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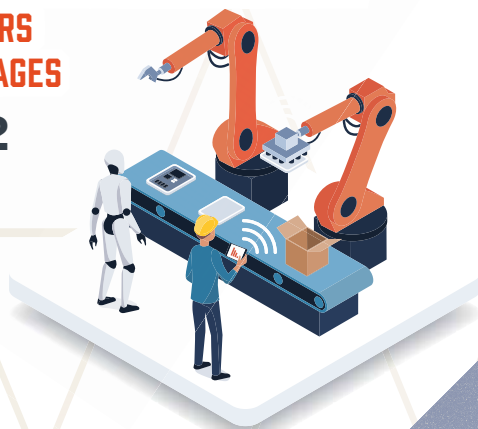


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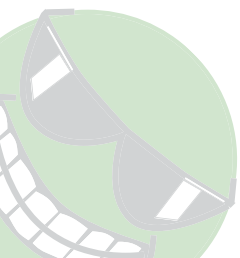
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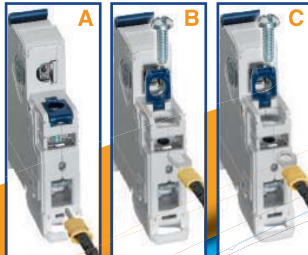
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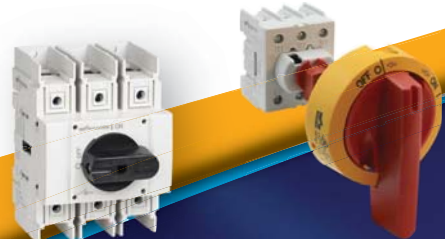
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Distributors and design engineers forge a closer partnership to overcome supply shortages.

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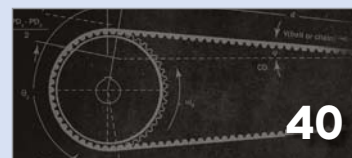
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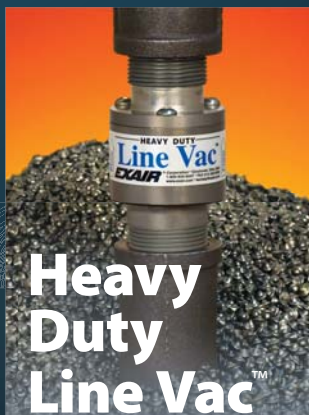


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From the Editor

By Bob Vavra, Senior Content Director

The More Things Change...



The world once again finds itself buffeted by technological and organizational chaos, but the path forward remains clear.

TOM PETERS IS my favorite business author. His combination of practical case studies, in-depth research, deep thinking and snappy prose makes it a pleasure to dig through such weighty topics as change management and global competition. His first book, *In Search Of Excellence*, is still regarded as one of the seminal business volumes.

I'm currently reading *Thriving On Chaos*, which I picked up because it seemed like a great title for this day and age. Peters proved he had his finger on the pulse of the time when he wrote, "The world has not just 'turned upside down.' It is turning every which way at an accelerating pace. To meet the demands of the fast-changing competitive scene, we must simply learn to love change as much as we have hated it in the past... Today, loving change tumult, even chaos, is a prerequisite for survival, let alone success."

That passage is both startling and sage—even more so when you realize that Peters wrote those words in 1987. This year is the 35th anniversary of the initial publication of *Thriving On Chaos*, and if we look at our current world and realize Peters' message then went largely unheeded, its basic point still can be applied to our modern issues.

In 1987, the issues were offshoring of labor, worker unrest, wage challenges and global competition. At that time, Japan was the manufacturing superpower that was challenging America's dominance. Peters argued then that an unwillingness to embrace technological and organizational change was putting us behind other nations.

The players have changed, but the challenges are the same—utilizing workers to their highest advantage and compensating them appropriately for the value of that skill; embracing technology to provide speed and precision on the plant floor; and developing a flexible, adaptive and interactive system across sales, manufacturing, procurement and distribution that shortens the time between the desire for a product and its arrival at our front door.

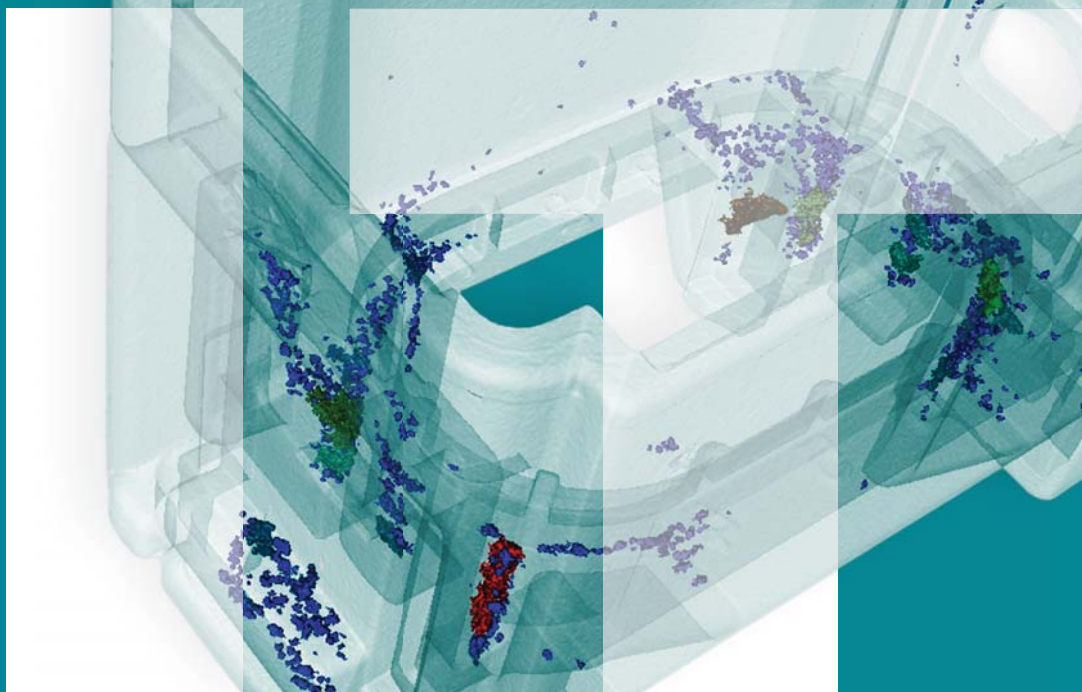
Machine Design's content partner *Industry Week* reviewed the book at the time and wrote, "From yesterday's viewpoint, it may look like chaos. From tomorrow's, it may be the only route to survival." But the other important lesson to take from Peters' 35-year-old tome is that in between its relevance then and its relevance today have been more than three decades of growth and economic expansion. Much of Peters' wisdom was embraced for a time, and then apparently relegated to the bargain shelves.

And yet, as chaotic as the world looked then and now, we have always found the way to improve our operations. We have yet to fully optimize what we do because optimization always is a destination. Still, we have seen vast improvements in safety and productivity while innovating with digital technologies largely unimagined at the time Peters wrote his book. But the basic principles remain: There are crises and challenges, and there are innovations and ideas developed to meet them.

The advantage of six-plus decades roaming this planet is that I feel like we've been through times every bit as tough as we face today, and we have always—always!—persevered. The specifics of this moment are different; the challenge remains. We can do better. We can't shrink from the challenges of this day. We can embrace the chaos because we have the confidence that as we have in the past, we will innovate and ultimately cooperate to find the answer. ■

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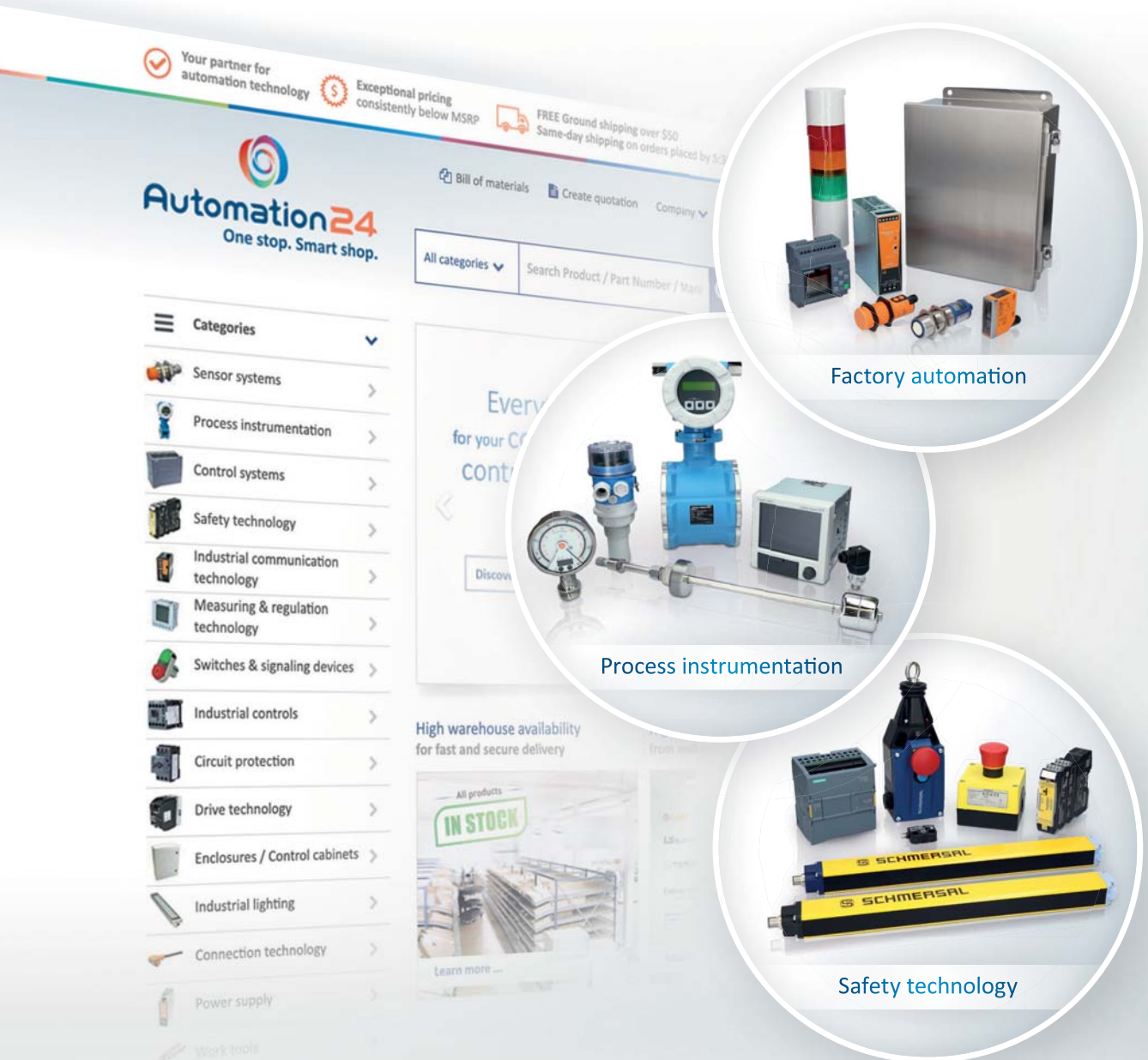
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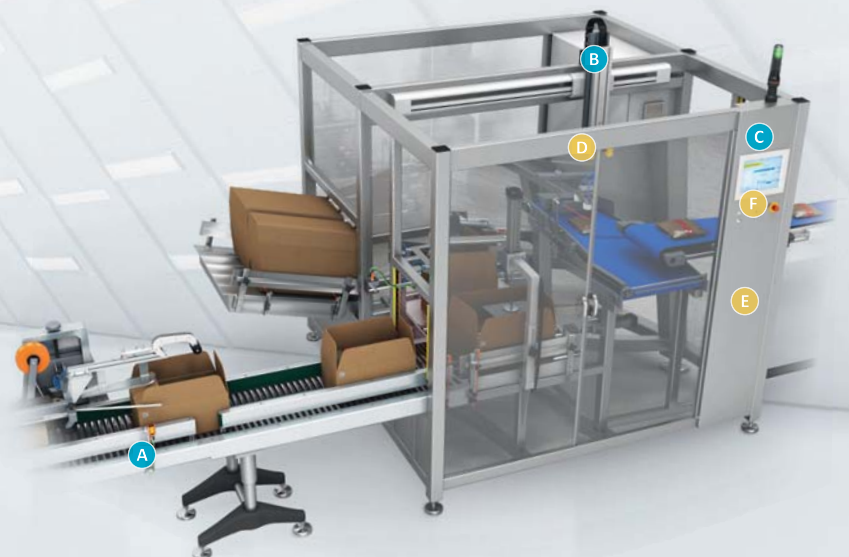
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Why Chip Fabs are a Need, Not a Want

The bulk of the know-how on how to develop tools to make chips resides in the U.S. Access to funding for fabs will increase capacity.

PETER SULIGA IS an electrical engineer specializing in motion control solutions. With more than 15 years of experience in electronics, Suliga is responsible for business development for the electronics industry in North America. He and his West Coast-based team work closely with HEIDENHAIN researchers in Europe to develop industry-leading solutions for suppliers across the semiconductor supply chain.

Machine Design invited Suliga to share his take on the tumultuous, yet critical, semiconductor sector.

Q: What impact does the electronics industry have?

A: The electronics industry is essentially everything that goes into the manufacturing of computer chips and printed circuit boards. It's an industry that touches every facet of our lives. If we didn't have a semiconductor industry, we would basically go back to the 1960s in terms of the everyday technologies we use. Every single LED lightbulb you have at home is a result of the semiconductor industry and processes developed there.

We're all connected today; everybody has a cellphone or a tablet. Just a few years ago, if you had home Wi-Fi, it would have just a handful of devices connected. Now, you probably have 20 or 30 devices connected. We are living in the era of Internet of Things so you can find chips in just about everything.

Q: Where is the electronics industry heading?

A: It's growing exponentially. So much so that Intel CEO Patrick Gelsinger recently made a bold prediction: In 2019 computer



chips made up about 4% of a car's bill of materials, but by the end of 2030 it will look more like 20%. That's just one example, but if I look at what they're trying to do with computers in cars, I can clearly see why we need a lot more capacity and why the industry is going to be growing significantly into the foreseeable future.

Q: Can you explain the geographical breakdown in the electronics supply chain?

A: There are really two sides to it: One is the factories that make the chips and the other is made up of the companies who make chip production possible—capital equipment builders. If you think about the biggest suppliers of capital equipment, so-called tier one, we have Tokyo Electron in Japan; ASML in the U.S. and the Netherlands; and based in the U.S. there is Applied Materials, Lam Research and KLA-Tencor. The U.S.-based capital equipment builders do manufacture in Asia and Israel. However, the bulk of the know-how on how to develop tools to make those chips resides in the U.S.

Until very recently, the U.S. was really underfunded in terms of the number of fabs (microchip fabrication plants) that were built here. There's just not a huge amount of capacity in the U.S. We have Intel fabs in Oregon and Arizona, Sam-

sung in Texas, Global Foundries on the East Coast, and Micron in Idaho and Utah, plus a few others.

Now everybody's realizing that this is a strategic supply, so the U.S. government is advancing a proposal for a \$50 billion investment in support of U.S.-based manufacturing and research. For comparison, the Korean government recently committed \$450 billion in an effort to make South Korea the world's biggest chip making base.

Q: How did that split happen in the first place?

A: I think it was probably due to cost. Electronics production went from U.S. to Japan, then from Japan to other places across Asia (like Korea and Taiwan), all because production was less expensive. More recently, within the last decade, China has had a big initiative to bring a lot of semiconductor production into their country. They spent a couple of hundred billion dollars to make that happen.

We kind of woke up late in the U.S., but at least there was recognition that we need to have a lot more of those facilities here. This year alone we had announcements from major players investing tens of billions in expanding their production capacity in the U.S. Our share right now isn't huge, but we're hoping for it to grow significantly in the next five years.

Q: What is the state of the supply chain in 2021?

A: Unprecedented demand. The recession in 2008 and 2009 put a hold on many things. When the rebound came, people were caught off-guard and the upswing was very challenging to keep up with. Compared to that, what we're looking at here is a totally different order of magnitude.

Chip shortages are everywhere, everybody is struggling and prices are going up. If you want that batch of chips you better buy a lot more than you normally would and pay many times more while you're at it, or somebody else will pay the price and get the chips.

Of course, at HEIDENHAIN we're in the same fight because we're supplying equipment into machines that will build those next-generation chips. Luckily, we are able to keep up, but it's kind of a cycle: We need more chips, we need more equipment to build the chips and we don't have enough chips to build that equipment. That's kind of where we are.

As for the impact of COVID, one theory is that current demand is partly the result of people not buying in the middle of the pandemic. Maybe this is true to some extent, but if you look at the electronics industry specifically, 2020 was solid despite COVID.

Factories did close, a lot of people left their jobs and a lot of them didn't come back, so now some suppliers can't run at the same capacity they used to. People notice shortages and everybody gets in line to buy extra. Buyers now are even more motivated to stock up and start hoarding. The combination of demand and people buying things well ahead of what they would normally will suck oxygen out of 2023, I think.

Q: What makes it so difficult to ramp up a facility?

A: On one hand we are creating individual transistors, which are the basic building block of electronic circuits—about five billion in a nicer computer chip. As a size comparison, the width of your hair

is 10,000x bigger. To make things even more challenging, you are building those layer upon layer and relying on each to be aligned perfectly with the one below it on the order of a couple of nanometers.

To give you an idea, there are five silicon atoms per nanometer, so you're aligning dozens of silicon atoms on top of dozens of silicon atoms. If you're off by just a few atoms the thing doesn't work. If you have five billion transistors and 9999% of them work, you wouldn't have a working computer chip. You have to have tremendous yield and quality control for such a mass of tiny electronic components and miles of interconnecting nanowires.

There's a reason there are only four or five top-tier suppliers, because the know-how is very specialized and takes decades to develop.

We do see a lot of spending to build up the capacity, but that's going to take 18 months to a couple years. A build cycle for these tools is typically more than six months. Think about all the different supply chains involved, and then the facility itself which needs to be populated, tested and validated all before production starts. Because the demand is so tremendous, those companies will be relying more and more on public and private partnerships for incentives or funding to make these facilities a reality.

Q: Where does HEIDENHAIN fit in the semiconductor supply chain?

A: We have a longstanding relationship with many of the biggest companies that produce capital equipment, including all four tier-one capital equipment suppliers who account for more than 60% of all machines sold to the semiconductor industry. We also work closely with quite a few of the tier-two and three suppliers.

On one hand, our standard portfolio of products offers solutions that others don't. For some things we're the only place where you can get the level of accuracy and precision required continually to get those smaller and smaller structures for the semiconductor process to develop.

On the other hand, because we've been in the business of precision for so long we have a tremendous amount of internal know-how on all aspects related to measuring things on that scale.

 *Companies we work with shouldn't just come expecting for us to walk them through our catalog and point to what looks interesting. What we're actually more interested in is hearing about their highest-value problems."*

Companies we work with shouldn't just come expecting for us to walk them through our catalog and point to what looks interesting. What we're actually more interested in is hearing about their highest-value problems. What are their challenges? What is it they're struggling with solving? From there we see how we can leverage our internal knowledge base and fundamental research capabilities to help find solutions.

For example, when we engage with forward-looking units, which are parts of companies that are thinking about future endeavors and how to leverage their existing technology, this is what we talk about. We talk about creating, or making available to them, technology that enables them to go well beyond what they're thinking today.

Q: How do you work with customers in the electronics industry?

A: We pay very close attention to what's happening. What are the key industry drivers? We try to gather a very significant amount of application knowledge, not just whether they need five nanometers or one nanometer. What are customers trying to do with their process? What's keeping them from getting to the next level? We take those questions and then we look at our products and solutions to see how we can help. ■

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3D Replicator Manufactures Cartilage in Space

Scientists use volumetric additive manufacturing techniques for bioprinting cartilage in microgravity. The objective is to make it efficient, affordable and scalable.

IN A RECENT PROJECT selected by NASA's In Space Production Applications (InSPA) awards program, scientists and engineers are exploring how volumetric additive manufacturing (VAM) 3D printing technology can produce artificial cartilage tissue in space.

Project collaborators—Lawrence Livermore National Laboratory (LLNL) and Kentucky-based space life sciences company Space Tango—are using VAM 3D printing techniques for bioprinting cartilage in microgravity on the International Space Station (ISS).

The VAM technology takes computed tomography (CT) impressions of 3D objects from multiple angles before projecting the images into a photosensitive resin. The scientists explained that “the resin cures at points where the accumulated, absorbed light energy exceeds the gel thresholds.” Once the remaining liquid resin is drained, 3D objects emerge. This process happens within seconds or minutes, which makes it much faster

than traditional layer-by-layer 3D printing techniques.

Mimicking the science fiction machine aboard the Starship Enterprise, the ultra-fast 3D printer was playfully named “The Replicator” by co-developers LLNL and the University of California, Berkeley. The VAM printers are expected to operate with little to no crew intervention, they reported.

LLNL principal investigator Maxim Shusteff pointed out that space-based manufacturing has been of interest for several years for the LLNL 3D printing community. He said support from Space Tango validates the promise the VAM technology shows and it connects the technology with the commercial space-flight industry.

Space Tango has for several years been leveraging microgravity to improve the layer-by-layer deposition process. The R&D facility has conducted more than 200 automated microgravity experiments on the ISS since 2017.

“Cartilage tissue was chosen as a good balance of market need, impact to patients, technical feasibility and our available expertise.”

—Maxim Shusteff

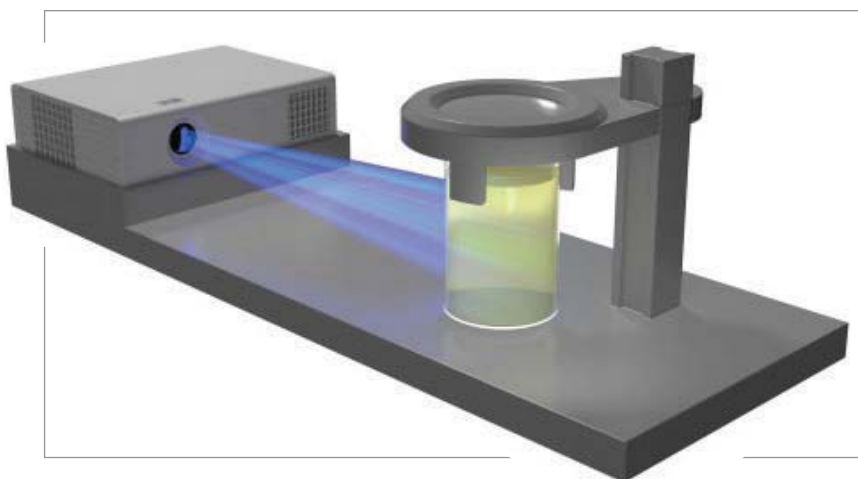
Microgravity environments allow objects to appear to be weightless and enable scientists to better understand physical properties and processes, which ultimately improve design and modeling. Without gravity, shapes are more perfect.

As a platform for innovation, VAM technology is expected to perform well in zero or microgravity environments. In normal environments, VAM can cause “buoyant settling or convection of the resin,” noted the scientists. Eliminating gravity, in contrast, will lead to the creation of better-precision prints.

Shusteff said that tissue engineering with VAM could be one area where space-borne production in microgravity may significantly benefit the outcome. “Cartilage tissue was chosen as a good balance of market need, impact to patients, technical feasibility and our available expertise,” he said.

What's the Big Picture?

The InSPA awards support NASA's plans to enable manufacturing “In Space for Earth” on the ISS; to develop new and promising technologies for advanced materials and products for use on Earth; and create a robust economy in low-Earth orbit. ■



Nicknamed “The Replicator,” the breakthrough volumetric additive manufacturing technology co-developed by Lawrence Livermore National Laboratory and the University of California, Berkeley takes computed tomography “views” of 3D objects from multiple angles, and projects these images into a photosensitive resin. The process produces 3D objects within seconds or minutes, beating traditional layer-by-layer 3D printing techniques. Illustration by Jake Long/TID

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Sustainable Jet Fuel Produced from Agricultural Waste

A patented process turns lignin from agricultural waste into bio-based lignin jet fuel.

RESEARCHERS AT WASHINGTON STATE UNIVERSITY have developed a patented process that turns lignin from agricultural waste into bio-based jet fuel.

The research, published in the journal *Fuel*, is touted for producing material properties that are critical to jet engine operation, including seal swell, density, efficiency and emissions. The authors noted that the sustainable lignin-based fuel could be mixed with other biofuels. To boot, it could replace petroleum-derived fuels, they said.

The new fuel is experimental, but the results have direct resonance for the aviation industry based on at least two factors—increased energy density and O-ring swelling potential.

Increased energy density. “We found that it not only had increased energy density and content but also could totally replace aromatics, which are a real problem for the aviation industry,” said Bin Yang, professor with WSU’s Department of Biological Systems Engineering and corresponding author on the study. Aromatics are



A Pacific Northwest National Laboratory scientist at Richland, Wash. helps develop a sustainable fuel component as part of research into bio-based jet fuels. *Images: WSJ*

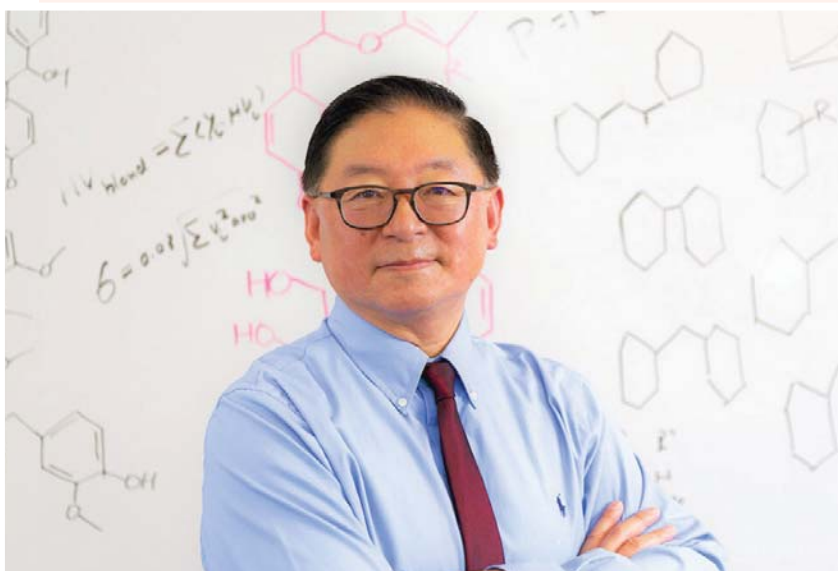
undesirable in jet fuel because they lower the smoke point and cetane, which ignites easily under pressure.

To address environmental concerns, EPA regulations typically limit both the overall volume percent of aromatics. Yet, aromatics continue to be used because alternative solutions are not yet viable. “[Aromatics] provide jet

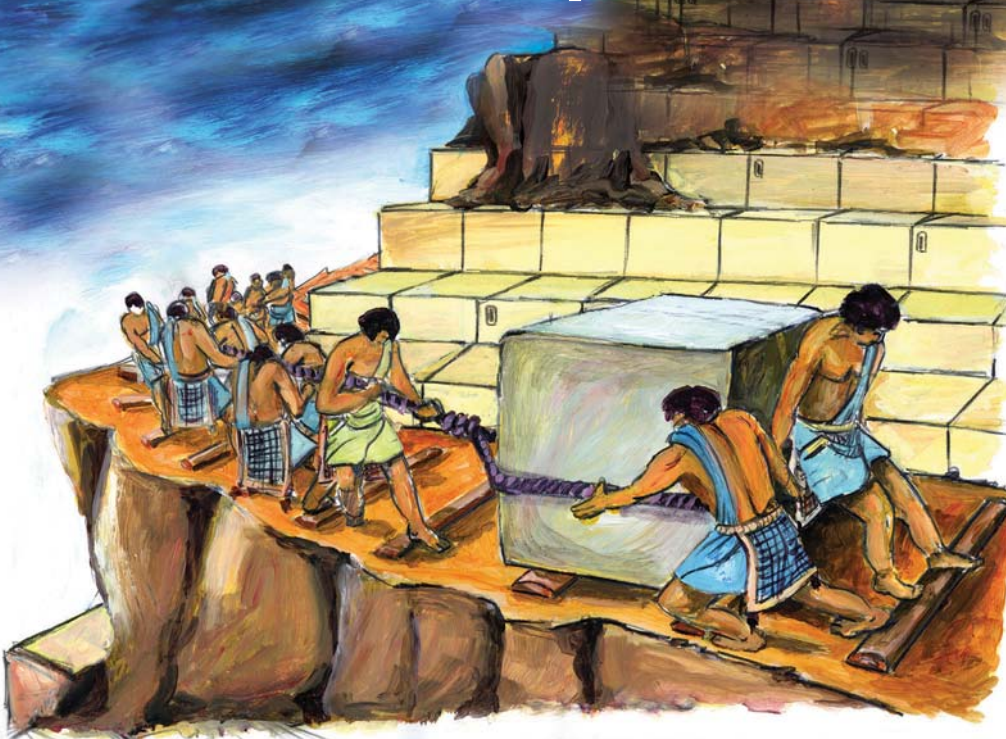
fuel with a density that other sustainable technologies do not,” said Joshua Heyne, co-author, University of Dayton scientist and current co-director of the joint WSU-Pacific Northwest National Laboratory Bioproducts Institute. “Most unique is their ability to swell the O-rings used to seal metal-to-metal joints, and they do this well,” he added.

O-ring-swelling potential. The lignin-based fuel’s properties “offer great opportunities for increasing fuel performance, higher fuel efficiency, reduced emission and lower costs,” noted the authors. The paper, “Lignin-based jet fuel and its blending effect with conventional jet fuel,” discussed how the novel fuel molecules show sealant volume swell that is comparable with aromatics. “While meeting our material needs, these sustainable blends confer higher energy densities and specific energies without using aromatics,” said Heyne. ■

Professor Bin Yang developed a patented method to turn lignin from agricultural waste into a sustainable jet fuel.



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much easier if the Egyptians
had used the wheel to
build the Pyramids**



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A New Lead for Cardiac Defibrillators

A NEW CANADIAN STUDY reports an alternative way to connect leads to cardiac defibrillators.

Leads are special connectors or wires that deliver energy from an implantable cardioverter defibrillator (ICD) to the heart. Placing an ICD involves placing a wire through a vein, into the chest and into the heart.

The ICD study, conducted by researchers at Population Health Research Institute (PHRI), has demonstrated that a new type of cardiac defibrillator, called a subcutaneous ICD (S-ICD), reduced patient complications by more than 90%, compared to traditional defibrillator, called a transvenous ICD (TV-ICD).

The S-ICD, explained the researchers, is implanted under the skin just below the patient's armpit. The S-ICD lead runs under the skin, alongside the breastbone. The procedure eliminates the need to place leads into the heart or blood vessels.

"The S-ICD greatly reduces perioperative, lead-related complications without significantly compromising ICD performance," said Jeff Healey, a senior scientist at PHRI, a research institute of McMaster University and Hamilton Health Sciences (HHS).

The S-ICD is an "attractive alternative" to the TV-ICD, particularly in patients at increased risk for lead-related complications. That's partly because a drawback of the procedure is that



Dr. Jeff Healey implants a subcutaneous defibrillator in a patient at the electrophysiology lab at HHS. Image: Owen Thomas, Hamilton Health Sciences

leads are the least reliable component of a traditional defibrillator. They can cause complications such as perforations in the heart muscle or lungs and blood clotting in veins, according to Healey, a professor of cardiology at McMaster as well as an electrophysiologist at HHS.

Healey also noted they may contribute to premature revision of the system in up to 20% of patients during the typical lifespan of an ICD generator.

The study involved 544 electrocardiographically screened patients; 251 were randomized to receive the S-ICD (a Boston Scientific Emblem device), and 252 patients received a TV-ICD.

Patients were followed up for an average of 2.5 years to this point and follow-up is ongoing for the study.

Findings of the trial, "Avoid Transvenous Leads in Appropriate Subjects (ATLAS) S-ICD," were presented at Heart Rhythm 2022 in San Francisco on April 30. ■

A large advertisement for Trim-Lok. At the top left, there's a graphic of various black plastic trim and seal profiles. Next to it is a gold circular emblem that says "CELEBRATING 50 YEARS 1971-2021". To the right of the emblem, the text "50 YEARS AND STILL GROWING!" is written in large, bold, white letters with a black outline. Below this, it says "NEW FACILITY COMING FALL 2022 ELKHART, INDIANA". The background of the lower half of the ad is a photograph of a modern, single-story industrial building with large windows and a parking lot. At the bottom, there's a red banner with white text that reads "WWW.TRIMLOK.COM", "INFO@TRIMLOK.COM", "CALL US TODAY! 800-853-4489", and "6855 HERMOSA CIRCLE BUENA PARK, CA 90620".

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Snap-in Mount

The snap-in mount style has tabs on the outer surface of the component setting just under the mounting flange. As the component is inserted through the cutout hole, the tabs slide back until they clear the panel surface. The tabs snap back into the original position. This holds the panel between the tabs and the mounting flange.

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AUTOMATION CRITICAL: CLEAN RELIABLE POWER IN A COMPACT PACKAGE

This white paper will discuss the critical state of providing DC power to the ever expanding needs of manufacturing automation, including plant floor equipment, robotics, the industrial internet of things (IIoT), and other enterprise resources.

Power management is a huge concern in industrial and manufacturing applications for everything from food and beverage machines to industrial control cabinets and more. Providing clean, reliable power under greater limitations can be challenging. As the lifeblood of automation—whether part of a packaging system, robot or cobot, conveyor system, or any other machine—DC power supplies today must be rugged, compact, efficient, and comply with multiple standards.

Designing for Compactness

Control and power supply equipment are designed to fit into cabinets that protect them from the varied environments equipment is often operated in (see Figure 1). These cabinets typically use a DIN rail system to provide quick and easy installation. It doesn't matter whether used in medical equipment, telecommunications, or transportation, the growth of control electronics, sensor systems, and IIoT interfacing means that the space inside a cabinet for additional functions is getting harder to come by.

As control cabinets become more tightly packed with electronics the need for systems that can withstand greater temperatures becomes important as well. All this leads to design engineers being continually on the lookout for the latest generation of small,



Figure 1: Power supplies are a critical component in a wide variety of applications, including telecommunications, industrial panels, water treatment facilities, and conveyors as illustrated here.

efficient and rugged DIN rail power supplies to incorporate into their equipment. The key element of such supplies include availability, ease of installation, and performance reliability for long life cycles. Furthermore, with a global customer base, companies need a single product range that offers multiple certifications.

Greater Innovation

Design constraints based on these needs spurred innovation in electronic power components and power supply topologies. Switch mode power supplies using high-frequency electronics were able to dramatically boost efficiency, seeing power density rapidly climb together with efficiency and reliability. Advances in electronics like these have evolved through a new generation of power components—such as power transistors, inductors and transformers—which support increases in power density while improving voltage regulation, reducing electromagnetic interference (EMI), and boosting long-term reliability. All told, these advancements have allowed for products supplying 480 W to now fit into the space formerly occupied by 120 W power supplies (see Figure 2).

Multiple Solutions

As such an important component in any piece of industrial equipment, Altech has designed and manufactured a series of ultra slim metal case DIN rail power supplies for industrial applications such as video inspection, auxiliary power, and machine tools. These components were designed to take up less than half the space that a current power supply would normally occupy on a DIN rail. If you consider the 120 W supply as mentioned above, a normal DIN rail version would take up about 2.5 inches of DIN rail space, whereas Altech's PSC-120 series needs only 1¼ inches of space (see Figure 3). With this ultra-compact power supply, Altech makes it easier for customers to include additional functionality in the same space as well as for use in shallow cabinets—without increasing costs.



Figure 2: This illustrates the size difference between a standard and compact power supply due to the power density technologies now available.



Figure 3: The Ultra-Compact PSC series is a rugged power supply for industrial use.

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These ultra-compact high efficiency units support 1+1 or N+1 redundancy and built-in current sharing functions. Regardless of power supply output, every product in the series has an input requirement of 85-264 VAC/127-360 VDC. Output specifications for the PSC series power supplies are from 12 VDC to 48 VDC and up to 480 Watts. The PSC series is rugged for industrial use, offers high efficiency operation with a wide adjustment range, are lightweight and compact.

The company's PSD series of compact DIN rail power supplies also share the input requirements of 85-264 VAC/127-360 VDC as the PSC series of products (see Figure 4). The difference is that the PSD series power supplies cover wattages from 15 W up to 100 W. Standard voltages for these supplies include 5, 12, 15, 24 and 48 VDC. These high efficiency supplies are designed for a wide range of industrial applications as well as consumer applications such as elevators, escalators, and other building systems.

Features for both product lines include 100% full load burn-in, low voltage and current ripple, Class II isolation, and overload, overvoltage, overtemperature and short-circuit protection.



Figure 4: The PSD series of power supplies provide a low profile for use in tight spaces such as equipment enclosures.

These supplies provide users efficiencies of over 90% for lower power dissipation and enhanced thermal performance. They also feature conformally coated PCBs to provide greater protection against contamination and humidity.

Worldwide Capabilities

The Flex line of DIN rail power supplies designed and manufactured by Altech is based on semi-resonant switching power supply technology to provide dynamic output power efficiencies to 93%. Used for electronic loads, motor loads, PLCs, sensors, and other common industrial loads, one unit can cover most input voltage options. The wide range of input voltages enables these products to operate in any part of the world.

The company's PSA and PSB lines are DIN Rail mountable for ease of installation and maintenance. As compact, robust and reliable units, they also offer IP20 protection. Both the PSA and PSB units are designed to provide 1, 2, and 3-phase input up to 600 W with current ratings ranging to 25 A, and power flexibility that reaches 50% of the rated current I_n (see Figure 2). These specifications are meant to provide solutions for industrial application that are in constant evolution, which makes them remarkably flexible. These series of products offer a declared ambient temperature operations field that ranges from -25°C to 70°C. Besides offering 1-phase, 115-230 VAC units, the company also offers 2-phase, 230-500 VAC units, which allows customers to be able to use and store only one product.

These product lines are also equipped with three short-circuit overload protection features. The hiccup mode is a default factory setting for each product in the FLEX line of power supplies. In case of a short-circuit or overloading, the output current is interrupted. The device will try again to

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Model	Output Current A @ 40oC	Input Voltage VAC	Output Voltage VDC
PSA-6024	3	110-230	24
PSA-12024	5	110-230	24
PSA-18024	7.5	110-230	24
PSA-36024	14	110-230	24
PSA-60024	25	110-230	24
PSB-12024	5	230-400-500	24
PSB-18024	7.5	230-400-500	24
PSB-36024	14	230-400-500	24
PSB-60024	25	400-500 3-phase	24

Figure 2: This chart shows the product range available from the PSA and PSB flexible power supply line.

re-establish output voltage and normal conditions about every two seconds until the problem has been cleared. A manual reset is available to the operator as well. In order to restart the output after an overload or short-circuit has interrupted the output, it is necessary to switch off the input circuit for about one minute. This approach is offered where safety procedures specifically require that reset be carried out by an authorized person only. The units also offer a continuous output mode where the output current is kept at a high value with near zero voltage during a short-circuit or overload condition. In this case, the current can reach up to three times the rated current. This mode is used to meet the requirements of demanding loads such as motors, solenoid valves, lamps, PLCs with highly capacitive input circuits, and other loads with marked transient overload behavior.

Certifications

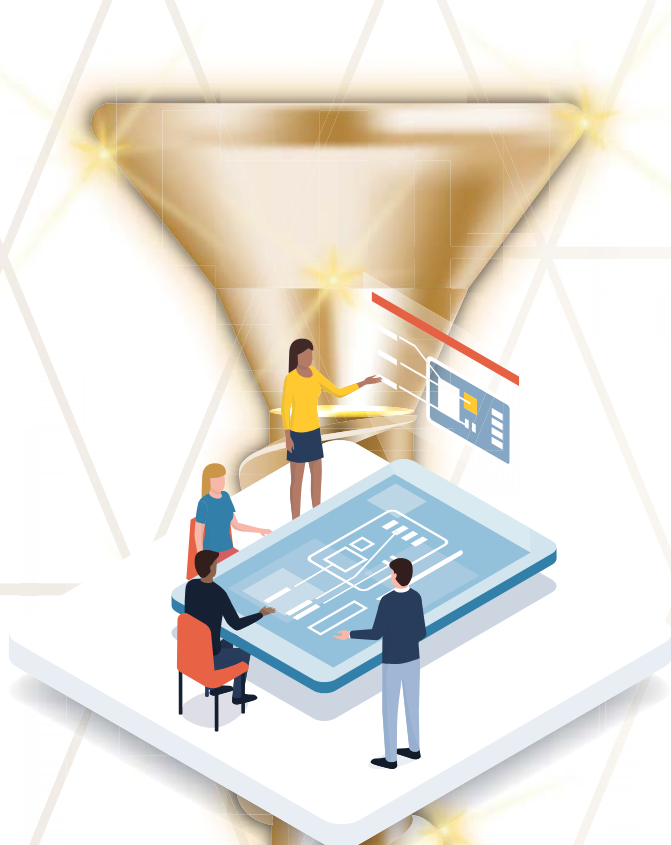
In order for equipment to be sold and operated in various parts of the world, it is important that companies adhere to the certifications needed for their specific applications. As power supplies are such an integral part of every system, having proper

certification is a critical requirement. Products mentioned here offer a number of key certifications, including UL, CE and CSA approvals. Others include UL508 listed for USA and Canada, 89/336/EEC EMC directive, 006/95/EC (low voltage), IEC 61000-6-4 for emissions, and IEC 61000-6-2 for immunity. Also note that the units offer safety approvals including EN60204-1, EN60950, and military standard MIL-HDBK-217F. In addition, the PSD low profile units are UL62368-1 recognized as well.

Conclusion

Power supplies are critical components to the industrial automation landscape. They must be reliable, robust, highly efficient, and compact in order to fit today’s needs. Through the use of DIN rail systems and the latest power density designs, the latest power supplies provide thousands of hours of operation as well as savings in installation time and overall cost. Altech offers several lines of power supply products to fit most applications with the clean, reliable, and high-performance they need for worldwide distribution of systems.

Images: 1019823314 and 1201263514 | iStock Getty Images Plus



THE SEARCH FOR “THE GOLDEN SCREW”

Distributors and design engineers forge a closer partnership to overcome supply shortages.



by Bob Vavra, Senior Content Editor

In the well-lit offices and dark warehouse aisles, there is a treasure hunt under way. Despite a still-expanding manufacturing landscape, machine designers and OEMs face parts shortages and a fractured supply chain. They have their designs ready to go into production, but they lack the availability of the one last piece of their project.

It's what distributors who attended May's EDS Leadership Summit in Las Vegas called “The Golden Screw”—the single part needed to complete a project. In reality, it's not a quest for a single item as much as a search through the vast supplies in the market for parts that can perform the same function, but have greater supply availability. It also is changing the dynamic between design and production teams, their suppliers and their distributors—forcing new discussions, greater collaboration and fresh questions.

“Are components available? Are these the right parts to have on design? There's now a bigger willingness to put in an alternate source,” said Don Akery, a distribution industry veteran and now the CEO of Waldom Electronics. “We're no longer a commodity company; we've become a consultancy. That's where electronic distribution needed to go.”

Added Jim Banovich, CEO of Marsh Electronics, “What we're seeing our customer base is that they're looking for more input from us. They're looking for design assistance.”

Technology and Design

In a tight supply market, the conversations have changed. Designers and distributors are working more closely together to help not just identify the parts supply, but also provide engineering support for those efforts. With the expansion of CAD/CAM and 3D design tools and greater connectivity to parts suppliers, designers are finding it easier to evaluate not just which part they'd prefer to use, but which one can give them both productivity and availability.

“There's a lot of engineers wouldn't have asked. That has changed,” said Richard Diaz, vice president of operations and supply chain at Avnet. “They're looking at alternatives and optimizing design. There's a lot of collaboration. We're letting them know all of their options.”

"As an organization representing different product lines, we work with so many different manufacturers and design engineers. We like to get in front of engineering teams," said Joshua Uhlich, director materials for Bisco Industries. "Especially in aerospace, designers like to use standard parts that have been around for decades. We're showing them there are some new solutions out there."

"They are designing for availability," said Karim Yasmine, corporate vice president at Future Electronics. "We ask, 'How do we guide our customers get better control of their supply chain?' The good news is the creativity of customers is picking up."

"Customers are taking advantage of our engineering services, and we expect that will continue," Yasmine added. "It's our job to provide volume optimization. A lot of manufacturers are fighting over the same capacity. There's a challenge."

Distribution Business is Booming

While the search for The Golden Screw is frustrating for designers and suppliers alike, the business of distribution is stampeding forward at a strong pace. The *Source Today* Top 50 Electronics Distributors list (see page 25) shows that despite difficulties in transportation costs, parts availability and worker shortages, the industry continues to expand. (*Source Today* and *Machine Design* both are part of Endeavor Business Media's Design & Engineering group.)

All of the top 20 electronics distributors reported increases in 2021 at a time before inflationary cost increases began to take hold. While revenues from 2019 to 2020 remained largely flat, revenues in 2021 took a giant leap forward.

Arrow Electronics once again heads the *Source Today* Top 50 list with almost \$34.5 billion in revenue in 2021, a 20% increase over 2020. After not participating in past years, Taiwan-based WPG Holdings Ltd. reported \$27.8 billion in revenue to move into the second spot, with AVNET/Farrell in third position with \$19.5 billion in revenues, a 19.5% increase from 2021.

All of the top 10 electronic distributors surveyed reported more than \$1 billion in revenue and all reported double-digit growth rates from 2020. In the 2021 report, 11 companies had more than \$1 billion in revenue and six more were between \$500 million and \$1 billion—or five more than in 2020.

“If there is any silver lining to COVID, it has caused all players in the supply chain to evaluate their resiliency and adaptability to non-linear events.”

**—Dave Doherty
President,
Digi-Key Electronics**

Perhaps the most pressing challenge facing the electronics industry is the continuing semiconductor shortage. "Throughout all of the recent supply chain disruptions it has been challenging to keep high-demand products, like semiconductors, in stock," said Dave Doherty, president of Digi-Key Electronics, in a written interview with *Source Today*. "Some product types are in a more 'normal' amount of demand, but within semiconductors, for example, micro-controllers, sensors, commodity linear, analog and discrete are still a struggle to obtain in full supply as lead times in many cases have continued to remain on a 40-plus week schedule."

"If there is any silver lining to COVID, it has caused all players in the supply chain to evaluate their resiliency and adaptability to non-linear events," Doherty added. "Within Digi-Key (#5 on the *Source Today* Top 50) our model has always been built on selling from available inventory; in hindsight, a more simplistic model than we are faced with today."

One thing suppliers and manufacturers want above all else is predictability, and that at least is one outcome of recent challenges. "For a time, many segments

of business were almost completely shut down. Automotive is a good example," said Jeff Ittel, executive vice president, Flip Electronics (#35 on the *Source Today* Top 50) in a written interview. "Fortunately, most of these segments are up and running and forecasting so at least the demand feed is becoming more consistent."

"We have also seen the industry stress lead times and insist on more visibility from the OEM's buying chips," Ittel added. "This has helped the semiconductor manufacturers incorporate build plans with a greater window."

(See the April 2022 issue of *Machine Design* for a look at the semiconductor issue and its impact on the design community.)

Finding the Pain Points

While revenues have grown and strategic investments have followed, the day-to-day challenges of the supply chain remain unresolved. It has had an impact on every aspect of manufacturing. The April 2022 report from the Institute for Supply Management saw another drop in the PMI Manufacturing Index. The index was at 60.8% in October 2021—more than 20% above the index's growth level. In April, the PMI had slipped to 55.4%—still well above the 50% growth threshold for manufacturing, but well off its recent highs.

"The U.S. manufacturing sector remains in a demand-driven, supply chain-constrained environment. In April, progress slowed in solving labor shortage problems at all tiers of the supply chain," said Timothy Fiore, chairman of the ISM Manufacturing Business Survey Committee in the monthly press release on the ISM data. "Panelists reported higher rates of quits compared to previous months, with fewer panelists reporting improvement in meeting head-count targets. April saw a slight easing of prices expansion, but instability in global energy markets continues."

One chemical process distributor who contributes to the PMI report pointed to the dichotomy in the current manufac-



turing world. "Tier-2 supplier shutdowns in Shanghai are causing a ripple effect for our suppliers in other parts of China. Long delays at ports, including in the U.S., are still providing supply challenges. Inflation is out of control. Fuel costs, and therefore freight costs, are leading the upward cycle," the distributor said in the press release. "At some point, the economy must give way; it will be tough to have real growth with such pressure on costs." And then the distributor added, "Despite the issues and poor outlook, business remains brisk."

Those attitudes are reflected in the distributors that *Source Today* interviewed. "In our current environment of tight supply and extended lead times, we encourage customers to create designs with components that can be sourced from multiple suppliers," said Doherty. "Of course, they can't do that for every part, but there are often ways to reconfigure a design in a few ways using different part numbers. Having a flexible bill of materials for parts with different manufacturers creates some insurance in the event that stock is not available."

"Customers are naturally frustrated by the product shortages and are placing orders many months ahead," said Mark Burr-Lonnon, senior vice president of Global Service & EMEA and APAC Business for Mouser Electronics (#9 on the *Source Today* Top 50). "Distributors are not immune to global factors and there have been extended lead times and restricted allocation on some of the more popular product lines. Our teams are closely monitoring shortages and are working closely with manufacturers to replenish products as quickly as possible."

"Despite the challenges, innovation continues. We are seeing exciting new sensor technologies, as well as the latest in power management and, of course, advancements in microprocessors, automotive, factory and home automation also will continue to be emerging markets as more technologies are introduced to make buildings, homes and vehicles smarter and safer," Burr-Lonnon added. "Certainly, 5G,

artificial intelligence, robotics, industrial automation and transportation are major growth drivers in the industry."

"Closer to our Customers"

The partnership between OEMs and distributors, always strong, has been tightened by the shared challenges of the past few years. Distributors are expanding their engineering services and OEMs are getting more creative in their design specifications.

Inflationary pressures and Russia's invasion of Ukraine adding to the global uncertainty, yet suppliers interviewed by *Source Today* found optimism—and even some longer-term benefits for the future.

"The underlying demand for semiconductors is exciting and will only continue to grow. Technology is being incorporated into more and more of virtually all products. This bodes well," Ittel told *Source Today*. "Hopefully, we can see a day soon with less pandemics, less wars and get back to some level of normalcy."

"Despite the current supply chain instability and inflationary pressures, there are reasons for optimism and confidence as we look ahead to the future of the industry," Burr-Lonnon said. "Projections call for robust demand for components, particularly in the data, communication and transportation sectors."

"Our customers have been very focused on building out redundancies and resiliency in their supply chains through creative inventory management programs," said Luke LeSaffre, CRO of Fusion Worldwide (#10 on the *Source Today* Top 50) in a written interview with *Source Today*, "and we expect that part of our business to grow considerably, as holding more inventory becomes a major legacy of this shortage market."

"The current market has brought us closer to our customers," LeSaffre added. "We have forged a number of deep and enduring partnerships in the wake of this crisis. We are encouraged about what our business will look like when the world eventually emerges from this ongoing crisis." ■

1. Arrow Electronics, Inc.
2. WPG Holdings LTD
3. Avnet, Inc.
4. Future Electronics
5. Digi Key
6. TTI, Inc.
7. Smith
8. RS Group plc/Allied Electronics & Automation
9. Mouser
10. Fusion Worldwide
11. Rutronik
12. Farnell, trading as Newark in North America
13. DAC
14. NewPower Worldwide
15. A2 Global Electronics + Solutions
16. Velocity
17. Sourceability
18. Master Electronics
19. Chip 1 Exchange
20. Sager Electronics
21. Classic Components
22. Corestaff Co., Ltd.
23. PEI-Genesis
24. bisco industries
25. RFMW, Ltd.
26. Powell Electronics Group
27. Richardson Electronics
28. Electro Enterprises Inc.
29. Steven Engineering
30. Hughes Peters
31. Symmetry Electronics
32. Flame Enterprises Inc.
33. Direct Components
34. IBS Electronics, Inc.
35. Flip Electronics
36. Marsh Electronics
37. Area51 Electronics
38. SMD Inc.
39. All Tech Electronics, Inc.
40. Brevan Electronics
41. Diverse Electronics
42. March Electronics
43. Air Electro Inc.
44. Nasco Aerospace & Electronics
45. Suntsu Electronics
46. Jameco Electronics
47. Marine Air Supply
48. PUI (Projections Unlimited, Inc.)
49. Kensington Electronics
50. Advantage Electric Supply

Adaptable AGVs

Give OEMs New Choices

Smart electric actuators provide a flexible solution across many applications.

by Travis Gilmer, Hakan Persson,
Ian Miller

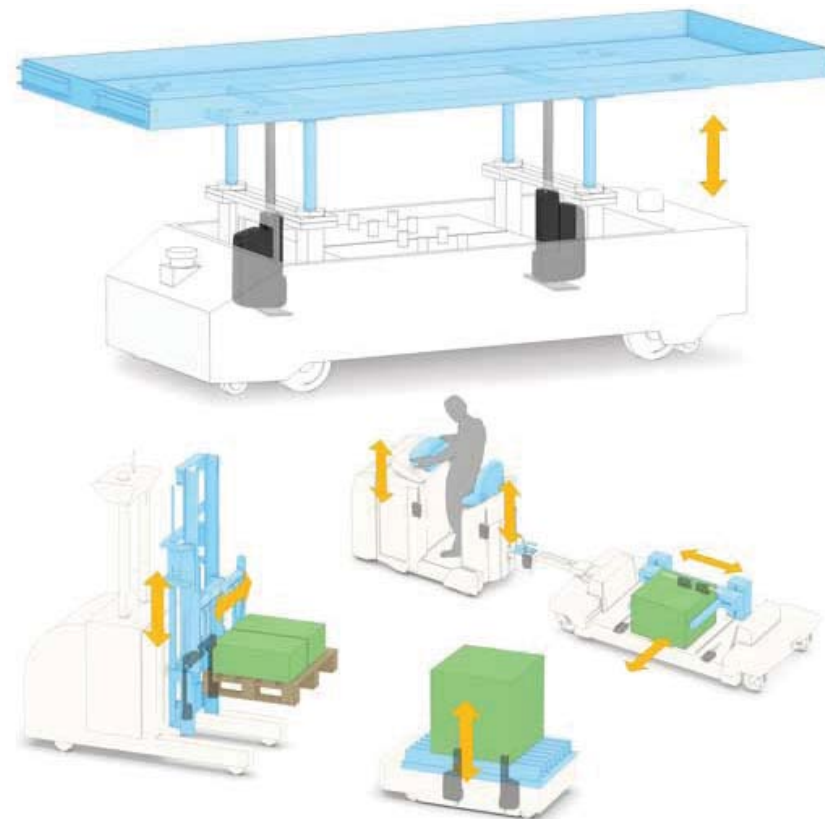
The need for more complex motion profiles specific to a factory's operations is one big reason why automated guided vehicles (AGVs) typically are used less frequently than in distribution centers. Industrial OEMs often must engineer AGVs for an end-user, and that can prove to be expensive and require longer lead times.

As the demand for specialized industrial AGVs grows, OEMs are increasingly meeting customer needs for special functionality and economy by offering standard AGV models that can be easily adapted to a wider range of factory floor applications. Equipping AGVs with such versatility is an evolving new generation of smart electric linear actuators armed with onboard intelligence and communications, extended durability, modular assemblies and flexible mounting options.

AGVs on the Plant Floor

Industrial AGVs, including carts, tuggers, self-driving forklifts and mobile robots, improve manufacturing efficiency. These machines relieve much of the human lifting involved in material transport, such as delivering materials and components to a production line. An assembly line operator at a workstation might message the need for a component to a logistics computer system.

The management system then sends the request to the AGV management software, assigning the closest vehicle to the task based on priority and motion type. After



While AGVs may differ in form, they share the functionality of aiding manual labor and increase material handling efficiency. Electric linear actuators with integrated communications (shown installed in each example) are key in designing AGVs as part of a smart factory. *Images courtesy Thomson Industries, Inc.*

the AGV finishes the job, it signals the control system to the next step.

Much of an AGV's work involves sliding under pallets and using actuators to raise them to transport contents wherever needed. To meet the ambitions of modern plant floor process innovation, new AGV applications demand more complex motion profiles and often require accessories such as grasping arms, claws and clamps.

Onboard Intelligence, Communications

The key to this new generation of actuators is a microprocessor and communications via an open protocol such as CANopen or SAE J1939 CAN bus. AGVs equipped with smart actuators and communications provide maximum flexibility in designing movement profiles. Getting this kind of control might have traditionally required external devices

such as encoders. Today's smart devices do it with an all-in-one solution combining software and integrated feedback devices.

The host computer knows the state, position, speed, direction and power supplied to the AGV. With such information at hand, designers can program the AGV to adapt to changing scenarios. For example, by knowing how much weight the vehicle carries and comparing it to what a plan might call for, production supervisors can evaluate the AGV's performance.

By reading pressure from strain gauge sensors on a gripper arm, they can set it to reduce its force to prevent the gripper from crushing an object. Conversely, operators can increase the force to prevent it from dropping the object when a bump or other disruption occurs. Through real-time communication among four actuators supporting a stack of pallets, the AGV can be programmed to move only two actuators to tilt the pallet to compensate for load shifts or imbalance.

Having such detail on the AGV's movement can also reduce maintenance costs and improve uptime. By tracking the AGV actuator and the travel distance and comparing it to the predicted life cycle, maintenance teams can reduce downtime by proactively replacing components before they break.

Mixing and Matching Other Motion Components

An actuator assembly includes a gearbox with several different gear reductions that can be adapted for load and speed, a lead screw, a nut that could have multiple capabilities, and a motor that might either be brushed or feature brushless steppers. Modern electric actuators offer more flexibility in configuring these options within the same envelope.

When partnering with a manufacturer whose can create collaboration among all engineers, the result is an actuator that meets the specific application requirements and quickly delivers a more accurate solution that also is less expensive.

If the application calls for higher speed, the designer could use a lower gear reduction. If it requires optimization for lifting force, they might use a higher gear reduction to maximize current that can adjust the voltage. If safety is a primary concern, they might integrate limit switches for an interlock design. However, one of the most significant

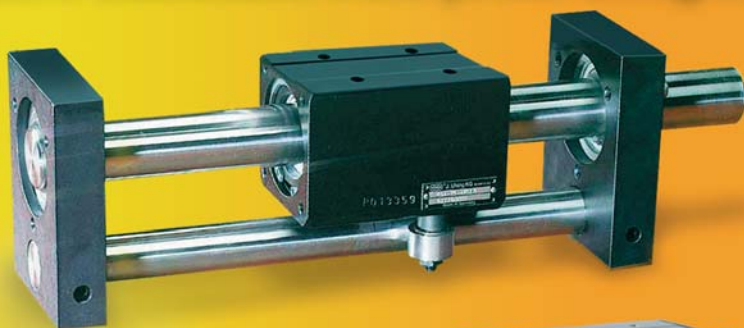
choices impacting AGVs is to optimize around the duty cycle by using brushless motors instead of the brushed variety.

Expanding Application Horizons With Brushless Motors

Where the brushed motor may provide duty cycles of 25%, brushless motors can deliver up to 100% duty cycles because

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they run without wearing down contact brushes with high current and heat. Inexpensive brushed motors are effective and useful for simpler distribution warehouse applications—though volumes are high, movements are short, simple, up-and-down strokes that do not wear down the brush material much.

For more complex operations involving frequent starting and stopping, load shifts, higher speeds and external accessories, however, a brushed motor would burn out faster than a brushless design. Whether the application requires cycling every 10 min. or millions of continuous cycles, brushless motor-driven actuators can expand the application range for AGVs.



The automation needs of factory warehouses are increasingly complex to meet industry standards and demands. Today's AGVs feature advanced intelligence to help reduce maintenance and improve uptime.



Smart electric linear actuators, such as select models of the Electrak series from Thomson Industries, have been designed with the intelligence requirements of automated factories.

Flexible Mounting

Modern actuators provide more flexibility when it comes to mounting as well. Traditional vertical mounting is always an option, but certain applications might benefit more from a horizontal orientation that extends or retracts to control a scissor jack fixed on one side and free on the other. A vertical or horizontal mount may affect safety considerations and involve adding a foot mount on the rear of the actuator.

Another option is to use a threaded end instead of a plain rod, decreasing the overall installation length for tight design

envelopes. The latter two options are available on electric actuators developed specifically for AGVs, mobile equipment and industrial automation.

Smart electric actuators, combined with modular assemblies, brushless motors and mounting options, can provide a new range of flexibility for AGVs that would not have been feasible only a decade ago. Incumbent designs could never cost-effectively deliver the necessary control, intelligence and modularity. As a result, AGVs can now go more places, do more things and bring more end-user value. ■

TO LEARN MORE about Electrak smart actuators, visit www.motion.com/machinedesign or watch the video at <https://motionind.biz/3seNmRQ>.

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THE TOP 50 Electronics Distributors

 2022 Platinum Sponsor



Company		2019 Global Revenue
1. Arrow		\$34,477,018,000
2. WPG HOLDINGS LTD		\$27,810,000,000
3. AVNET/Farnell		\$19,534,679,000
4. FUTURE ELECTRONICS *		\$6,000,000,000
5. DIGI-KEY CORPORATION		\$4,700,000,000
6. TTI INC		\$3,405,000,000
7. SMITH		\$3,400,000,000
8. ALLIED ELECTRONICS, INC.		\$3,315,353,694
9. MOUSER		\$3,266,800,000
10. Fusion Worldwide		\$2,498,768,000
11. Rutronik *		\$1,192,257,350
12. NEWARK		\$1,482,200,000
13. DAC		\$1,193,000,000
14. NewPower Worldwide		\$755,300,000
15. A2 Global Electronics + Solutions		\$731,000,000
16. Velocity		\$652,000,000
17. Sourceability		\$580,000,000
18. Master Electronics		\$538,000,000
19. Chip 1 Exchange		\$500,000,000
20. SAGER		\$381,000,000
21. CLASSIC COMPONENTS		\$318,000,000
22. CoreStaff		\$280,000,000
23. PEI GENESIS		\$258,000,000
24. BISCO		\$252,528,000
25. RFMW		\$250,000,000
26. Powell Electronics Group		\$229,000,000
27. Richardson Electronics *		\$177,000,000
28. ELECTRO ENTERPRISES		\$167,105,110
29. STEVEN ENGINEERING		\$106,290,000
30. HUGHES-PETERS		\$99,100,000
31. SYMMETRY ELECTRONICS CORP.		\$90,000,000
32. FLAME ENTERPRISES		\$88,300,000
33. DIRECT COMPONENTS		\$86,009,477
34. IBS		\$81,000,000
35. FLIP ELECTRONICS		\$73,800,000
36. MARSH ELECTRONICS, INC.		\$73,571,751
37. AREA 51		\$49,033,050
38. SMD		\$48,600,000
39. All Tech Electronics, Inc		\$46,000,000
40. Brevan Electronics		\$44,200,000
41. Diverse Electronics		\$40,900,000
42. MARCH ELECTRONICS		\$34,700,000
43. AIR ELECTRO INC		\$32,000,000
44. NASCO Aerospace & Electronics		\$30,550,000
45. Suntsu Electronics		\$22,860,769
46. Jameco		\$22,000,000
47. MARINE AIR SUPPLY		\$21,000,000
48. PUI (PROJECTIONS UNLIMITED, INC.)		\$20,600,000
49. KENSINGTON ELECTRONICS, INC.		\$20,549,000
50. Advantage Electric Supply		\$20,000,000

* Publishers Estimate



System Integrators: The Key to Project Success

Companies about to upgrade their hydraulic controls should consider hiring a system integrator to bump up the project's chances at success.

by Aaron Heinrich, Delta Computer Systems, Inc.

For a host of reasons, many companies—including those making or modifying hydraulic components, controls and equipment—strongly resist asking for help when it comes to product development and implementation. Most of their reasons may revolve around ego and short-term cost considerations, but some companies just insist on doing everything in-house. From a business

perspective, however, “doing everything” entails undertaking tasks outside a company's core competencies, which is often a fraught decision.

Companies eyeing upgrades and installations of hydraulic controls would do well to consider bringing system integrators (SIs) into their projects to improve the project's chances at success.

That said, SIs are like every group of engineering professional: Some are

amazing, and some less so. Some seem to almost instantly establish a rapport with a client company's design team and management; others always seem like out-of-touch outsiders. Like many consultants, some overstate their capabilities.

To help companies get the most out of using SIs, here are some observations we have made at Delta Computer Systems over decades in the hydraulics and motion control industries.

Why Outsource to SIs?

First, it's important to understand the need for bringing system integrators into your design team. It might help if you consider hiring SIs as outsourcing, subcontracting or facility management. Your firm lacks the expertise to tackle complex wiring and components or programming in proprietary development environments, so you bring in outside resources. And that can take the form of contracting with SIs to provide the critical expertise.

SIs can provide a wide range of benefits, including:

- Lowering operating costs.
- Upgrading the technical capabilities for tackling a project.
- Providing formal and informal technical training for staff on the team.
- Reducing or eliminating the need for staff to become fluent in a particular programming language or environment.
- Freeing staff for other, potentially more lucrative and beneficial tasks.
- Delegating project scoping, planning, procurement and upfront capital expenditures.

"The biggest benefit to hiring SIs is their experience," says Nick Bell, controls engineer and programmer at Milwaukee-based InterConnecting Automation, Inc. "We're not working with 1980s PLCs anymore. The power and capabilities are far greater, and users are pushing the limits every day with how they are using PLCs."

"You need someone who understands modern bi-directional communications, varies signal types, programming and debugging," Bell continues. "Additionally, a lot of the systems deal with high voltages, so it can become dangerous if proper precautions and protections aren't taken on the systems."


Hiring an SI can bring in expertise from across a variety of control systems, some of which may be beyond your company's knowledge or experience and be overlooked or ignored during planning. Good SIs can help guide decisions on controls integration according to priori-

ties you establish early on, such as budget priorities and future scalability. In the end, SIs may be the quickest and best route to a finished system that delivers the performance you need.

SIs as Partners

Anyone experienced in subcontracting knows you can hire help in an impersonal, all-business fashion, as if interfacing with a machine. And there's nothing wrong with this. System integrators are consultants often hired to execute specific tasks, which can be done in an almost scripted manner.

However, companies will likely get more from SIs if they hire them as if they are bringing a partner into the fold. Ultimately, SIs want to collaborate, build and see projects succeed. No one wants to be just a cog in a machine; respecting an integrator's feelings and desires can make a world of difference in the relationship and the success of the project.

 *The biggest benefit to hiring SIs is their experience. We're not working with 1980s PLCs anymore. The power and capabilities are far greater, and users are pushing the limits every day with how they are using PLCs."*

—Nick Bell, InterConnecting Automation, Inc.

In some cases, building partner relationships is easier with local SIs rather than multi-regional or national organizations. Smaller outfits might only have one or two employees, but they can often deliver the same or better benefits and partnerships as their larger counterparts. It's the personality of your SI representative that will likely have more to do with the quality of the company/SI relationship rather than the size or reach of the SI's firm. In other words, companies shouldn't overlook smaller SIs.

Some SIs specialize in certain systems, which is generally a good thing. This means a company can take advantage of that deep expertise. For companies that didn't standardize on a particular control platform, or if one their priorities is to remain platform-agnostic for future compatibility and/or scalability, it is usually best to team up with SIs who have a broader rather than a narrower knowledge base.

Also consider brand-agnostic SIs are less likely to be under pressure to sell or meet quotas for a particular brand. This frees them to keep your priorities and needs above all others.

Similarly, be leery of how SIs might gain long-term control of your systems. For example, some SIs have been known to password-protect their code and force clients to hire them for every change. It's clearly a nefarious tactic to be avoided (and specifically called out in contracting agreements), and one step removed from ransomware.

When companies treat SI as partner, they're more likely to keep the SI involved in all stages from planning through review. And SIs should have the qualifications to ensure specified components (especially controls) meet requirements and are the parts actually used. They should have a record of delivering results defined by a project's established metrics and goals.

Potential SI Problems

Obviously, there can be problems with SIs. But it's not always the SI's fault. For example, when an SI handles design and implementation of the machine controls, company employees may not be involved and thus don't feel much ownership. The SI could set up training, but staff may not get much from it. This can add cost and complications once the SI leaves and employees must troubleshoot and fine-tune parameters alone.

To prevent this, companies can arrange for the SI to provide employee training after commissioning. "A lot of our customers want to learn," says Bell. "They don't necessarily want to do the technical

stuff, but they want to have the knowledge and control. If they can't understand the system and how to make changes, then every tweak means going back to the SI."

Another source of problems stem from using smaller SI firms. Larger SIs may have better volume pricing arrangements with suppliers, better vendor support and better access to limited inventory. (This is why distributors with SI-like capabilities may be a better choice in some cases.) Additionally, with more support staff, larger firms often have availability when smaller SIs are closed or with another client. Also, can the SI stay on-site to finish commissioning if there are unexpected time overruns.

Not least of all, the lines between project scope and system ownership can get blurry. For example, if a power supply is defective or performing outside of spec, who is responsible—you, the distributor, or the SI? Such concerns should not sour companies on SIs. Rather, talk about these concerns and issues upfront when vetting SIs for a new project.

Getting the Right SI

The best way to find capable SIs is to listen to their customers, industry colleagues and other business owners, engineers and industry insiders. Nothing speaks louder and with more authority than hearty rec-

ommendations from someone you know and trust and who has the appropriate industry knowledge and experience.

These people know how a given SI work on projects in terms of real-world expertise and secondary-but critical factors, such as being a team player, adaptability and the ability to add value above and beyond the stated project's scope.

Recognize that highly recommended distributors may offer SI-like services, but being more than happy with how a distributor handles distribution does not guarantee that they will be adept at providing integration services. Companies must ask distributors the same questions

The System Integrator's "Prenuptial" Agreement

WHEN YOU'RE YOUNG and in love, chances are higher that you'll rush headlong into marriage on wings of passion and...well, good luck. When you're 50 and more experienced, however, with potentially more to lose, you might trust emotion less than prudent communication codified in a well-planned document.

Similarly, when starting out on an SI partnership, don't assume first impressions and friendly handshakes will get a difficult project into the win column. Have as many conversations as necessary to clearly define the project's variables and roles from planning to ongoing support. The details and decisions should be compiled into a formal agreement, if only as an addendum to a statement of work.

Here is some advice on the discussions and agreements companies need to have with SI, all based on my firm's industry experience:

Define the project's scope. This should include all the stakeholders in the project so that the effort is collaborative and no one will feel their voice hadn't been heard once the project is completed. The scope should lay out objectives, establish all project constraints, and clearly define what are and are not project deliverables.

It should also include milestones with dates as metrics for assessing progress being made toward reaching those milestones. If there are assumptions, note them, and if there are criteria that must be met before the project is complete both by the SI and client, they need to be detailed.

Also, don't shy away from being exact and specific about the deliverables' look and feel. What are the specific sequences for cylinders? What should touchscreen interfaces look like? More detail up front breeds less waste and better outcomes down the line. And be advised, scope documents can and do exceed 50 pages.

Establish responsibilities. "Some customers just want the SI to do the programming," notes Nick Bell. "Others want the complete kit and caboodle—spec the motors, run the conduit, land everything and handle all the control system's electrical needs. So set unambiguous expectations on what you want from the integrator, because some won't touch any other job if, for instance, they're only doing the programming."

Establish durations. Will this be a long-term relationship or a one-time project? Will the SI be on retainer, billing

for time and materials? Or will the work be for a clearly defined contract, paid for hitting milestones or on completion?

Play the field. Make sure to explore the SI's fluency and track record in your particular control-system type, brand, technology or application. How long has the SI worked in your industry? Try not to pick the first candidate that looks like a reasonably good fit.

Go through the options in this section and carve a long list of prospects down to a short list of top candidates. When one job can win or lose potentially millions of dollars in revenue, do not cut corners at this stage.

Define support details. This is a major area some clients overlook. For example, training should be built into the agreement if needed. Specify how much training there will be and when you'll know training is complete. Will the SI be under contract for ongoing technical support? If so, for how long and under what terms?

Will the SI have the ability and responsibility to remotely administer and troubleshoot the system, or must such matters be handled on-site? Surprisingly often, the "after sale" details play the largest role in determining a project's long-term value. ■

and have the same conversations they would with a prospective SI. Alternatively, distributors can likely recommend a range of successful SIs if they don't offer those services themselves.

Several trade publications maintain annual directories of SIs. In addition, the same publications may offer articles detailing system integrators' work in different projects and illustrating their fields of expertise. If nothing else, those publications and websites carry SI advertisements that explicitly reference your needs and state their capabilities.

Finally, there are trade groups such as the Control System Integrators Association (CSIA). It hosts a web directory of SIs, the CSIA Industrial Automation Exchange. This resource lists SIs from around the world and lets users filter by different criteria, including CSIA membership, as well as CSIA certification—which, according to CSIA CEO Jose Rivera, demonstrates an SI's commitment to the business and industry.

“The CSIA Best Practices and Benchmarks Manual sets the standard for professional management of an SI company.”

—Jose Rivera, CSIA

“The CSIA Best Practices and Benchmarks Manual sets the standard for professional management of an SI company,” says Rivera. “SI companies that successfully deploy best practices and can successfully demonstrate that can earn three-year certification through an audit.”

“Synergy” may be an overused buzzword, but it definitely applies to well-crafted collaborations between industrial companies and SIs. Each acts as a force multiplier on the other rather than just adding their strengths to each another. It radically expands the expertise brought to bear on a host of challenges and elevates the potential of the entire engineering team.

The SI community is somewhat hidden from the industry. Most SIs grow through word-of-mouth and can fly under the radar for decades. That's why many industrial firms have little to no experience with them. This is unfortunate. Strong SI partnerships can deliver outsized value and benefits that last for years. It would be wise move to inves-

tigate some SI options on your next control project. ■

EDITOR'S NOTE: More information on the CSIA certification, can be found at <http://www.controlsys.org/certification/mark-of-excellence>.

This article appeared in *Power & Motion*.



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Walker Reynolds is president and solutions architect at 4.0 Solutions and chairman at Intellic Integration in Dallas.

Digital Transformation: The CEO of the Future is a Technologist, Not an MBA

In this Q&A, Walker Reynolds discusses the need to leverage every possible IT pathway to solve problems—and why the employee of the future is a technologist.

by **Rehana Begg**, Senior Editor

When Walker Reynolds meets with company directors, he tends to hear the same question: “What does digital transformation look like?”

The chairman of Intellic Integration, a full-service systems integrator based in Dallas, has a standard response: “Digital transformation happens in two giant steps. Step number one is, you become a ‘smart’ business, which takes three to five years, no matter how big or small

the company is. And you do that through the following process: You connect, you collect, you store, you analyze and you visualize all your data and information.

“Then you find patterns, you predict, you report and then you solve the problems that machine learning and artificial intelligence found in those patterns. That’s a smart business.”

The long-term objective for manufacturers hoping to secure their future, according to Reynolds, is to plug into a digital supply chain, which is a supply

chain made up of smart companies. When they have this capability, they refer not only to the links directly upstream and directly downstream, but also the links that enterprises don’t currently work with. “Explain that to the Board of Directors, and the lightbulb turns on,” said Reynolds.

As a solutions architect and an educator at 4.0 Solutions, a distributor of software and products, Reynolds trains engineers and digital transformation professionals on how to support and lead digital transformation initiatives in manufacturing.

In this Q&A with *Machine Design*, Reynolds discusses his firm's digital transformation maturity assessment process, the fundamentals needed to enforce Industry 4.0, how a Unified Namespace serves as a single source of truth and why he believes the future C-suite should be run by engineers.

Content has been edited for length and clarity.

Machine Design: At the recent ISA IIoT & Smart Manufacturing Virtual Conference, you were vocal about your views on how to achieve a “smart” factory. Can you recap what said about getting started on a digital transformation?

Walker Reynolds: Believe it or not, digital transformation starts with education. If you look at the Industry 4.0 specification that was written in the EU, in 2012-2013, it says that digital transformation starts with computerization. Computerization is just infrastructure and manufacturers all have infrastructure. What you do with that infrastructure is a function of knowledge, and it has to start with education. Legacy organizations have to stop approaching solving problems the way they've been solving them during the Third Industrial Revolution—which is one use case at a time, one machine at a time, one piece of software platform at a time, one capability at a time.


We have a process called the digital transformation maturity assessment. When clients hire us to come in for an assessment, we do basically three things. Number one, we assess the organization top to bottom. Where are you right now? Number two, where do you want to go?

Where do you want to go as a function of solving the problems that you're aware of and of identifying problems you're not aware of all. And, number three is charting a path to get you to where you want to go.

We have five core meetings during that digital transformation maturity assessment. One of those is with IT. The first question we ask the IT group is, “Are you a security and compliance organization first, or are you a service organization

first? And we always get a laugh and they generally answer like this: “I want to say we're a service organization, but we're really security and compliance first.”

If a subset of digital transformation is IT/OT convergence—that is, taking the technology on the plant floor and merging it with the technology on the business side—then the thought processes, the culture on the plant floor and the culture on the business side have to change.

 *If a subset of digital transformation is IT/OT convergence—that is, taking the technology on the plant floor and merging it with the technology on the business side—then the thought processes, the culture on the plant floor and the culture on the business side have to change.”*

How do they change? We acknowledge that the first problems we have to solve are the OT problems. The smartest people in your organization are on the plant floor. They already know what all your problems are. Just go talk to an operator and ask them what's wrong with the process. They're going to give you a list of 20 things that, if you somehow could enable them to solve, you would capture millions or tens of millions of dollars in gained efficiency. IT's role is to serve that enablement. Most IT departments don't understand that. There's generally one or two young people who understand that, but the legacy IT professional really, really struggles with that concept.

Think about it: Look at IT policies inside manufacturers. What are they? There's zero trust. (“Trust no one.”) If one person makes a mistake, lock everyone down. So, when someone plugs a USB fob into a USB drive in their computer and opens an executable file that takes down the network, that IT department makes

it impossible for anyone to use a USB thumb drive. What they've been doing over the last 20 or 30 years is close down the pathways to leverage technology to solve problems. But a truly transformative organization leverages every possible IT pathway to solve problems.

MD: What do organizations need to enforce Industry 4.0? What are the fundamentals and where do they start?

WR: The problem I want to solve today is a function of what we know today as an organization. We have to acknowledge that digital transformation is about exponentially increasing the collective knowledge of the organization. Why? As we transform data into information, we get that information into the hands of the people who need it, when they need it, where they need it, in the format they need it. Collectively, as an organization, we get smarter.

So, we have to start by acknowledging that we have no idea where the finish line is. We have no idea where we're going, but what we do know is that we're gonna adopt some guiding principles. Number one: We are going to codify a digital strategy using a three-sentence statement that says: This is how and why we're going to become a smart company; this is the technology we're going to use; and this is how our customer is going to benefit. It takes transformative and disruptive leadership to do that. It takes a visionary leader to define that digital strategy.

Then, we acknowledge that we're going to write minimum technical requirements for all the smart things in our business. What that means is that if I want to use the Siemens PLC, and Rockwell software, and I want to use SEEK analytics, and I want to use PTC's cloud technology, and I want to use AWS over here, I want to use Azure over there, we're going to enable people to do that. But we're going provide the list of the minimum technical requirements those solutions have to meet. The three things are: They have to support this protocol, they have to be edge-driven and report by exception lightweight.

The next step is to start iterating. We acknowledge that what we want is a function of what we know. The organization is going to get exponentially smarter, which means that what we want is going to change exponentially.

To summarize, a digital transformation starts with a digital strategy, it is driven by transformative leadership, it is based on common technology and we acknowledge that what we want is a function of what we know.

MD: Explain what you mean by the Unified Namespace.

WR: I'll read it to you. The Unified Namespace is the structure of your business and all of the events. It's a single source of truth for all data and information in your business. It's a place where the current state of the business exists (where it lives). It's the hub through which the smart things in your business communicate with one another. And it's the architectural foundation of your Industry 4.0

in digital transformation initiative, which is based on your digital strategy.

In a nutshell, for the layperson, the best way to describe a Unified Namespace is think of a file share. If I go into Windows Explorer and I want to navigate through a file share, the hierarchy that you create in that file share is a hierarchy designed to get you to the data and information that you need.

We use ISA-95 Part 2. So, it's not a file share; it's really a broker namespace. But the best way to describe it is to compare it to a file share, or a tree system that gets you to the current value of the thing you care about. So, using ISA-95 Part 2, which structures data sources: for instance, following from Enterprise to Site to Area to Line to Cell. My first folder is going to be the name of my enterprise, the second folder is going to be the site I want to go (the plant location), the third folder will be information in that site level that I care about. It might be the CEO of that site, or it might be the general manager of

that site, or it could be current electricity consumption at that site.

Imagine you're navigating through a file share that gets you to any data point that you want to view in your organization. This gives you the current value, and it's structured on a common standard. All of the smart things in your business publish data into that namespace and they consume it from that namespace. So, if I want my MES system to consume raw events from my PLCs, so that they can calculate overall equipment effectiveness, and then write the OEE number, then they're consuming from the Unified Namespace and they're writing back to the Unified Namespace. It is the single source of truth for all data and information in your business. It records only current state—the structure of the business right now.

If you want to look at historical values, you need to use another smart device, connected to the Unified Namespace, to store the history. That could be either a historian or data lake.



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MD: What is your take on using agnostic technology?

WR: I am a huge proponent of remaining agnostic. I'm the chairman of a systems integrator.

We're values-driven, we're mission-driven, we're agnostic. We do not sign distribution agreements with any one vendor. We recommend the best solution for our client's use case, as long as it meets the minimum technical requirements. It could be Rockwell's connected enterprise, or it could be PTC...As long as they meet the minimum technical requirements.

What technology do we use in our organization to interoperate our data? In 90% of the cases, we use MQTT Sparkplug. We use MQTT as the communications protocol, and we use Sparkplug B as the specification for how we package everything and create the Unified Namespace. What we say is, if you want to use Rockwell's MES system, it has to support and MQTT Sparkplug B.

The reason you need to remain agnostic is this: Digital transformation happens from the ground up; it doesn't happen from the data center down. It doesn't happen from the boardroom down. The data center and the boardroom enable solving problems from the plant floor up. I get this question a lot...My recommendation is to always remain agnostic; pick best in class for your problem, not best in class from the limited suite of solutions from one vendor.

MD: Let's circle back to the future state of manufacturing. What are the limitations and what needs to change in order to achieve digital transformation?

WR: When I'm in the boardroom, the executives are generally MBAs. They're not engineers. What fundamentally needs to change about manufacturing organizations is that they need to be run by technologists. You need more engineers as a CEO and fewer MBAs.

It's no secret that the most transformative organizations in the world are run by engineers. All the Industry 4.0 companies are run by people who either are

professional engineers, formally trained engineers or self-trained, self-taught engineers. So, the CEO of the future is a technologist, not an MBA.

“It's no secret that the most transformative organizations in the world are run by engineers.”

Here's the message I give the boardroom: If you have not defined your employee the future, if you haven't codified your digital strategy, and you're not working toward a technology-driven infrastructure in lieu of buying capability focused products, then you are wasting your time and your money, and you will fail. Full stop. ■

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Let Your Application Guide Your Protocol Choice

Communication variables should be considered in selecting a standard.

by Adam Justice, Cristian Codreanu,
Grid Connect, Inc.

What's in a name? A lot when you consider communication protocols such as LoRaWAN, Bluetooth, NB-IoT and more. Each has benefits and drawbacks for the Industrial Internet of Things. The best protocol for an application depends on parameters like the industrial process, geography and employer's business goal.

Some protocols have limited specificity, and they're not intended to access the internet. For instance, a manager might

be deploying, say, sensors to gather data within a confined geography. But if a manager wanted to gather that same sensor data remotely, and Wi-Fi wasn't an option, then a protocol could be NB-IoT, or Narrowband Internet of Things. NB-IoT is a low-power wide area network telecommunication standard created by a group of organizations known as 3GPP and operated under that standard or in the guard band of an LTE carrier.

Applications Drive the Selection of Protocols

Selecting a protocol is a function of the application one must work with. With fleet management, for example, a user would look for a wireless technology that is agnostic to geography, since the goal is tracking assets across many directions and distances. In this situation, NB-IoT is a fit. NB-IoT supports simpler devices with narrow bandwidth (i.e., 200 kHz). This assumes there's cellular coverage in the locations where your device would be at any specific moment.

Another option for fleet management could be LoRaWAN, which is a low-power, wide area network protocol. With LoRaWAN as a protocol, a manager could connect battery-operated assets to the internet. LoRaWAN technology offers longer range than, for example, Wi-Fi (i.e., 2.4 GHz and 5 GHz), or Bluetooth. But LoRaWAN isn't that popular yet. LoRaWAN technology uses repeaters placed on infrastructure that proponents are still installing around the world. NB-IoT, however, takes advantage of infrastructure already in place around the world. Either protocol could be effective for tracking assets like containers on a ship moving from country to country.

Tracking the health of industrial machinery is another consideration. Let's say a facility owner wants to connect the factory's smart machines and legacy equipment to the internet, so managers can know in advance when a machine needs maintenance. An easy way to do this would be via a Wi-Fi protocol. That said, in the industrial world, managers

resist using wireless network protocols because of the reliability of connections and security concerns. It's easier to hack a wireless connection than a wired one. Users experience problems with Wi-Fi routers, too. So, it's critical to test connectivity with many routers and determine the compatibility of these routers with the application.

A third application scenario is a robotic apple picker working in an orchard. In this case, Bluetooth, a standard for exchanging data over short distances using UHF radio waves, and Wi-Fi would not be options, especially with acres of orchard to cover. Instead, the owner of the apple picker could opt for LoRaWAN.

It's important to consider the potential amount of data transfer between the apple picker and a server. LoRaWAN is a good choice for trafficking low levels of data over large areas. But people typically opt for LoRaWAN technology to deliver status reports and small bits of information. If the orchard owner wants a higher level of data flowing to and from the robot in the orchard, then NB-IoT would be the better protocol. And if the machine frequently reaches points where its owner must (or desires to) make decisions, then the orchard operator ought to consider normal cellular connectivity.

Next, imagine a dairy plant with robotic palletizing stations at the end of its production lines. Here a Wi-Fi protocol would work well. For the palletizing robot, a facility manager would need to place a Wi-Fi module to connect the palletizer to a Wi-Fi network. Once the manager had access to Wi-Fi, the communications would stay within the plant's intranet, on a local server.

This scenario relies on an intranet and limits access to the internet. The dairy plant manager might want to send his owner status reports on the production lines and rates of palletization or even give the owner a way to monitor things remotely from across the county. The manager can do that without opening control of the operation, which protects security.

Applications in a War Zone

An application in the headlines today is shipping supplies to forces fighting in Ukraine. A container filled with supplies destined for Ukraine could employ battery-powered devices with the capacity to cover the duration of the shipping operation. As the shipment progressed across countries, the devices on the containers would need GPS capabilities to serve up location and connect to a cellular network or via NB-IoT.

The shipper would want a device that supports NB-IoT and CAT-M1. CAT-M1 is also a low-power wide area cellular technology for IoT devices. CAT-M1 offers a few advantages over NB-IoT in terms of power and coverage, but NB-IoT is a bit less costly. In a situation like this, the shipper would want to guarantee there is information about the container's location and status throughout its journey.

In a war zone, however, enemy cyberattacks could try and impersonate a device or even jam the device. When an enemy combatant is jamming the radio spectrum, the protocols don't matter because the good guys can't read the signals. In peacetime, a shipper could use RFID tags and rely on workers scanning the container as it moved from point to point. With RFID tags, the shipper only has information when someone scans the container.

To avoid getting lost in a comparison of the pros and cons of technology protocols, first determine what you're trying to accomplish. Let the application and what you want to derive in the way of information be your guide in picking a protocol for the job. ■

ADAM JUSTICE is CEO of Grid Connect, Inc. and co-host of The Smart Home Show podcast.

CRISTIAN CODREANU is vice president of Engineering for Grid Connect, Inc. He holds two patents for smart electrical devices and a Master of Science degree from the Academia Tehnica Militara in Bucharest, Romania.

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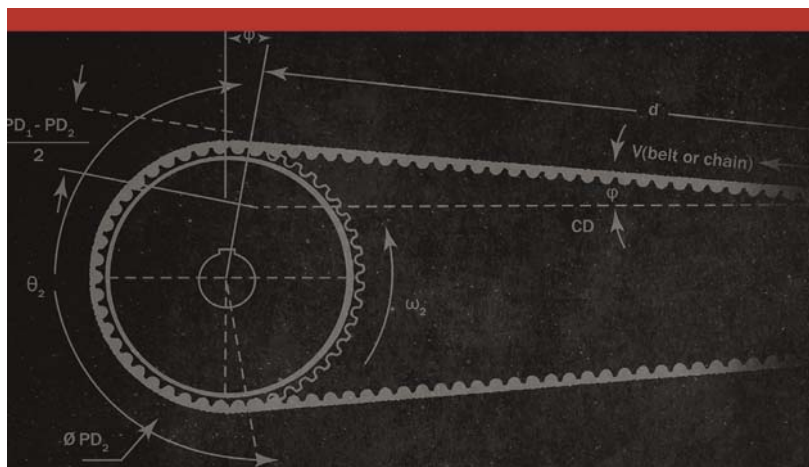


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The ELM3002-0205 EtherCAT measurement terminal from Beckhoff delivers high-voltage measurement functionality for batteries, generators and motors. This I/O terminal supports the four measurement ranges of ± 60 , ± 120 , ± 500 and $\pm 1,000$ V, respectively, and is particularly suitable for applications in the fields of electric vehicles (EVs) and renewable energy. The dual-channel measurement terminal achieves a maximum sampling rate of 50 ksp/s per channel, enabling deeper data insights in energy applications. In generator control, for example, faster response times are possible as a result. Moreover, high measurement accuracy enables more accurate frequency detection, which in turn improves frequency stabilization in power grids. In battery testing applications, load and quality tests can be reliably performed due to the high sampling rates.

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Design Power is a new software platform offering multiple digital design tools to support the engineering and specification of belt-drive systems across a broad array of applications, making the process easier and more robust than ever before. This new digital toolkit consists of six modules, including four all-new applications and substantially upgraded versions of Gates digital tools, Design IQTM and Design Flex ProTM. Among the all-new modules is an industry-first Mobility Drive Analysis tool. The Design Power platform is designed to provide application-specific drive systems, ultimately improving safety and operating costs, while reducing energy consumption and downtime in their operations.

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The ASO safety mats and edges can protect people and machinery from harm. Mats detect the presence of personnel on horizontal surfaces (usually the floor), edges can be used on any surface (usually near possible crushing or shearing points), and bumpers are used in applications involving vehicles or other moving equipment. The safety mats include five additional sizes of the standard black mats with straight or tapered edges, and four new mats in safety yellow. The safety edges include additional 25 × 30 mm profile edges with a sealing lip and a new 30 × 70 mm profile option. They are available in lengths up to 5 ft. Safety bumpers increase the maximum length to 6 ft; 100 × 200 mm profile bumpers, in lengths from 1 to 6 ft also have been added. These bumpers are resistant to vibration and excellent for mobile applications such as industrial vehicles. Mounting rails are included to simplify installation.

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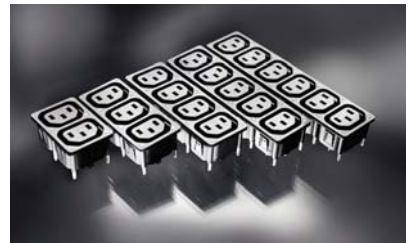


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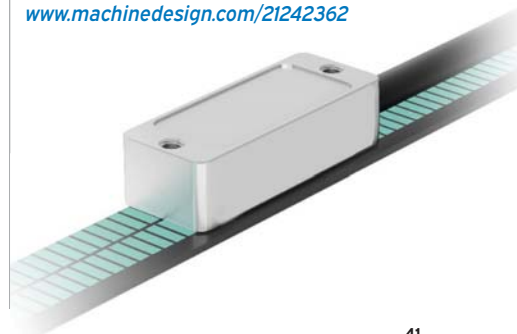


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The SMA3 contactless absolute encoder can be installed in rotary and linear applications and integrates the MARS Multi Adaptive Range Sensor. It enables the size of the pole to be adjusted in order to fit the ring or the linear travel in the specific application. It is designed for long linear measuring lengths up to 19.3 m/63.32 ft, for shaft diameters greater than 6 m/19.685 ft in a rotary application. It can be used in material handling and transportation systems, automated storage systems and pallet transport systems, even in curved installations. Installation is easy thanks to the wide mounting tolerances larger than 1 mm.

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FAQ

DC POWER SUPPLIES FOR MISSION CRITICAL AUTOMATION APPLICATIONS

Q: What do you mean when you say mission critical applications aren't all power supply needs critical?

A: Besides the fact that every piece of electronics equipment needs a solid power supply, some machines like printers, scanners, copiers, and desktop computers don't need the same quality of DC power as automation devices such as plant floor equipment, robotics, edge computing and sensor devices for the industrial internet of things, and other enterprise resources where downtime and a loss of production can have a very heavy cost associated with it.

Q: What are some key elements I need to look for in such a power supply?

A: It doesn't matter if you're involved with food and beverage machines, industrial control cabinets, electronics production, or automotive manufacturing, you'll need clean, ripple-free, reliable power that is available under a variety of environmental conditions. DC power supplies, in these types of applications, must deliver rugged, efficient power that is compliant with multiple standards, while maintaining compactness for installation into tighter and tighter spaces. Users must also look for products that are readily available while offering the performance and reliability needed for long life cycles.

Q: Are there industry standard interfaces that make this selection easier?

A: Most industrial control enclosures and cabinets employ a standard DIN rail system to provide quick and easy installation and maintenance. The challenge is the growing amount of control electronics, sensor systems, and IIoT interfacing that can take up a lot of the usable space making it difficult to include power management devices easily. The fact that most manufacturers have a global customer base these days, means that they require their power supply provider offers a single product line that is highly flexible.

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Q: How are power supply providers meeting these challenges?

A: Innovations such as the use of high-frequency electronics has helped companies boost efficiency, seeing power density rapidly increase along with efficiency and reliability. These advancements have led to a new generation of power components including power transistors, inductors and transformers, voltage regulation devices, and other components. All this technology leads to reduced electromagnetic interference while increasing reliability.

Q: What benefits have we gained from all this advancement in technology?

A: Advancements like those mentioned have permitted products supplying 480 Watts to now fit into the space that formerly only handled a 120 Watt power supply (see photo below). Companies, such as Altech have designed and manufactured a series of ultra slim metal case DIN rail power supplies designed to take up less than half the space that a current power supply would normally occupy on a DIN rail. For example, the company's Ultra-compact PSC-120 series needs only 1 ¼ inches of space rather than the 2.5 inches of space a competitor's product might take up. Also, the company's low-profile series are ideal for shallow equipment enclosures. These series make it easier for customers to include additional functionality in the same enclosure space (see photos below).

Photo A illustrates how big the difference is between a standard and compact DIN rail power supply while photo B shows a series of low-profile units.



Q: What other features and benefits can I expect from these power supplies?

A: Every product in the Altech series of high efficiency units supports 1+1 or N+1 redundancy with built-in current sharing. Regardless of output, each product in the series has the same input requirement of 85-264 VAC/127-360 VDC, making it so much easier to specify them into a new design or retrofit them into an old design. Additional features include 100% full load burn-in, low voltage and current ripple, Class II isolation, and overload, overvoltage, overtemperature and short-circuit protection. Users get efficiencies of over 90% that provide for lower power dissipation and enhanced thermal performance.

Q: What if my needs continually change as I'm working on new machines?

Units that offer the proper specifications can provide solutions for industrial applications that are in constant evolution, which makes them remarkably flexible. For example, you'll want to make sure the line of products you choose offers an ambient temperature operation field that ranges from at least -25°C to 70°C as well as units that offer both 1-phase, 115-230 VAC units and 2-phase, 230-500 VAC—to allow customers to be able to use and store only one product. In addition, where it is possible for loads to increase significantly, it is possible for some supplies to be connected together—two or more—where the voltage is consistent but the load capability increases.

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Q: If my needs are varied what protection levels are covered?

A: Select product lines with at least three short-circuit overload protection levels, including a hiccup mode as a default factory setting for each power supply unit. Devices should offer output current interruption for short-circuit or overloading conditions with a manual reset available to the operator. If safety procedure are specified to be carried out only by an authorized person, supplies should provide a way to switch off the input circuit prior to restart. For demanding load, such as motors, solenoid valves, and PLCs with highly capacitive input circuits some units offer a continuous output mode where the output current is kept at a high value with near zero voltage during a short-circuit or overload condition. This allows the current to reach up to three times the rated current if needed.

Q: How would I protect from high levels of salt and humid conditions near water?

A: Coastal companies, where there are high salt levels or where there are high humidity levels should consider that supplies must include a conformal coating as a protection against corrosion. This approach greatly extends the life of the supply. This is even the case for markets where humidity can enter into the control panel, such as supermarkets and frozen food stores like fisheries. High enough humidity can cause short circuits to appear more easily. Besides a conformal coating, companies can also include shrink tubing or white glue to protect components, particularly on high-voltage components.



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Q: What certifications should I look for when selecting a flexible power supply for worldwide use?

A: Always check the local and country requirements. Here are a few certifications you might look for: UL, CE and CSA approvals, which may include UL508 listed for USA and Canada, 89/336/EEC EMC directive, 006/95/EC (low voltage), IEC 61000-6-4 for emissions, and IEC 61000-6-2 for immunity. Safety approvals to look for include EN60204-1, EN60950, and military standard MIL-HDBK-217F. Note that product safety standards continually change. One of these includes IEC 62368-1, which supersedes the IEC and UL60950 and 60065 across the world. The goal of the new standard is to establish a more universal and clear approach to hazard-based product testing.

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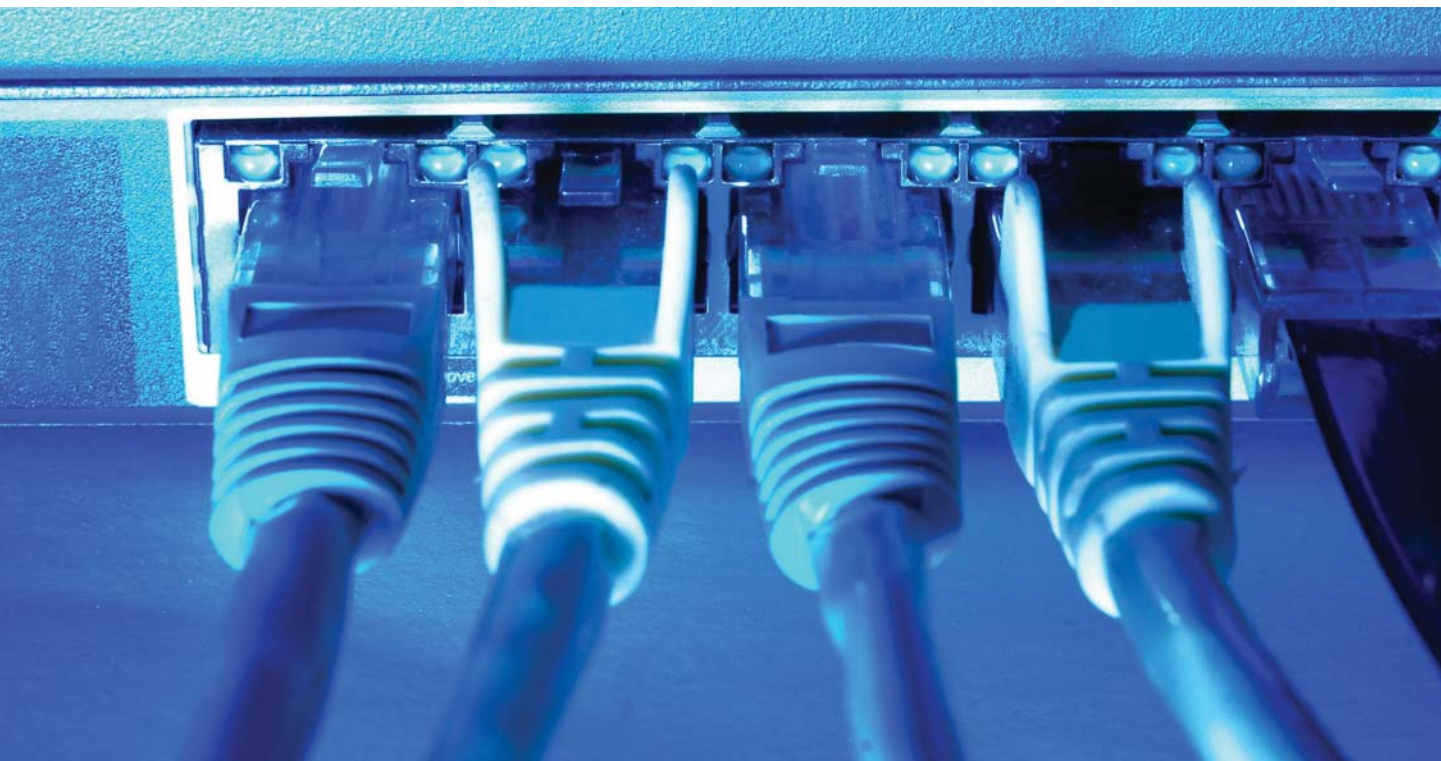



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Time-Sensitive Networking a Pathway to the Future

An Ethernet extension helps increase operational transparency.



by **Thomas Burke**, Global Strategic Advisor, CC Link Partner Association

Industry 4.0-enabling technologies such as the Industrial Internet of Things (IIoT) are helping machine designers to develop increasingly digitalized, connected and data-driven manufacturing through the use of smarter equipment. By adopting technologies that support digital transformation strategies, equipment builders can enable smart, interconnected factories.

The vision of the factory of tomorrow is one of machines, production lines, plants and entire supply chains that communicate with each other to enhance productivity, efficiency and flexibility. The benefits that can be achieved with these frameworks are significant.

For instance, companies can combine shop floor data with higher enterprise-level information and perform advanced Big Data analytics to gain unique busi-

ness intelligence. This actionable insight can then be leveraged to set up self-regulating automated processes to optimize manufacturing activities and deliver high-quality products while minimizing cycle times.

So-called “value chains” are dependent on highly interconnected enterprises building on established strategies such as just-in-time manufacturing to reduce inventory costs while increasing flexibility.

Businesses can make smarter decisions about equipment utilization for optimized performance, quality or both. Moreover, businesses can streamline maintenance activities by predicting potential equipment failure ahead of time using condition-based monitoring and scheduling repairs to minimize downtime.

To help companies thrive in a world where competition is fierce and customer demand requires increasingly agile operations, automation vendors need to offer advanced solutions to help customers realize smart manufacturing strategies. A key technology to achieve this is Time-Sensitive Networking (TSN), which was specifically developed by the IEEE 802.1 working group to enhance standard Ethernet and support futureproof capabilities by adding the ability to both shape and prioritize traffic.

Ethernet TSN Functionality

The core benefits offered by TSN are determinism and convergence.

Determinism is fundamental to supporting time-critical communications on the factory floor, as it ensures the predictable delivery of data by minimizing latency and jitter. This requires that the Ethernet specification is enhanced in three areas:

- Delivering a highly accurate time synchronization to that all devices on the network can communicate intelligently and in a coordinated fashion
- That traffic can be shaped—large transmissions can be broken into many smaller transmissions to enable preemption by higher priority traffic
- The ability to define prioritization to communications between devices. This, in turn, supports real-time applications and provides the foundation for convergence.

Convergence, the second key benefit of TSN, enables companies to merge different traffic types onto a single network without affecting the performance of shop floor

communications. This is fundamental to sharing operational insights and hence increasing process transparency across an enterprise, which can then be used to derive insights to optimize manufacturing facilities and entire organizations.

Since TSN is an extension of standard Ethernet, it is also interoperable with existing network technologies and devices. As such, it can be used with existing devices, reducing system investments.

There are four benefits to a converged network:

- Control devices that have previously been isolated to separated control networks, which are required to ensure deterministic performance, can now be addressable and accessible to other applications for use in advanced analytics and digital twins
- Devices are becoming smarter and more complex, and require management that can now be accomplished over one connection
- Architectures are simplified through the use of one network, improving deployment and troubleshooting
- Costs are reduced through the simplification of architectures. [SESB:AD72:ME]

TSN Market Opportunities

TSN is recognized across different sectors as the future of industrial Ethernet and industrial communications. Consequently, interest in and adoption of this technology is growing at a rapid pace.

Leading technology companies have already delivered silicon and firmware to enable the development of new TSN-based devices and infrastructure components.

Leading technology companies have already delivered silicon and firmware to enable the development of new TSN-based devices and infrastructure components. Leading automation suppliers have

already adopted those new components in their automation equipment offerings, including PLCs, I/O and motion controls.

Proof of concepts have been on display for several years now at trade shows around the world, demonstrating amazingly new levels of motion control determinism that directly leads to higher quality products. We can now combine video and deterministic control communications on the same wire.

This technology trend offers particularly exciting commercial opportunities for machine designers and builders. By selecting state-of-the-art products with TSN capabilities, machine designers can increase their market coverage and gain a competitive advantage.

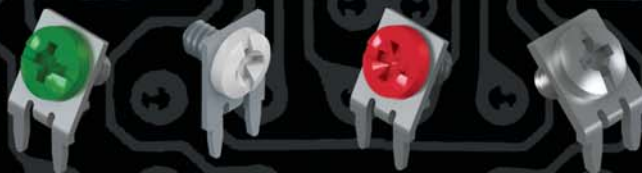
To quickly tap into this market, machine designers can select products from leading suppliers to produce TSN-based equipment. Thanks to software and straightforward hardware modifications, it is often possible to update existing industrial controls to support next-level capabilities.

TSN is a key enabling technology for the digital transformation of manufacturing, and will offer four key benefits for machine builders and their end-users:

- Simpler network architectures/machine designs
- Greater process transparency and better management
- More productivity
- Better integration of OT and IT systems

To enable futureproof industrial communications and next-level performance, machine designers and builders should think outside the box and embrace this new technology, ahead of their competition, to achieve a clear and measurable competitive edge. They need to act now to deliver TSN-compatible products or upgrade existing machines with TSN capabilities. By doing so they can help their customers to create the factories of the future while enhancing their own competitiveness in a fast-growing market. ■

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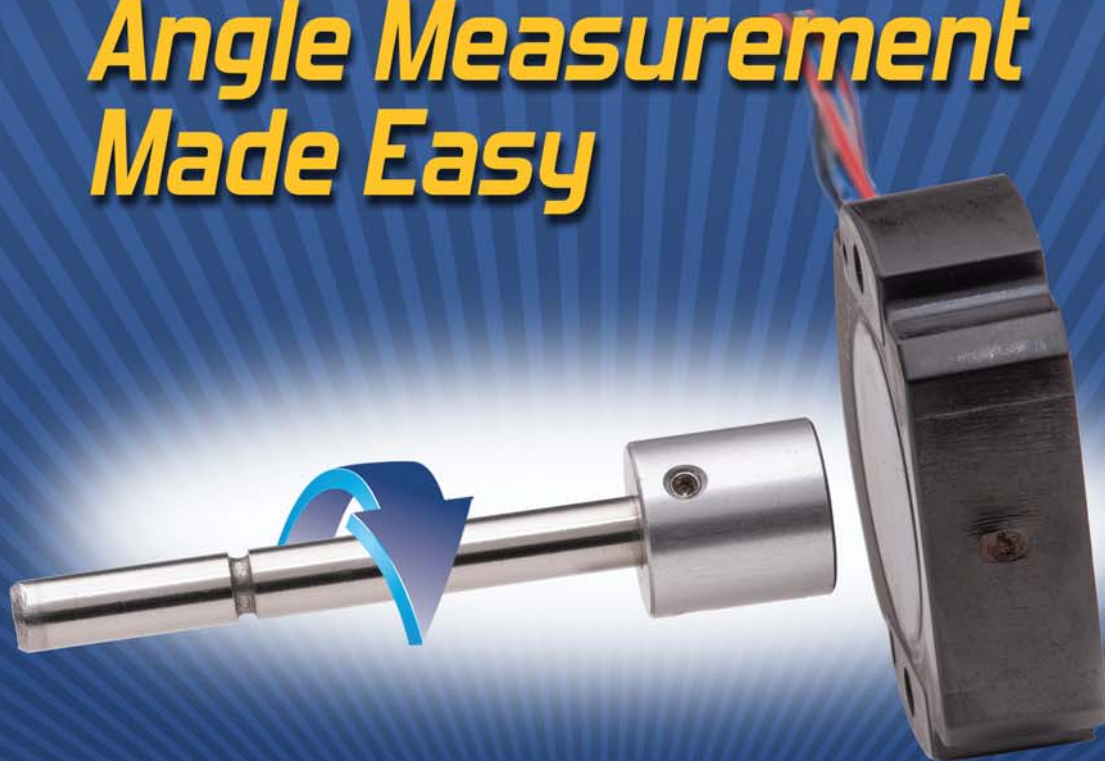
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