

Type LAFG is a UL listed, CSA certified "Heavy-Duty," flexible liquid-tight steel conduit that is now antimicrobial. It is designed to safety route electrical wiring through modern food processing plants, while safeguarding foreign material contamination, and inhibiting bacteria growth. The flexible PVC jacketing contains an antimicrobial biocide additive, inhibiting bacteria growth and reducing commonly known food processing microbes in a 24-hour period. The blue jacketing color does not occur naturally in the food chain, making plastic contamination in the product stream easy to spot. The increased high/low working temperature are critical for installations near heat-producing equipment and hot washdowns.

Electri-Flex Company
www.electriflex.com

BRONZE | MACHINES & COMPONENTS

Four Outlet Gen4 Power Supply

EXAIR's Gen4 Four Outlet Selectable Voltage Power Supply allows the choice of input voltages of 115 VAC or 230 VAC. Four 5kV stainless steel output connectors can energize four static eliminators at once. They are UL component recognized, CE and RoHS compliant. They feature an electromagnetically-shielded modular power supply cable which eases routing and connections. An integrated fuse on the primary protects against voltage spikes. The lighted power switch indicates operation and is field replaceable. The Gen4 Power Supply is housed in a durable metal enclosure (6 in. L x 4.0 in. W x 4.4 in. H) that is ideal for rugged, industrial environments.

EXAIR Corporation
www.exair.com

GOLD | MOTION CONTROL

PGVA Pressure Vacuum Box

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Festo
www.festo.com

SILVER | MOTION CONTROL

SmartStage XY

The SmartStage Linear is the first of its kind high performance stage where the motion controller, drive circuit and encoder are all built-in, reducing the overall motion footprint within the instrument. By embedding multiple cables and external electronics, the control is seamless and performance-optimized for low noise.

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- 50-200 mm travel available, stackable for XY

Dover Motion
www.dovermotion.com

BRONZE | MOTION CONTROL

Electrak LL Electric Actuator

Thomson Electrak LL actuators give linear motion designers new capabilities to deploy intelligent electric products for long-life operations in challenging environments. A brushless motor design enables up to 100% duty cycle and ten-fold increase over standard travel distance. High ingress protection and wide temperature ratings maximize reliability in harsh environments. Designers can now leverage smart actuators in applications that previously required more complex and expensive configurations, such as battery-powered mobile devices and machines. The Electrak LL is ideal for lifting and positioning in mobile equipment; pantographs; door, hatch and valve control; pick, place and sort; material handling; and conveyor control.

Thomson Industries, Inc.
www.thompsonlinear.com

GOLD | MOTORS & DRIVES

Hägglunds Atom

The Hägglunds Atom from Bosch Rexroth is one of the fastest, most power-dense hydraulic motors in its class. A revamped version of the Hägglunds CAb, Bosch Rexroth's smallest Hägglunds motor, this radial piston motor supplies maximum torque of up to 13.6 kNm and a specific torque of 40 Nm/bar. With full torque at speeds up to 400 rpm, its maximum power of 394 kW substantially outstrips motors of similar size. Hägglunds Atom is ideal for mobile, marine and recycling applications.

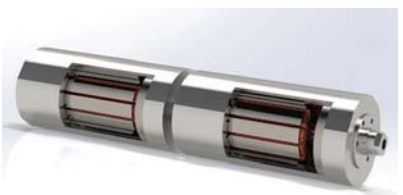
Bosch Rexroth
www.BoschRexroth.com

SILVER | MOTORS & DRIVES

Twin Multi-Drive

The Twin Multi-Drive by One Motion is a revolutionary design that allows for independent control of two rollers on a single shaft, with precise registration and speed ranging from up to 500 RPM. Motion is created by directly driving the outer rotating shell using magnetic force. The gearless, magnetic direct drive design is hygienic, reliable and highly efficient. The Twin offers a high-performance solution for numerous applications such as product merge, skew correction and more.

One Motion
www.onemotion.info



BRONZE | MOTORS & DRIVES

DS2020 Digital Servo Drive

Moog's DS2020 drive with Combitronic capability satisfies customers who need larger, high torque motors, while leveraging the advantages of SmartMotor technology. The DS2020 expands Moog's standard drive's capabilities by allowing it to act as a follower device on the Combitronic network, which means the drive can be controlled by any Moog SmartMotor on that network. The DS2020 works seamlessly in SmartMotor-based machines and applications, while supporting the SMI software and AniBasic programming language to configure and program the entire system.

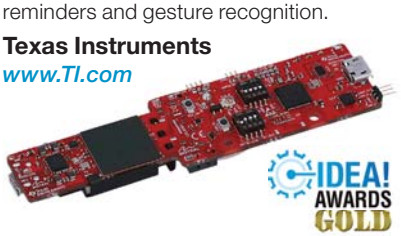
Moog Inc.
www.moog.com

GOLD | SENSORS

AWR Antenna on Package Sensor

TI's family of pin-to-pin compatible 77GHz/60GHz single-chip radar sensors with integrated antenna-on -package (AOP) for near-field and in-cabin automotive applications are 25% smaller than non-AOP devices. Sensors can be added to space-constrained areas such as door handles and headlights for smart door openers and parking sensors and the vehicle pillars and overhead console to enable child-presence detection, seat belt reminders and gesture recognition.

Texas Instruments
www.TI.com



BRONZE | SENSORS

SBV-01

The SBV-01 is the first world safety motion device for industrial applications based on radar technology certified SIL2 PLd. It consists of a controller and from one to six sensors that monitor operator body presence both in access and in restart prevention, and even when the operator is standing still. Volumetric 3D detection and increased robustness allows for outdoor and harsh environment use.

INXPECT
www.inxpect.com

BRONZE | SENSORS

Tag-It Program

The Regal Tag-It program powered by Perceptiv intelligence is an asset management platform with functionality that enables users to view details on mechanical and electrical assets in operation and reduce redundant or obsolete inventory. Perceptiv wireless monitoring can also be added to watch critical assets at all times. A push of a button shows the equipment health, allowing users to be proactive with maintenance and replacements.

Regal Beloit
RegalBeloit.com

SILVER | SENSORS

Cordis Electronic Flow Controllers

Clippard's new compact Cordis Flow Controller utilizes an extremely fast-reacting mems technology sensor upstream of Clippard's proportional electronic valve. Adding an optional DR-2 precision regulator for accurate and precise pressure control makes for a very small, compact package by eliminating the need for an external regulated supply. <50 ms response time, ≤25 mV resolution and IP65 housed. It features:

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Clippard
www.clippard.com

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Available in sizes 1/4 or 3/8. Watch the How-To-Video for more information.
parker.com/56-rapid-assembly

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PATRICK COENEN | Project Engineer, Sharpe Products

Metal Fabrication Fundamentals: Find the Right Method

The TubeInspect equipment offers real-time diagnostics and monitoring, allowing immediate bend correction and decision-making.
Sharpe Products

The metal fabrication industry consists of numerous different segments, from large OEMs that supply the machine technology needed for creating parts to smaller, more specialized shops that build to customer demand. Many markets rely on this type of manufacturing, as in some cases it is more cost-effective to outsource this work than to invest in the resources and develop the skills needed to do the work onsite.

In aviation and aerospace, part forming is commonly needed to create rotors, landing gear and hydraulic controls; for automotive, custom formed metal tubing may be used for heat exchangers and exhaust manifolds; and for food and beverage, bent tubing is needed for commercial serving tables as well as the piping used in craft brewing equipment.

In the furniture and fixtures industry, you'll notice tube and pipe in chair legs, rounded frames for tables or metal safety bars for bathrooms. For many medical and healthcare equipment companies, formed pipe and tube is used to construct patient beds, as handles and frames for mobile supply carts and disinfectant equipment, and in the institutional seating found all over clinics and hospitals.

The recreation industry relies on metal fabricators for custom tube bends that form the frames for seating or structures in public playgrounds and parks, or for off-road recreational vehicles such as ATVs or related equipment. In the commercial building space, you'll find ornamental metal fabricators that focus on highly curated metal work, as well as those that focus on standard metal parts for more discrete structural applications.

AT A GLANCE:

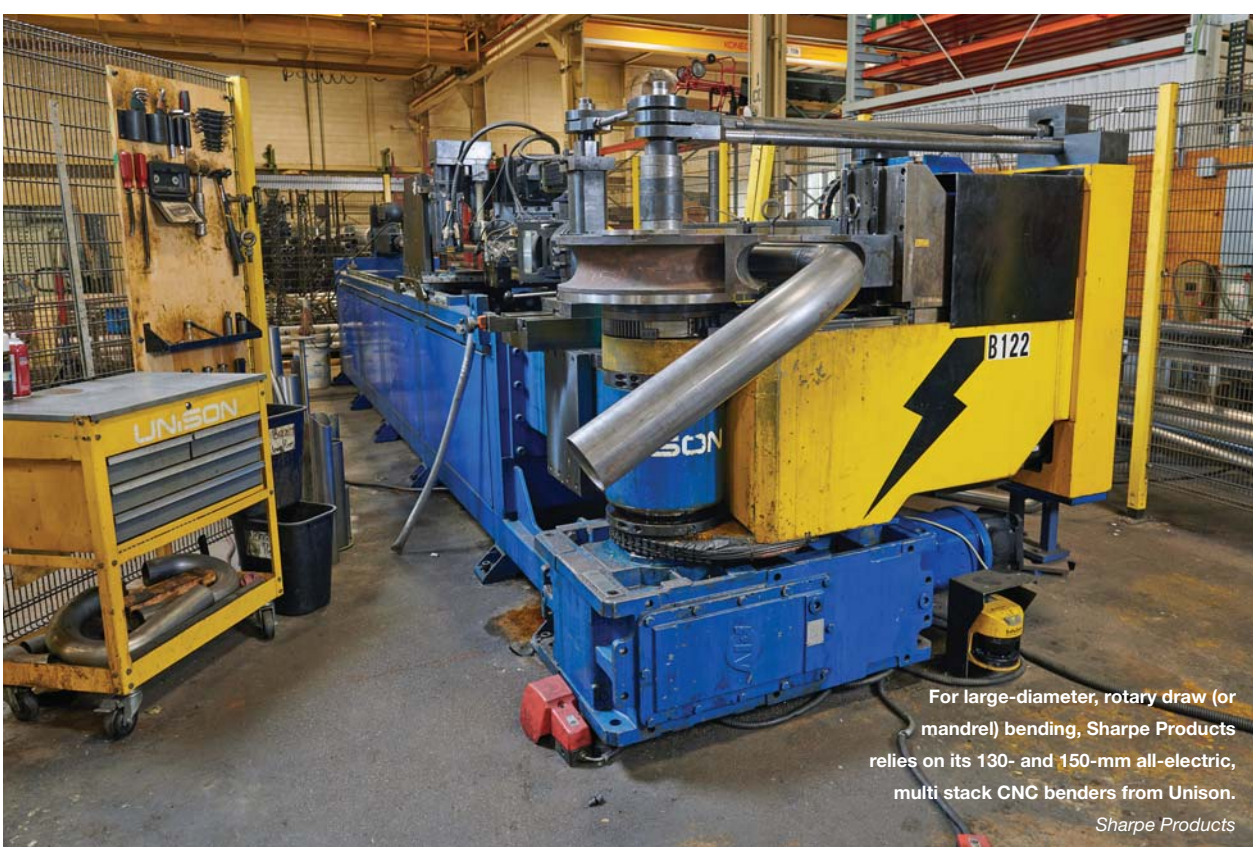
- While applications vary by industry, quality metal fabrication conforms to several basic rules and requires fundamental processes.
- While there are many bending solutions and strategies, nothing can get properly accomplished without proper tooling.
- Understanding the fundamental processes, tools and terms in the metal fabrication discipline can help ensure a successful project outcome.

Identifying Bending Methods

When it comes to bending pipe or tube, there are several methods used to achieve a quality, custom-formed part. The primary bending methods are compression bending, roll bending, freeform bending and mandrel bending (also called rotary draw bending), which is the most common method. Here is more detail about each of these techniques:

Compression Bending

This is a simple method of bending pipe or tube where the bend die stays stationary while a counter die bends or compresses



For large-diameter, rotary draw (or mandrel) bending, Sharpe Products relies on its 130- and 150-mm all-electric, multi stack CNC benders from Unison.
Sharpe Products

With freeform bending, the material is continuously guided through the machine using one die that is the size of the pipe or tube being bent. *Nissin Precision Machines Co. Ltd.*

the material around the fixed die. This method requires a bend die that is the size of the desired bend radius. The material is then formed around the bend die, without the use of a mandrel.

Roll Bending

Roll bending is typically used for large radius bending. In this process a piece of pipe or tube rotates through three rollers that are in a triangle configuration. The two outer rollers, usually stationary, cradle the bottom of the material while the inner roller, which is adjustable, presses on the top of the material. This method is ideal for large radius bends and is best suited for producing large, wide radius sweeps.

Freeform Bending

Freeform bending uses one set of tooling to bend variable or multiple radii. Normally pipe and tube bending requires a bend die, a clamp die, a pressure die and sometimes a wiper; with freeform bending, the material is continuously guided through the machine using one die that is the size of the pipe or tube being bent. Most any radius can be achieved using a single die set.

Rotary Draw or Mandrel Bending

One of the most precise methods, CNC rotary draw bending is probably the most tooling-oriented. As many as six tooling sets may be needed for a project, based on its size and scope. Of these, the three most important types are the bend die, pressure die and clamp die. Depending on the bend radius and wall thickness, a mandrel, wiper and collet may also be needed.

Within this discipline is also multi-radius bending, which is commonly used for complex parts when one continuous pipe or tube requires two or more center line radii. It is a good fit for parts with a large centerline radius, where hard tooling may not be an option, or for complex parts that need to be formed in one complete cycle.

Multi-radius bending is commonly used for complex parts when one continuous pipe or tube requires two or more center line radii.

Designing products with components that require custom tube or pipe forming can be more involved than it may initially appear. Factors such as tooling, materials and labor play a role in the approach to bending and associated services.

Multi-radius bending is ideal for exhaust and emissions control, oil and gas, and other process applications where interior surfaces must be consistent in order to withstand pressure, flow rate and volume of the material going through the tube or pipe. This type of bending is also used to create components for heavy equipment and a variety of structural frames.

Let's Talk About Tooling

Regardless of the amount of bending equipment available, nothing can be done without the right tooling. There several different types of tooling used in bending based on the application or end-use.

The bend die is central to the tube forming process, as it rotates to form the center line radius. A concave channel on the die mates with the outside diameter of the tube or pipe, helping to hold the material while it is being bent.

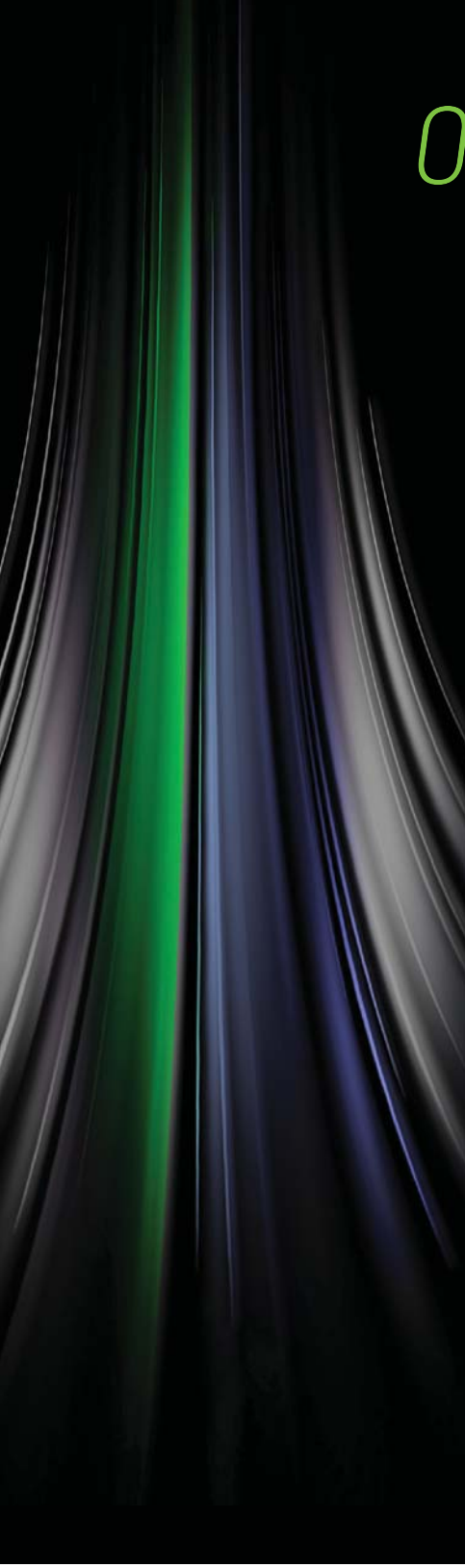
The pressure die mates up with the tube, adding stability as the tube wraps around the bend die. The clamp die works in tandem with the pressure die, holding the tube against the straight section of the bend die as it turns.

When needed, the wiper die is used. Riding toward the end of the bend die, this tooling helps to smooth out the surface along the inside radius as the tube or pipe moves through the bend, preventing wrinkles and supporting the tube wall.

A mandrel is a bronze alloy or chrome plated steel insert that supports the pipe or tube on its inside. Its purpose is to prevent the tube from collapsing and minimize ovality.

The collet grips onto the tube during the bend process, rotating it into position for the next bend. It softly closes onto the outside of the tube, guiding and moving it into place.

Depending on the size of the material being bent and the annual usage, it is sometimes necessary to create bend dies if none exists for the particular project. This type of upfront investment can range



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from $2,000 to $20,000 and is sometimes amortized across the life of a project.

If there is flexibility to adjust the part specification, an alternative is to consider using an existing bend die with a similar radius to the original part design, thus saving on cost and lead time to produce; however, sometimes this is unavoidable.

Terms in Custom Bending

For custom bending of metal tube and pipe, there are several standard terms that are widely used when determining feasibility and scope of work required for a project. Here are a few of the commonly used keywords you'll hear if working with a metal fabricator for this type of job:

Center line radius. As a general rule, the tightest achievable center line radius is one times the pipe or tube diameter. Whenever possible, try to choose a center line radius of one-and-a-half times or greater than the tube diameter to save labor costs. Check your vendor's tooling list to help you make this selection.

Wall thickness. When bending pipe or tube, the wall on the outside radius can thin up to 33%, depending on the radius and other factors. This is important to keep in mind if your application involves high pressure or flow, as a thicker wall may be necessary to achieve the desired results.

Straight length between bends. Typically, a straight dimension between bends should be two to three times the tube diameter, depending on the radius. Tubes with little or no straights between bends can be done using freeform bending, which in some cases may require additional tooling.

Tolerances. The industry standard is still considered to be ±1 deg. on bend angles. Tighter tolerances to 0.2 deg. can be achieved with laser spring back technology, if required by the application. Lineal tolerances are normally ±0.062 in. or tighter. The industry standard for ovality is 8% and can be lessened as needed.

Drawings. When submitting part drawings, it is important to include the pipe or tube specs, material type, center line radius, tolerances and any other details about the scope of the project. Be sure to include model files along with a PDF for easy viewing and analysis.

Designing products with components that require custom tube or pipe forming can be a more involved task than it initially appears. Factors such as tooling, materials and labor play a role in the approach to bending and associated services. And although the available machine technology for tube bending has evolved over the years, many of the variables remain the same. Having a basic understanding of what is involved in custom tube bending, and consulting with a trusted supplier, will help support the design process while informing project timelines and costs.

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COLM GAVIN | Portfolio Development Manager, Siemens Digital Industries Software

Robots Can Talk the Same Language

By implementing universal robot libraries, automation engineers use a single software environment.

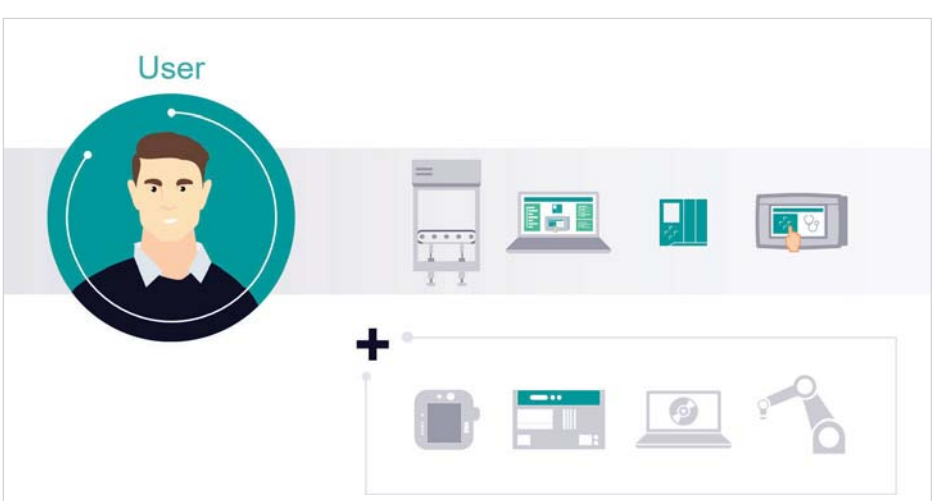
Siemens

Driven by technological innovations, increasing applications, falling prices and greater adoption of factory automation, the use of robots is ballooning globally. From just 2013 to 2017, the number of annual industrial robot installations more than doubled in the combined American, Asian, Australian and European markets.

The rise of robots is streamlining many corners of factory automation, ranging from automotive to pharmaceutical to electronics manufacturing, among many others. And like other innovations in manufacturing, the increasing utilization of robots comes with a set of challenges.

While robots often operate in concert with other machine automation equipment, proper configuration can be complicated utilizing available programmers in the best circumstances, and impossible without the assistance of specialists in the worst cases.

Modern robot libraries within integrated automation software—and artificial intelligence (AI)—improve on this situation, making cross-manufacturer robot integration more readily available to a broader base of automation engineers.



1. In the classical robot configuration narrative, an automation programmer is not only responsible for commissioning plant PLC, HMI and machine equipment, but also the robot, its controller and HMI. *Siemens*

Compatibility Issues

In many factories where robots are used, complex moves are configured and programmed within dedicated robot controllers. These controllers use inputs and outputs (I/O) for data exchange with PLCs and other automation components. This separation of controllers presents challenges for synchronous operation among robots and other machine equipment, especially among a diverse group of manufacturers' robots, each with a different robot controller.

Each robot controller typically operates with unique software I/O structures, creating the requirement for a central PLC programmer to pair a different structure of code with each manufacturers' controller among otherwise similar robots. The programmer must also ensure correct code usage in each of the various robot controllers, according to the rules of manufacturer-specific software and hardware.

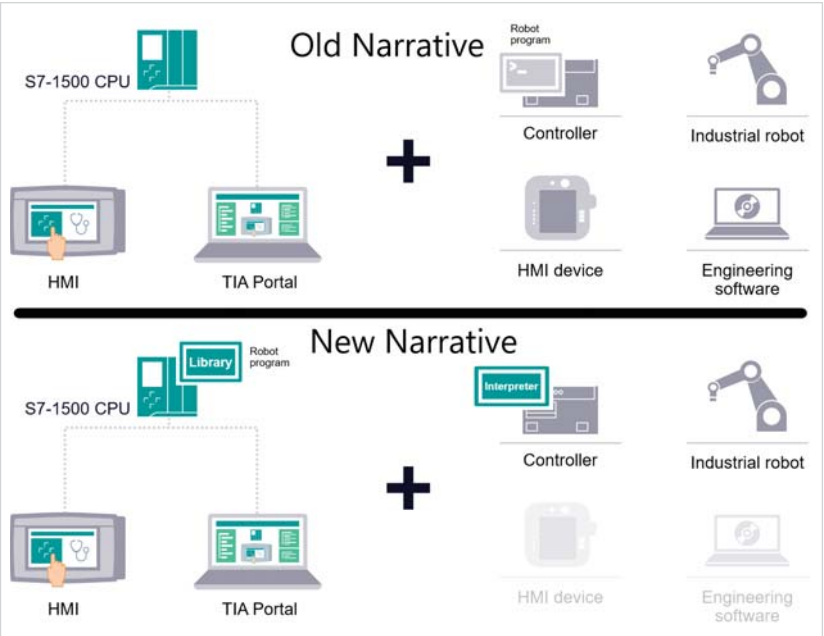
Additionally, there are often robot HMIs to configure. With so many configuration environments—each typically requiring specialized knowledge of its particular programming characteristics and language—the required engineering and commissioning efforts, along with propensity for errors, are high *(Fig. 1)*.

Service and maintenance also are complicated, particularly with many components to troubleshoot when issues arise.

Using Universal Robot Libraries

A new narrative in robot configuration and programming is on the rise, more closely integrating multi-axis robot control with other machine automation PLC code, driven by robot libraries provided with integrated automation software suites. These libraries—which provide the means to drive robots entirely in a PLC program—are empowering engineers and tech experts to program robots on their own, while reducing reliance on expensive specialists.

By bringing robot control within PLC code, automation engineers can program robots without the need to understand the intricacies of robot control language.



2. Siemens SIMATIC Robot Integrator software embeds robot control within a standardized PLC library, universal among multiple manufacturers' robots.

Siemens

The robot controller remains, acting as an interpreter of PLC code blocks, but interpretation takes place intelligently behind the scenes of the PLC-commanded moves *(Fig. 2)*.

This enables easy integration of robots with other machine automation components using the same and familiar PLC programming software to control multiple manufacturers' robots in a single subroutine, making time-sensitive robot interactions much easier to implement. In a typical deployment, there is no need to touch anything in the robot controllers.

While this functionality is especially useful for end-users, machine builders also benefit by increasing their ability to standardize automation programming. For end-users and machine builders alike, this functionality provides the ability to use the right robot for the desired job, with nearly identical programming and operational interfaces, regardless of the robot manufacturer.

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3. A picking robot improves its movement intelligence over time as it learns how to grasp and move products more efficiently. *Siemens*

These robot libraries also include standardized HMI faceplates, maintaining the same operational procedures, look and feel among multiple manufacturers. Within a robot faceplate on the primary machine HMI, programmed using the development software environment, engineers can place robots in jog mode to move them to defined positions. They can also teach robots positions and path points using built-in toolsets.

For new robots or paths, entire move trajectories are configurable in the graphical HMI faceplates, with the configured paths available for consumption and direct use in the PLC program. These universal HMI faceplates are ready-to-use in modern robot libraries, without any programming required—just relatively simple configuration.

The libraries serve as bridges to robotics, eliminating the need to change programming procedures or practices when switching among robot types or manufacturers. Some advanced systems even support simulation and AI-driven path planning, and the central location for all programming within a PLC makes edge computing with robots more achievable.

Robotic AI Enhancements

AI is further increasing the effectiveness of robots on the plant floor, with intelligent spatial assessment and smart object recognition automatically enabling robots to perform many tasks without the need for complex customized movement algorithms. This helps production lines scale up with limited programming effort required, and it empowers manufacturers to increase production while decreasing lead time.

Robots can work in tandem with visual analysis AI to verify quality standards are met, and to improve their own movement intelligence over time. Robot AI application examples include:

- Robotic arms with mounted cameras verifying products are free of defects.

- Autonomous guided vehicles in warehouses calculating and learning the most efficient routes for material handling.
- Self-driving cars identifying and avoiding road hazards and obstacles.
- Picking and packing robots optimizing product placement orientation *(Fig. 3)*.

Many robots still require operators or programmers to provide explicit instructions, but as these examples show, AI is becoming more prevalent. As this trend continues, robots will continue to carry out difficult, dangerous or demanding tasks otherwise executed by humans, freeing up skilled personnel to focus on innovative process improvements.

Identifying Results

A pharmaceutical manufacturer reduced programming and development time by about 30% by deploying the Siemens SIMATIC Robot Integrator software for use with its new and existing filling and sealing robots. Prior to the upgrade, engineers relayed messages for removing and placing hygienic labels between a robot controller and the PLC, which was driving other automated components on the line.

By deploying the Robot Integrator software, the manufacturer consolidated control to the central PLC, eliminating the need to write code in multiple robot controllers. This significantly reduced the programming learning curve because robot library code within the Siemens TIA Portal integrated automation suite is identical from robot manufacturer to manufacturer. Additionally, the robot HMI faceplates now provide the pharmaceutical manufacturer with the ability to quickly modify its recipes for pivoting between batches when required.

Save Time, Increase Efficiency

Robot integration libraries and advances in AI are increasing the value of robots on the plant floor by simplifying configuration, programming and maintenance. In some software environments, simulation and digital twins are available to help programmers tweak their code for more accurate robot moves prior to field deployment.

These capabilities provide automation engineers with more time to spend stringing together series of robot paths to get a job done—the time gained by eliminating the need to define the mechanics of each move, as well as data exchange between the PLC and robot controller. These capabilities also do away with custom robot software configuration and programming, making robot programming accessible to a wider base of engineers, regardless of the robot type or manufacturer *(Fig. 4)*.

As a result, implementers are reducing project development time and costs, and benefitting from increased machine efficiency and manufacturing profitability. md

4. The Siemens SIMATIC Robot Library empowers automation programmers to control robots within a single PLC using identical programming blocks regardless of robot manufacturer. *Siemens*

REHANA BEGG | Senior Editor

Manufacturing Manikins for Medical Simulation and Training

Human patient simulators and life-imitating technologies enable medical and frontline workers to respond with confidence in emergency situations.

Angela Alban had aspirations of becoming a physician before fashioning a career in developing manikins. Her aspirations were short-lived once she discovered that she fainted at the sight of blood.

Instead, Alban pursued a master's degree in computer engineering at the University of Central Florida, which placed her near the heart of Central Florida Research Park, a modeling, simulation and training hub that links defense, government, industry and academia.

Finding a niche in medical simulation and training, it turns out, was an excellent fit for Alban, as it created the impetus to start her own company. "I started SIMETRI in 2009 seeking to do direct work with the government in research and development of new training technologies to address training gaps," said Alban.

Angela Alban, President and CEO, SIMETRI.

Today, SIMETRI, based in Winter Park, Fla., manufactures state-of-the-art lifecycle designs of anatomical models that help prepare medical professionals for critical care situations and for training critical procedures without the safety concerns of practicing on live patients. The goal is to mimic real-life emergencies as accurately as possible so that complex medical scenarios can be performed safely, without risk to patients and to reinforce learning.

Human patient simulators may mimic the human body with varying degrees of realism—or fidelity—and can be used in almost every aspect of healthcare education. The most effective medical training devices are those that have the ability to create accurate modeling of the underlying structures of the human body and replicating them digitally and physically, noted Alban. It is why SIMETRI's anatomical models and medical training aides integrate electronic, mechanical and computational components and turn to materials science for innovations in soft and skeletal tissue.

SIMETRI's anatomical modules may be designed for the purpose of diagnosis, treating injuries or studying anatomy in support of military medics, first responders and trauma center personnel, explained Alban. Still others—e.g., par-

AT A GLANCE:

- Angela Alban, CEO, SIMETRI, describes how she built a medical simulation and training company from scratch.
- Based in Winter Park, Fla., SIMETRI manufactures state-of-the-art lifecycle designs of anatomical models that help prepare medical professionals for critical care and emergency situations.
- SIMETRI's anatomical models and medical training aides integrate electronic, mechanical and computational components coupled with materials science for innovations in soft and skeletal tissue.
- Miniaturization of electronic components has affected the manikin market and the pandemic has slowed the pace of growth.

tially amputated limbs—may be integrated with partner technologies such as those employed by the Laerdal SimMan.

Modular manikins have an advantage that allows one to add or change features, by adding or taking away fidelity to control costs, and to provide only what is needed for the training experiences. "We're already starting to see modules sold with different kinds of arms and legs for different purposes," Alban said.

In fact, it is this opportunity that is defining SIMETRI's role in the market, said Alban, as her company has veered toward catering to the peripheral market, or where the manufacturer augments what customers already have or what they're buying. "We're pushing the envelope that way," she said. "I'm starting to see that some of the manufacturers are starting to come out with those optional limbs and capabilities that we're already developing."

Product Development

For a recent design—supported by the Small Business Innovation Research (SBIR) program—Alban and her team were challenged to not only develop an anatomical prototype for a procedure called humeral head intraosseous insertion (HHIO), but to also prove whether the innovation could be commercialized.

In basic terms, the HHIO procedure allows the medic to quickly introduce

Angela Alban works with a team of experts to develop realistic models of human anatomy by using synthetic tissue and materials that mimic human tissue in look and feel.
All images courtesy of SIMETRI

fluids and medications into a patient's arm. "Imagine a scenario where you're in the military and doing the procedure in the dark," explained Alban. "This is very quickly done on the head of the humerus; you can push fluids through within 30 sec. and a with much higher volume than through any other means. It was a particular procedure that they were not able to train with accurate anatomical models; they were using other means to train."

SIMETRI's solution was a static arm that sat in a recommended position so one could feel the bone, insert or drill into it, then aspirate bone marrow and inject fluids. In effect, SIMETRI developed the mechanisms to help simulate the elbow and the shoulder, as well as the underlying bone and soft tissue.

The prototype or Phase I of the project demonstrated the concept and was done manually, said Alban. For the next phase, Alban's team brought in SolidWorks models and created CAD designs. Alban said her team purchased a "less expensive" 3D printer for prototyping the part's form, fit and function when fitted under the anatomical soft tissue simulating the arm and shoulder. They created a model that could articulate and rotate the arm so it could accurately rotate the humerus head. ("Once we're able to feel the humerus head, we can inject," she said.)

CAD and additive manufacturing.

Her team produced various designs and 3D printed versions of the model in-house. "Once we perfected it to provide the kind of friction and pushback comparable to the experience of drilling into a human bone, we had it mass-manufactured by a vendor," Alban said. "All of that saved us a ton of time and a ton of money, and also helped us accelerate the speed at which we could get to a point where we could get a usable model into the war-fighters' hands."

Embedding Sensors

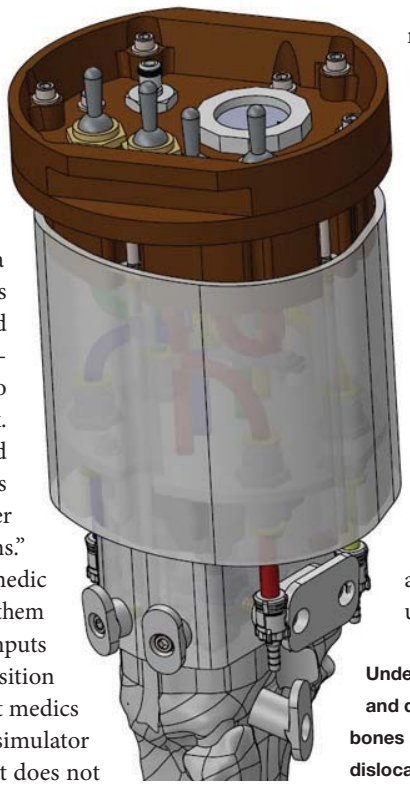
In another example, the Defense Health Agency, issued a call for a training device

that supported training on how to reduce a dislocated shoulder joint. "It's very hard to teach this procedure unless you actually are in the emergency room or in the clinic when someone comes in," said Alban. "You rarely will be able to actually physically train it."

SIMETRI responded by developing a medical device that incorporates sensors within the shoulder's soft tissue and behind the scapula, "where one should be massaging," said Alban. Part of the procedure is to give patients a sedative to help them relax. "It's very painful, so they're very tense," said Alban. "What's happening is that the muscles are constantly trying to bring that shoulder back—so they're fighting and having spasms."

Sedatives help calm the patient, but the medic still has to fatigue the muscles by massaging them in the correct locations and based on the inputs from the sensors. The sensors capture position data as well as pressure data to ensure that medics are doing it in the correct manner. "The simulator reduces the joint back into location, but it does not reduce back into location until you do it the right way," Alban said.

(The device was undergoing training effectiveness evaluation at the time of this writing.)



Under a U.S. Army contract, SIMETRI designed and developed a human shoulder joint, including bones and connective tissues, to simulate a shoulder dislocation and reduction part.

Going Digital

The roadmap to digitization for SIMETRI, said Alban, started first on the mechanical side, when mechanical models started to go from sketches to using SolidWorks and 3D models, and then embedding sensors to capture data before writing the related software and then advancing the software development capability.

For instance, SIMETRI has developed a standalone training device (which can also attach to a manikin) that has the ability to understand if and when tissue has been cut

or incised correctly or, depending on the procedure, if it has been incised in way that sufficient pressure is released. Alban explained that most instructors within the military are interested in the standalone model, but there are some who are doing more advanced training and want to digitally connect the device to a mannequin.

In another development, software can monitor when the fascia (connective tissue encasing the muscle) of a specific muscle compartment has been cut, and when and if the correct fascia has been cut enough to release pressure that is increasing in the compartment. That data is transmitted digitally to the manikin, and the physiology model of that manikin is updated as a result of that new data and, therefore, displays new vital signs. "If you have not done it the right way, you will have no pulse at the foot, but if you do this procedure correctly, you will gain back pulse at the foot because you relieved the pressure and are allowing circulation to flow through," explained Alban.

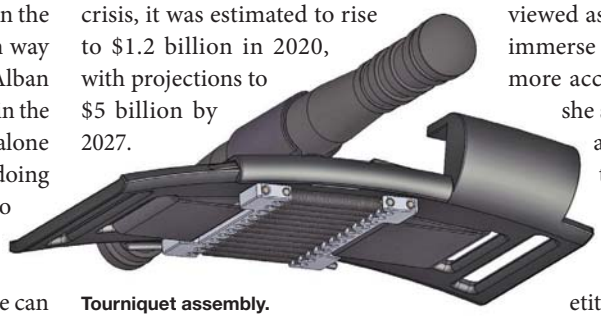
Innovation is in Demand

As a small business, said Alban, SIMETRI can be agile by using additive manufacturing to speed up the process and by using the collaborative business environment to accelerate innovations that are eventually going to be adopted.

"Once a manufacturer sets up a production line for an OEM product such as a manikin that requires tooling and a lot of investment, there will [necessarily] be some changes in how we operate in the future in order to allow for that modularity and to allow for more rapid changes and revisions of baseline manikin designs," she said.

Still, while there's a market for high-fidelity manikins, Alban said it isn't a big one. "That requires significant investment; I'm hoping and I know the government is interested in modular manikins," she said.

The manikin-based simulation market in the U.S. was estimated at $367.5 million in 2020, according to ResearchAndMarkets.com. Globally, amid the COVID-19 crisis, it was estimated to rise to $1.2 billion in 2020, with projections to $5 billion by 2027.



Tourniquet assembly.

> **"The miniaturization of electronic components has definitely affected the manikin market, but at the same time, during the pandemic, electronic components were hit because of the inability in the U.S. to source materials."**

The demand in the marketplace for making components smaller and less expensive is having an effect, too. "The miniaturization of electronic components has definitely affected the manikin market, but at the same time, during the pandemic, electronic components were hit because of the inability in the U.S. to source materials," said Alban.

This scenario will likely regain its balance once the pandemic settles down and the manikin market will continue to evolve. "Just like with any other electrical mechanical device, we're going to start seeing advancement for manikins as well," she said.

A Future for Manikin-Based Training

At a recent aviation conference Alban learned that beyond what's currently available on a manikin for medical use, or available in the physical simulator of a jet in aviation, virtual simulations are viewed as an opportunity to frequently immerse trainees and to make learning more accessible. The prevailing sense, she said, was that the use of virtual and augmented reality simulation and training is being used tactically to provide additional capability, in-depth knowledge and more opportunities for repetition and experience.

"Trainees don't have to travel to where the simulators are and they don't have to go inside a classroom," said Alban. "Ideally, they're going to have a headset that will allow them to do simulations anywhere—because it's just software. In the case of medical training, I think it's going to augment what's currently available. I don't know that it can necessarily be a replacement," she said.

When it comes to manikins, however, Alban asserts that the greatest value in medical simulation is patient safety and team training. "Within the military there's a significant opportunity for point-of-injury care and even prolonged care, which is a scenario where you're not necessarily a physician, but you are taking care of a patient as a paramedic or a special operations medic for a prolonged period of time," she said.

"This is where the skills are needed to be able to sustain that patient," points out Alban. "Patient safety is an area that has grown tremendously and will continue to drive the market in a way where we are proactively making sure that we are improving outcomes in the hospital or in the clinical setting." md

WISE WOMEN IN SCIENCE & ENGINEERING

Editor's Note: Machine Design's Women in Science and Engineering (WISE) hub compiles our coverage of gender representation issues affecting the engineering field, in addition to contributions from female authors and subject matter experts within various subdisciplines. Visit www.machinedesign.com/magazine/50144.

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MIKE KIEFER | Business Development Manager, Transportation, Southco, Inc.

Let's Hit the Road: ENHANCING TOUCH POINTS IN RVs

Photographerlondon/Dreamstime

AT A GLANCE:

- COVID-19 work-from-home guidelines have encouraged more people to work on the road.
- Outfitting different types of furnishings into one space is trending in RV interior design, and hinges are critical to that.
- As RVs become less recreational and more full-time residences, a significant quality consideration widely used in the automotive industry will become increasingly important in RV interiors: the buzz, squeak and rattle (BSR) factor.

The need to accommodate living spaces on recreational vehicles that can also support the remote worker is presenting a new set of challenges to RV designers.

The recreational vehicle (RV) market is experiencing one of its fastest and most dramatic growth surges. According to the RV Industry Association's June 2021 report, the RV industry has now set a new record for RV shipments in each of the last four quarters, with the second quarter (April-June 2021) setting a new all-time high.

Several factors are leading to this unprecedented growth, including the impact of COVID-19 on personal travel and vacation plans, combined with a new interest by many to make motor homes, vans and towable trailers their permanent residence—or, at the very least, home-away-from-home for significant portions of the year.

As much of the workforce has shifted from physical offices to work-from-anywhere over the past year, many are opting for a life on the road. RV manufacturers

now have an opportunity to use a range of well-designed manufactured devices to ensure these vehicles can act as an office on the road as well.

Since many more users will now be spending extended periods of time in their trailers or motor homes (rather than a few weekends or two-week vacations), RV manufacturers will benefit by paying closer attention to the touch point experiences supplied by high-quality devices like articulating hinges, monitor mounts and concealed latches.

If the touchpoint—the first thing the owner touches—is noisy and awkward, the perception of the vehicle's quality suffers. If, when opening or closing a panel or folded piece of furniture, the motion has a quiet, tight and good feel, it can improve the passenger's overall perception of quality. This increased quality in interior panels is often achieved with friction hinges that secure the panel throughout the motion or in bistable hinging that holds the panel open or pulls it closed.

These simple yet sophisticated mechanisms provide a range of technology options to provide safety, ease of use and comfort—elements that add up to a superior touch point experience that can enhance the value and customer appeal of recreational vehicles.

RV manufacturers can create flexible workspaces by incorporating fold-out desks into beds that swing up into wall panels when not in use or when the vehicle is in motion. *Southco*

RV manufacturers are designing multifunctional furnishings like highly modular tables that can be unfolded and changed to serve as a dining table as well as an office desk. *Southco*

Adding Workspace Flexibility to RVs

Today's RVs are large-scale, 30-ft-or-longer motor homes and towable trailers that truly are homes on wheels. They have complete kitchens, multiple bedrooms and full baths, with comfortable sitting and dining areas. Many of the popular models can easily sleep up to seven people.

Because of these amenities, it's possible to take the family and the trailer to the mountains or the beach, enjoy the weekend and then work from the trailer, since most of the trailers being sold now have complete living facilities that mirror rooms at resort condos.

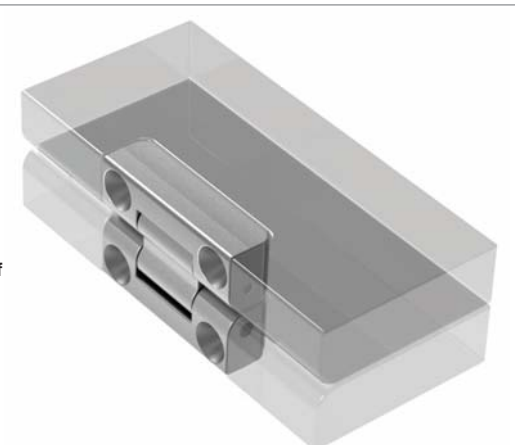
Two-week (or even longer) family vacations that span multiple states and scenic destinations are much more possible and appealing with a full-scale RV. Remote workers can take the family to these locations, put in a certain amount of work, take a break for a hike or other recreational activity, then return to the RV home office to wrap up the day's work.

The appeal of the work-from-anywhere-anytime model has been accelerated by the willingness of many businesses to support remote working setups. The need to accommodate and furnish well-designed workspaces that can support the remote worker is, however, presenting a new set of challenges to RV interior designers.

They must expand where and how they can fit support for workspaces among the other kinds of spaces—bedrooms, kitchen and dining areas, family spaces—already accommodated in their vehicles. "Flex spaces" is a relatively new term, meaning outfitting different types of furnishings into one space. For example, some RV manufacturers have created workspaces by incorporating fold-out desks into beds that swing up into wall panels when not being used. Other workspace designs include highly modular and adaptable tables that can be unfolded and changed to serve as a dining table as well as an office desk.

A key element that makes these flexible spaces both workable and appealing is the right hinge technology. Hinges are

Bifold constant-torque hinges, like Southco's AH-2E series, allows easy opening of two table leaves to double the size of a table in a trailer or motor home. *Southco*



Push-to-close latches, like Southco's R4 Rotary Latch series, provide remote latching of RV doors and panels. *Southco*

designed to add functionality to doors and panels, offering high-quality feel and performance that lasts over the lifetime of the application. There are a variety of hinges that can be used in flexible RV spaces, depending on the type of panel, door or furnishing that is being moved.

Detachable hinges can allow easy removal of doors or tables to provide easy access or additional space. Friction hinges and torque hinges can allow a heavy door or table to be held open, lifted or moved into one or many positions. Depending on where and how the hinges are used, they can also be designed to be hidden by being installed flush with flat surfaces for added aesthetic appeal.

Friction and torque hinges make it possible to design multifunctional furnishings, such as tables with leaves that open outward to create a larger work or dining surface. A bifold constant-torque hinge allows easy opening of two table leaves

to double the size of a table in a trailer or motor home. The friction hinge holds both table leaves in position when fully open. The same hinge can allow one or both leaves to be tilted up so that a tablet computer or flatscreen can be inserted into a notch, converting the flat leaf into a monitor mount. By using concealed-style bistable hinges, the hinge fits cleanly into the table, taking up minimal space.

Buzz, Squeak, Rattle: Engineering Touch Point Quality

As RVs become less "recreational" and treated more as full-time residences, a well-known and significant quality consideration widely used in the automotive industry will become increasingly important in RV interiors: the BSR factor: "buzz, squeak and rattle."

RVs, like cars, are on the move and experience plenty of vibration from the road and movement of the vehicle. If doors and panels are making BSR noises, it detracts from the interior experience and can imply that doors are not securely closed or that parts are wearing out.

To counteract this, it's essential for RV manufacturers to become more selective in the quality and value of hinges and latching mechanisms used in their interiors—key aspects to the overall touch point impression of their vehicles.

Monitor mounts are an important example. Many trailers and motor homes now have multiple flatscreen displays in use in their vehicles, both for entertainment and work purposes. Monitor mounts are now available that support intuitive and ergonomic positioning of displays with a range of options, from simple tilt devices to mount arms that allow the display to be easily manipulated into multiple axes. RV manufacturers should carefully assess which mounts they select. Some of the best mounts incorporate advanced engineering and design considerations to retain their functionality and not become loosened when exposed to regular vibration over time.

In addition to monitor mounts, latching mechanisms should also be selected with BSR considerations. There is a wide variety of latch security and styles now available. Push-to-close and pull-to-open latches, such as a magnet catch, detent cabinet latch or ball catch latch, supply a lower level of security suitable for smaller panels and cabinet doors in RV interior applications.

For larger panels or fixtures with increased weight that need higher security or force requirements, there are touch point and functional benefits from using push-to-close latches that have a required motion to unlatch, such as slide-to-open latches, knob latches, paddle latches, and concealed or remote latches.

For very large doors, such as those found on storage trailers or toy haulers, electronic rotary compression latches provide motorized assistance to create a tighter seal on doors. These doors can be difficult to fully seal just using mechanical latches. When a door outfitted with an electronic compression system is closed, the latch engages and then compresses the door and gasket to ensure that a complete seal is achieved.

Enhancing the RV Touch Point Experience

As RV manufacturers respond to changing customer preferences for using their trailers and motor homes as places where they live and work almost full-time, the importance of selecting mechanisms such as hinges and latches to provide a high-quality touch point experience is apparent.

Although they are simple and relatively low-cost compared to many other vehicle components, these devices are ones that people interact with and experience all day long. Picking the right device—especially as RV interior designers try to fit comfortable, ergonomic workspaces into their existing vehicle designs—can be challenging.

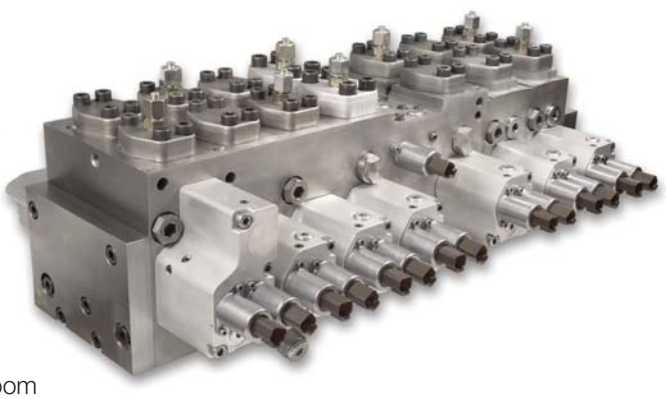
However, leading manufacturers and suppliers of high-quality latches, hinges and positioning technology can help make these decisions easier. They can assess how a new piece of fold-up furnishing or new pop-out feature like a complete outdoor kitchen will operate, or how to best utilize the interior to accommodate a remote work setup. Additionally, these manufacturers can provide expert suggestions on the right devices to choose to ensure smooth, reliable operation over the long term to help maximize the RV touch point experience. md

Wheel Provides Efficiency for AGVs

The MPW86 (200 mm wheel), provides a peak torque of up to 35 Nm (310 lb. in) at up to 4.3 meters/sec., while carrying up to 227 Kg (500 lb) per wheel. The result of the integrated design of the MPW is in the overall efficiency and performance of the robotic application. The MPW86 is ideal for larger size automated guided vehicles, autonomous mobile robots, motorized carts and tuggers, or practically any battery powered application designed to transport heavy loads. Available with eight different motor and gearing combinations, the MPW86 offers a variety of speed-torque configurations to match a wide range of application requirements.

ELECTROCRAFT, www.electrocraft.com

Valve Block Features Modular Design



The VW 22/18 M5-03 valve block for the open circuit has a modular system with five sections plus a pressure release section comprising the basic set-up. Three additional sections can be added on each side of the block, thus specifically addressing customer needs. Various functions can be selected for the additional sections, which are perfectly designed for the requirements in a wheeled excavator. Options such as boom or lift-regeneration, anti-drift and return flow bypass are available, as are rod-to-head-regeneration and an innovative float function for the excavator for the first time. In conventional control valves, the actuator is fixed. In certain applications, it is desired that a cylinder yields to external forces by being able to retract and extend—the so-called floating function. This is particularly important when either increased wear of the attachment on a hard surface or damage to a sensitive surface by the attachment is to be avoided. The control valve is available in two nominal sizes: nominal size 18 with a max. flow rate of 250 l/min and size 22, which allows a max. flow rate of 350 l/min.

LINDE HYDRAULICS, www.linde-hydraulics.com

Compact IPC Doubles as Machine Controller

The C7015 ultra-compact IPC measures just 85 × 167 × 43 mm. It is cost-effective and universally suited to high-performance automation, visualization and communication purposes. The C7015 leverages Intel Atom multi-core processors with up to four cores. Compared to conventional ARM-based edge devices, it supports more demanding applications as well as decentralized data pre-processing and the acquisition of large data volumes. The IP65/67-rated IPC also serves as a highly functional machine controller. Installing it directly in the field can save valuable electrical cabinet space. This reduces machine footprints significantly. The integrated EtherCAT P connection of the C7015 creates a range of new options for efficient sensor/actuator connection via the IP67-protected EPP modules.

BECKHOFF, www.beckhoff.com

Low-Profile Rotary Table Delivers High Speed

PI's A-630 series of low-profile rotary tables was recently extended by the new A-634 rotary stage with 150 mm table diameter and the A-638 model with 350 mm diameter. These high-precision, high-speed direct drive rotary tables are only 60 mm tall and provide high speed to 3,000 deg./sec. For transmitted light applications, the A-688 model with a large aperture is available.

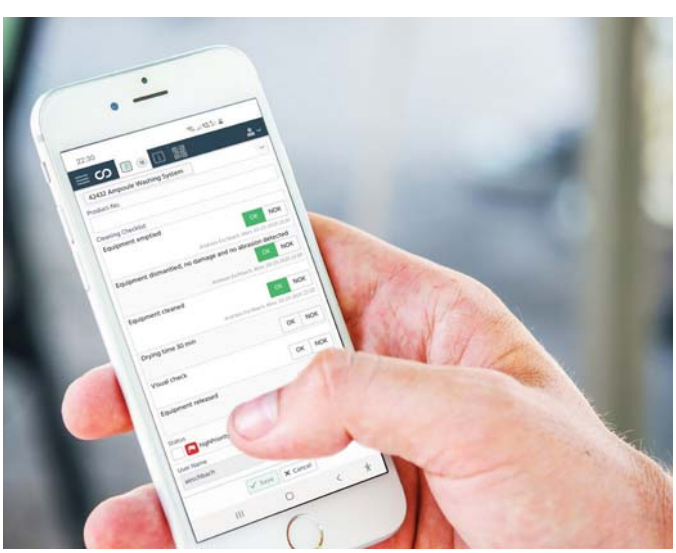
PI, www.pi-usa.us

Air Prep Units Connect to Flow Sensors

Emerson's AVENTICS Series 652/653 air preparation units now integrate with AVENTICS Series AF2 flow sensors. Expanded capabilities provide a clearer picture of potential leakages and air consumption in pneumatic systems and deliver valuable insight for improved energy efficiency and overall equipment effectiveness. Independently, Series 652/653 air preparation units provide clean air and pressure control to downstream pneumatic devices. The compact Series 652/653 with integrated AF2 sensor is easy to assemble and install. Now, both the in-line piped version and modular filter version with American National Standard Taper Pipe Thread (NPT) are available in the Americas.

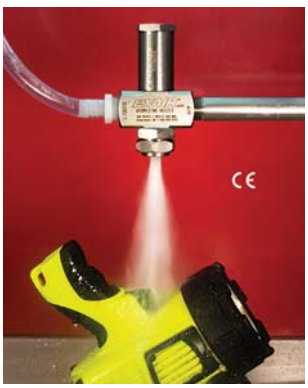
MOTION, www.motionindustries.com

Mobile Platform Connects Workers, Operators



The Shiftconnector Go Mobile Rounds application seamlessly connects field workers with board operators via the Shiftconnector platform for routine actions and compliance management. The application is available for iOS, Android and Windows, allowing workers to report activities directly from their mobile devices to a central location no matter where in the plant they are located. With its ability to function offline, Shiftconnector Go Mobile Rounds also gives workers the opportunity to document actions when they might be in a location that does not have cellular access. The information is saved on the device and delivered when access is restored. For security requirements, if devices are shared between shifts, users have a specified PIN or password, which must be applied to access the application.

ESCHBACH, www.eschbach.com



Atomizing Nozzle Offers High Liquid Flows

The 1/2 NPT siphon fed air atomizing spray nozzle atomizes a variety of fluids in a round spray pattern where no liquid pressure is available and heavy application of liquid is needed. This corrosion resistant type 303SS nozzle draws liquid into the airstream and mixes it internally while providing up to 24 in. of suction height. Liquid can be easily adjusted to meet the needs of the application using the adjustment valve. The patented No Drip design ensures conservation of precious liquids and protects surface finishes from drips. The 1/2 NPT spray nozzle provides high liquid flow up to 68 GPH in a 6 in. diameter round pattern. The stainless-steel construction of these atomizing nozzles adds to their durability and corrosion resistance.

EXAIR, www.exair.com

Hydraulic Hose is Lighter, More Flexible

The MegaSys MXG 5K hydraulic hose is lighter, more flexible and more durable than a typical 5,000 psi (350 bar) hose. It has been tested to 1 million impulse cycles at 250°F (121°C), twice the legacy industry standard for spiral hoses. The new hose platform is 20% lighter, 25% more flexible and 5% more compact than legacy spiral hoses, improving the safety and ergonomics of hose installation while also enhancing the performance of machinery by reducing weight. MXG 5K also offers greater abrasion resistance and more than 800 hours of ozone resistance to minimize downtime related to environmental conditions.

GATES, www.gates.com/mxg

Ad Index

STEPHEN J. MRAZ | Senior Editor

CHARTING THE COURSE TO ELECTRIC AIRCRAFT

How can federal labs and other research institutes contribute to the electrification of aviation?

Improvements in lithium batteries, combined with a push toward cutting back on the use of petroleum- and oil-based aviation fuels, are leading aerospace engineers to explore the possibilities of electric motors and batteries for powering aircraft of all sizes—from general aviation to long-range cargo and passenger transporters. Electric propulsion is said to offer several benefits, including lower fuel and maintenance costs, less noise and air pollution, and opportunities for new, innovative aircraft designs.

But how will aerospace and airline companies manage to make electric aircraft economical and durable? To get an idea of what is needed to make this happen, the DoE's Vehicle Technologies Office and NASA's Glenn Research Center convened a conference at the Argonne Collaborative Center for Energy Storage Science.

The two-day event drew nearly 100 experts from aircraft, battery and materials companies; component makers; carmakers; and academic and national lab researchers. At the end of the conference, they generated an outline of the battery requirements and R&D needed to accelerate commercialization of electric propulsion, going from air taxis in the near-term to 737 class aircraft in the long-term.

The paper explores four aircraft concepts: air taxis, 20-passenger commuter aircraft, 50-passenger regional jets and 150-passenger, single-aisle 737-class aircraft. For each concept, the paper describes a research area in which DOE and NASA could spur innovation in electric aviation batteries.

Air taxi and commuter aircraft. NASA/DOE should evaluate the next generation of lithium-ion battery options such as silicon, advanced cathodes and lithium-metal. Test should be done under aviation conditions and examine failure modes and safety.

The Maxwell X-57 was one of NASA's first all-electric aircraft. It was developed to show that an all-electric airplane can be more efficient, quieter and more environmentally friendly than planes powered by gas piston engines. It uses 14 motors arrayed along the main wing's leading edge, each turning its own propeller. They are powered by a 460 V battery.

Regional jets. NASA/DOE should conduct R&D into new designs, manufacturing approaches and high-temperature operation for solid-state batteries.

737 class aircraft. NASA/DOE should study high-energy systems, including sulfur-based batteries and hydrogen carriers, that are far beyond those currently in the R&D pipeline.

Significant investments are already being made in the next era of aviation by aerospace companies, including Boeing, Airbus, Rolls, GE, United Technologies, Embraer and Bell. In addition, numerous startups in the U.S. are based on innovations for aviation. This includes Uber Elevate, which aims to provide affordable shared flights on mostly electric aircraft by 2023. It also includes auto companies such as Daimler, Toyota, Hyundai and Porsche that are getting involved in aviation start-ups. In fact, Hyundai is in partnership with Uber on a concept airplane with a 60-mile range.

In the near-term, engineers could adapt lithium-ion batteries to meet the needs of short-range aircraft concepts for initial market introduction. More electric aircraft will then be developed as the market expands. However, electrification of large regional and 737-class aircraft will be stalled until a new type of energy storage is developed and proven. So, the next decade will see a global race to commercialize electric flight, according to the white paper. md

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Loudspeaker Simulation and Optimization in COMSOL Multiphysics®

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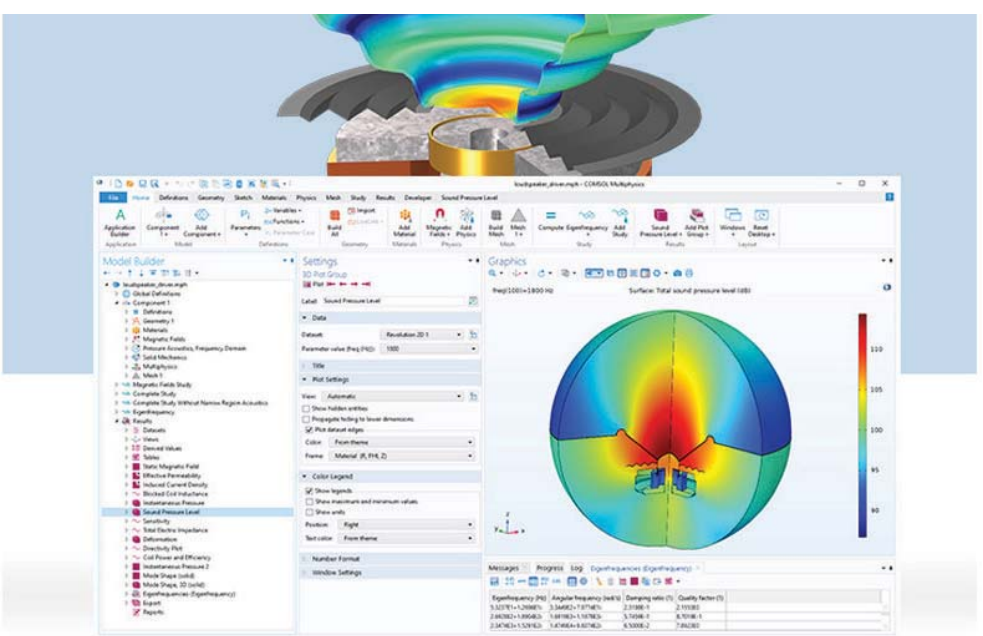

SPEAKER: **Mads J. Herring Jensen, Technology Manager, Acoustics, COMSOL**

Mads Herring Jensen joined COMSOL in 2011 and is the technology manager for the acoustics products. Mads has a PhD in computational fluid dynamics from the Technical University of Denmark. Before joining COMSOL, he worked in the hearing aid industry for five years as an acoustic finite element expert.

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