machine design

BY ENGINEERS FOR ENGINEERS

JANUARY 2016

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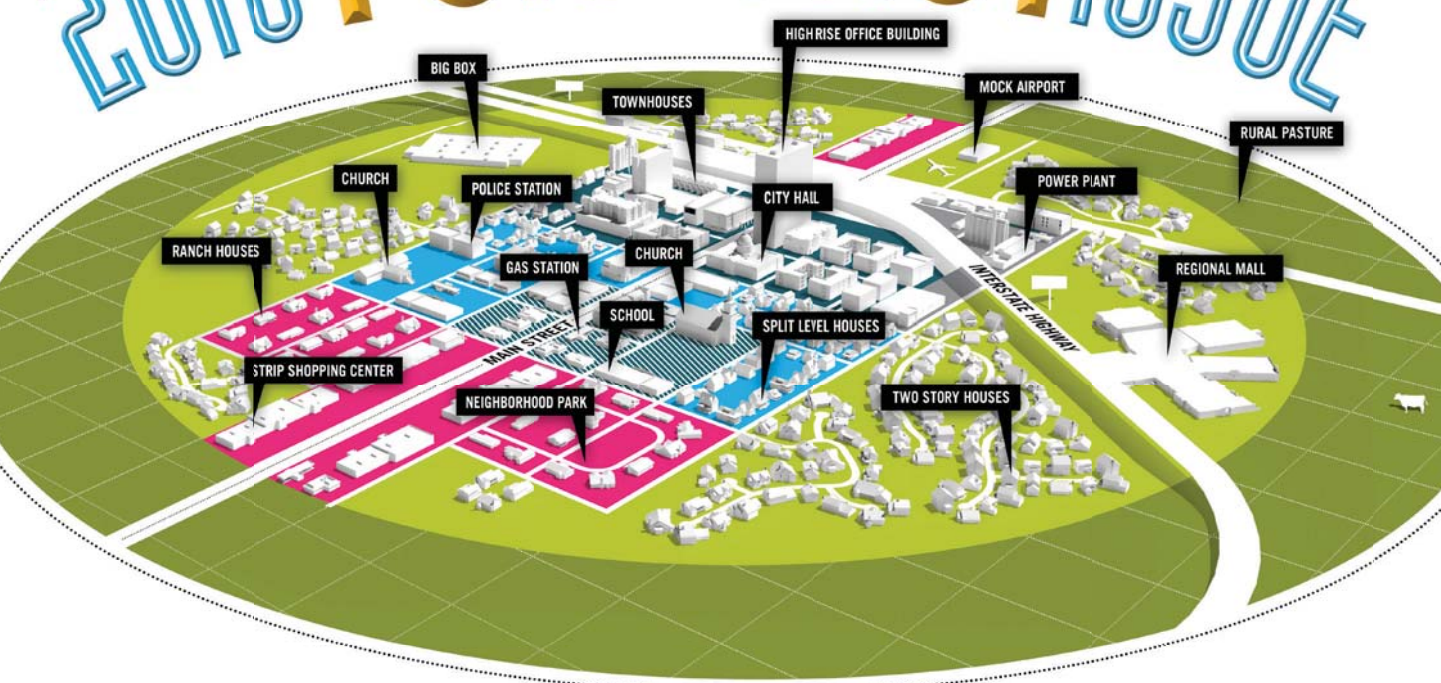
2016 FORECAST ISSUE



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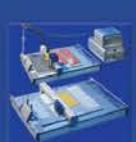
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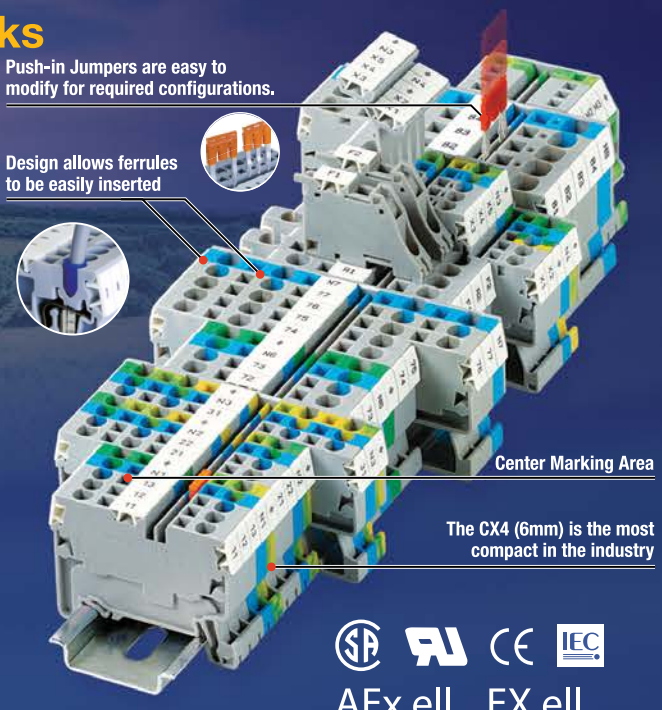

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DEPARTMENTS

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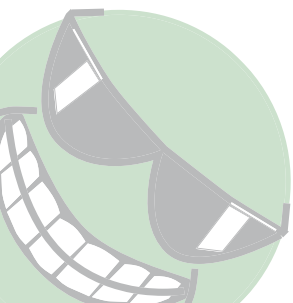

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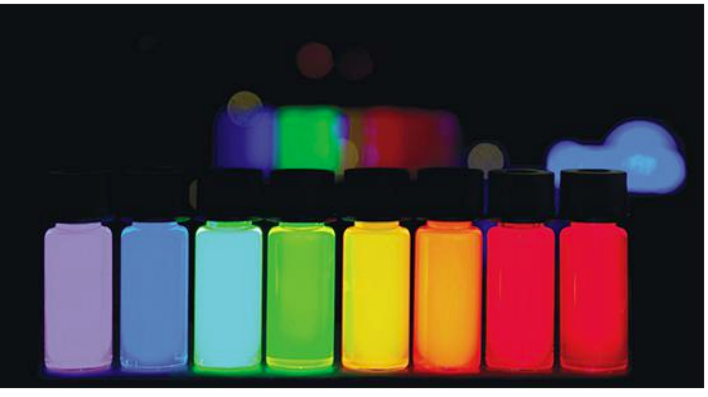

QUANTUM DOTS IN EVERYDAY TECH

http://machinedesign.com/semiconductor/quantum-dots-find-their-way-everyday-tech#slide-0-field_images-54211

With the successful fabrication of these nanoparticles in the 1980s, scientists found that they could control the distance between quantum-energy shells just by changing the size of a QD. The ability to control quanta as discrete energy levels has led scientists to create ultra-efficient semiconductors, precise wavelength-emitting LEDs, and other upgraded everyday technologies. As the technology improves, the market for QDs has become increasingly competitive, with expectations of it reaching $4.6 billion by 2021.

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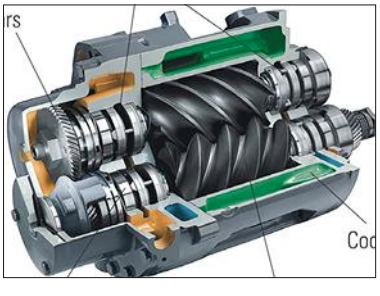
WHAT'S THE DIFFERENCE BETWEEN A PUMP AND A COMPRESSOR?

http://machinedesign.com/whats-difference-between/what-s-difference-between-pump-and-compressor

Moving hydraulic fluid through a system requires either a pump or compressor. Both achieve this goal, but through different operating methods. Pumps have the ability to move liquids or gases. Compressors typically only move gas due to its natural ability to be compressed. Pumps and compressors both have very high pressure rises. Here, we take a closer look at different types of pumps and compressors.



"HOW'S THE WEATHER?" IS MORE THAN SMALL TALK

http://machinedesign.com/blog/iot-how-s-weather-becomes-more-small-talk

The Weather Company is collecting over 2.2 billion points of data from weather stations—public and private—along with information from connected cars and smartphones to get accurate weather information for companies to improve logistics and much more. Tech Editor Jeff Kerns blogs about what this can mean in an IoT environment.

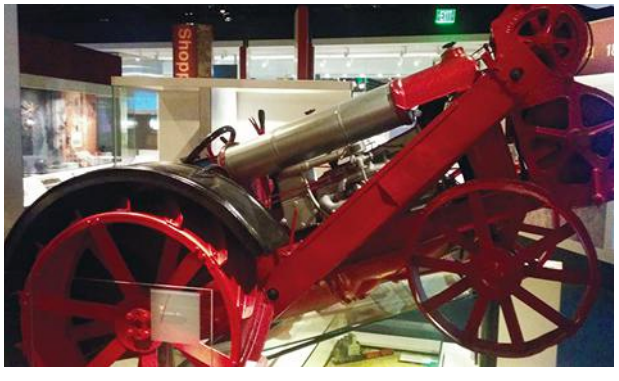


IMAGE GALLERY: A DAY AT THE SMITHSONIAN

http://machinedesign.com/recreation/day-smithsonian#slide-0-field_images-54161

Machine Design recently visited the Smithsonian's Museum of American History, where a wing is dedicated to inventions and how they shaped American culture. One of the things the exhibits showed was that failure is more accepted as a learning tool in the United States than in other countries. This tradition has allowed inventors to tinker and try things that haven't been done before without fear of failure—as seen in this gallery of unique American inventions.

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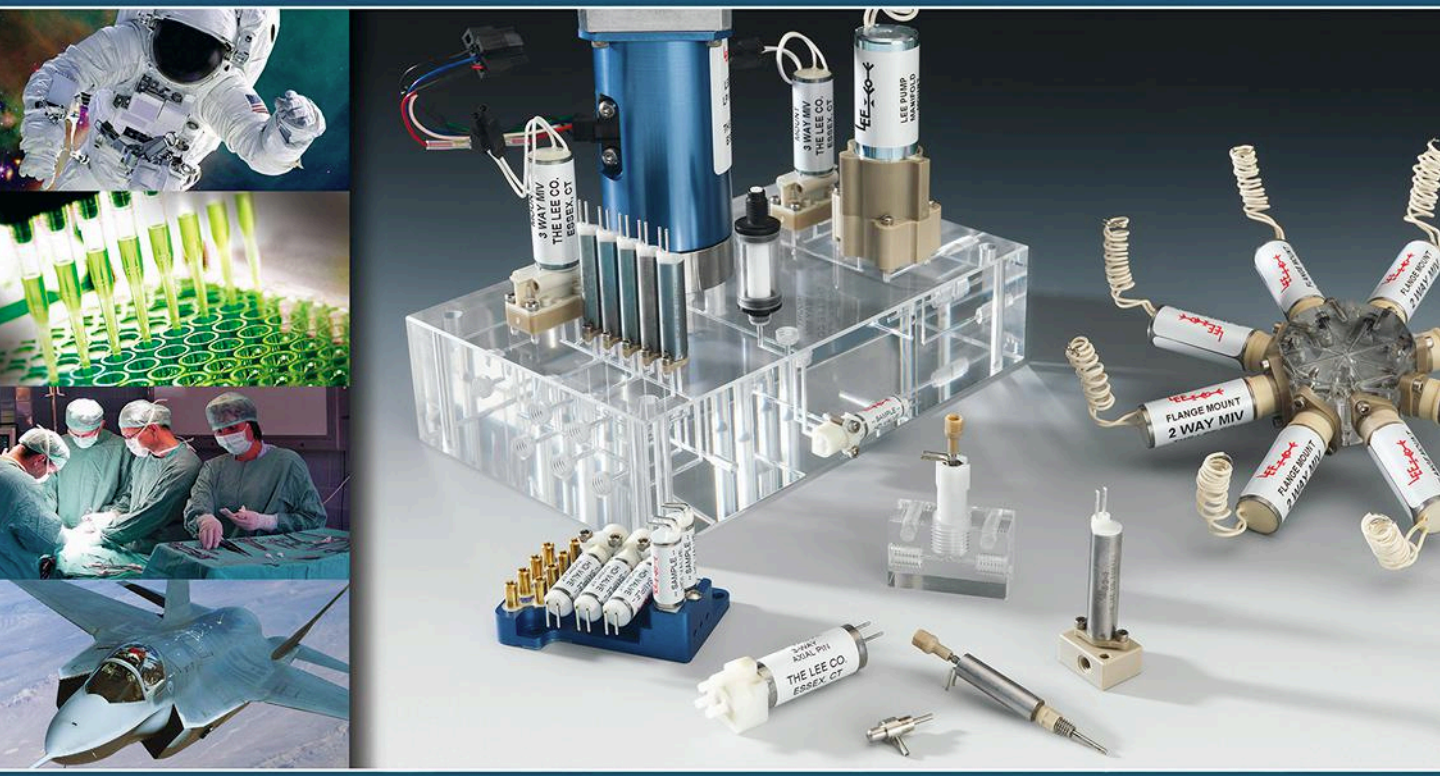

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Editorial

CARLOS M. GONZALEZ | Technical Editor
carlos.gonzalez@penton.com

Did My Major Prevent Me From Getting a Job?

Once upon a time, I wanted to be a toy engineer. Halfway through my seven years of working on helicopters, I wanted a change of pace in my career. The first thing I thought of was working with toys. I'm pretty much a big kid at times, and I can make a direct correlation between my love for engineering and my toys growing up. I would constantly think of how to make upgrades to my toys or build new ones.

I started down the traditional route: job applications to toy companies. Even after finding a friend who knew a HR representative of a very popular toy company, I still couldn't get my foot past the front door. I knew what was holding me back. I was an aerospace engineer. Whenever I applied somewhere, all they ever saw was my years of aerospace experience. My Master's degree didn't matter, nor did the fact that I had taken several machining and manufacturing classes along with my fluid classes. All they saw was my years of working on helicopters.

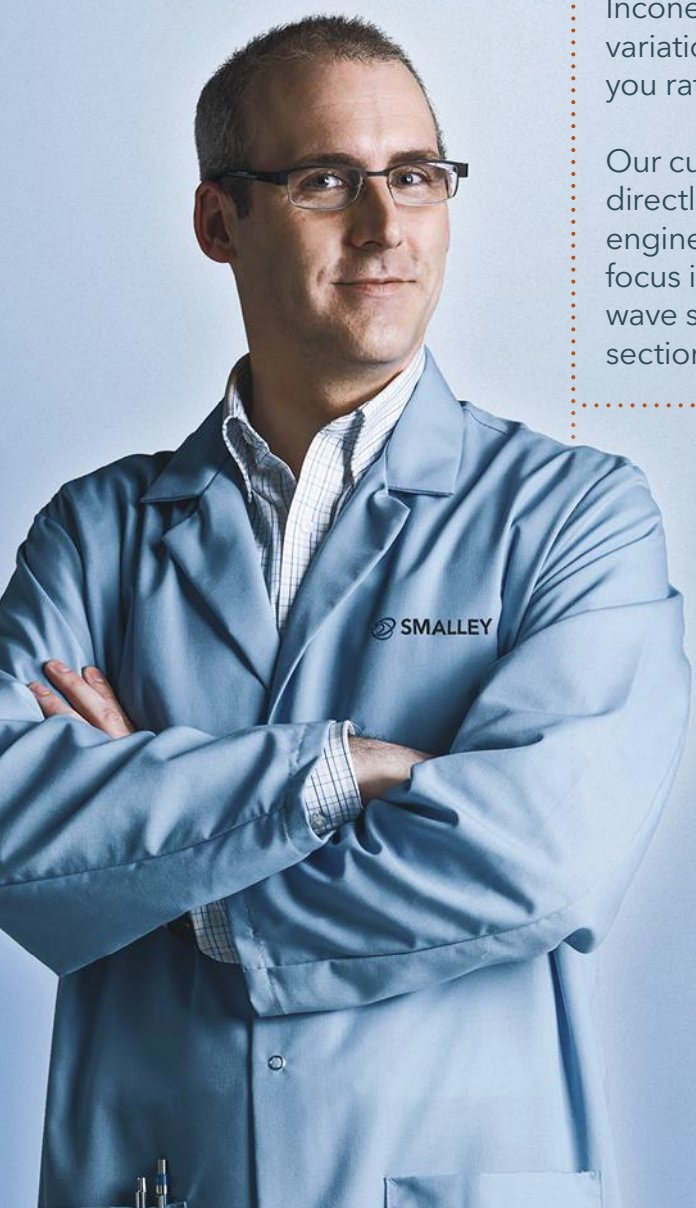
When you go to college for engineering, you'll run into a list of the classic majors: chemical, civil, mechanical, environmental, electrical, and computer engineering. Some schools will have aviation, biomedical, materials science, and maybe even manufacturing to choose from. Toy engineering, for example, is never presented as an option.

I focused on fluid courses throughout my undergraduate and graduate studies. It interested me the most out of my other options. But that was the problem—I never knew what other options were available.

Universities tend to group several professions into these majors. If you want to work in the petroleum industry, is that chemical or environmental? Can a mechanical engineer work in the environmental, plumbing, and water industries or civil construction? If you want to work on bridges, is it civil or mechanical? You might end up taking a bunch of classes non-related to your interests along the way.

I believe that we need to do a better job of telling our young engineers what they can do. A lot of our senior engineer readers have expressed to me the need for practical engineering education for young engineers; that too many of them are unprepared for the real engineering work that awaits them. If we ask incoming freshman engineers upfront what job or industry they want to end up in, rather than what major they like, we can gear their college work toward that goal. Classes become more practical and hands-on to create a group of engineers that love—and are better prepared for—their job. md

HOW DO I KNOW IF I'M TALKING TO AN ENGINEER OR A SALESMAN?



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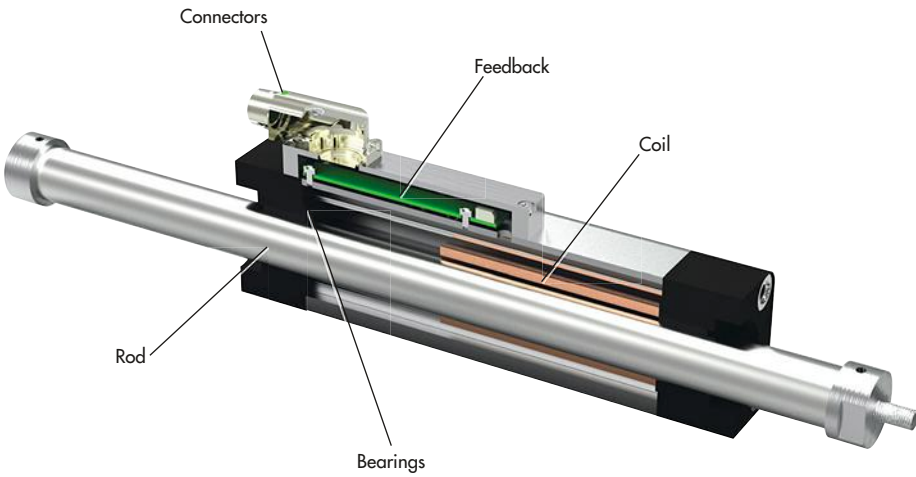
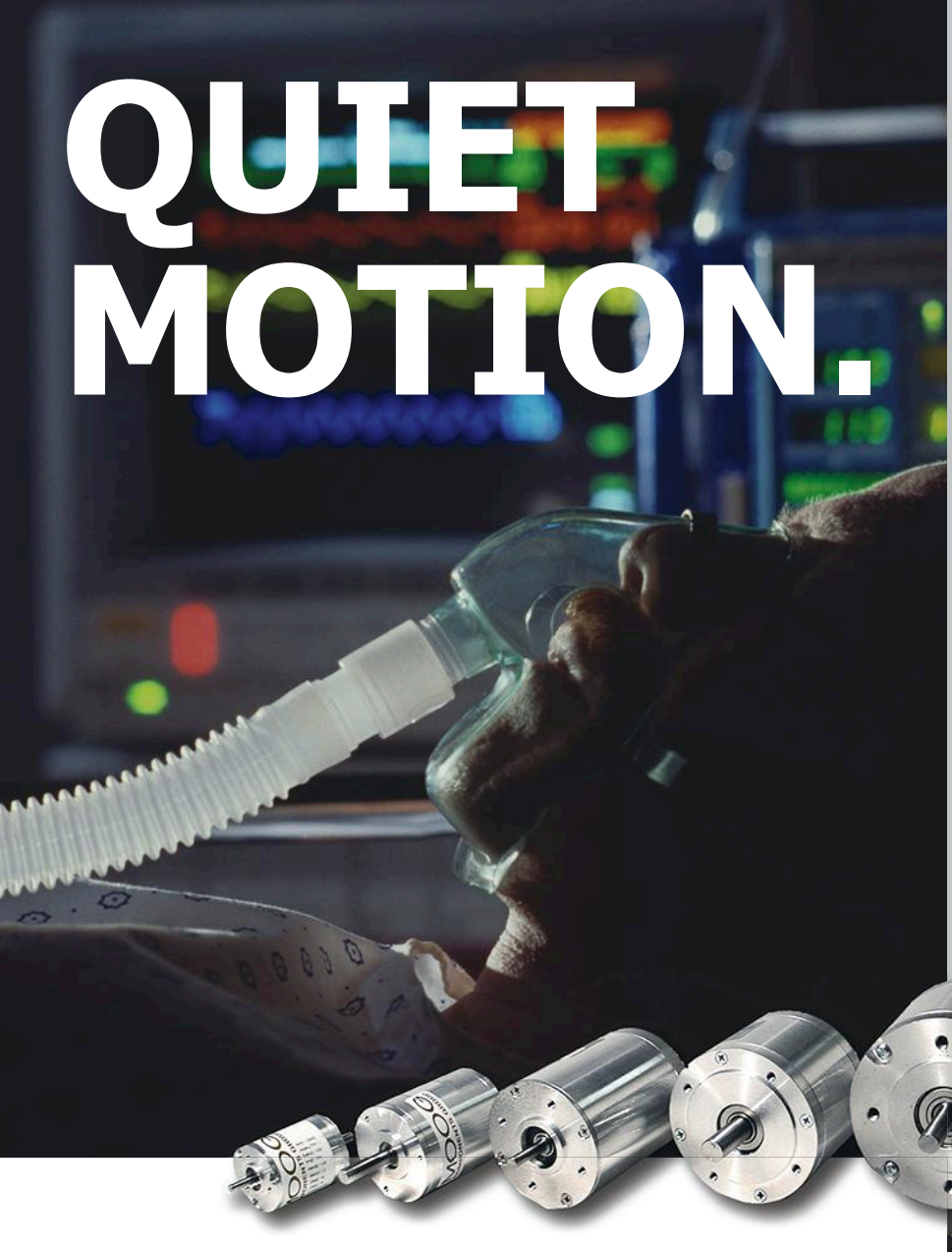


PARKER'S ELECTRIC THRUST Tubular (ETT) Series is a tubular style linear motor made up of two main components: the stator with integrated analog Sin/Cos feedback and 1 peak-to-peak voltage as standard (other standards are optional), and the rod, a stainless-steel AISI304 shaft with neodymium magnets. As a result, high-speed acceleration is possible. Using linear-motor technology eliminates the need for an additional belt or screw, gearhead, and motor as in many electromechanical positioners. Tubular linear motors suit any pick-and-place or linear handling application that requires high dynamic positioning.

Tubular linear motors have some interesting advantages in typical applications, including no wear components, no seals to fail, and flexible control. This model incorporates iglidur X guide bearings from igus for high speed and high temperature ranges, and a Class H coil with three-phase standard brushless design and 1000-V winding insulation. The unit also features a DIN ISO 15552:2005-12 mounting footprint for integration into existing mounting contingencies.

This construction serves a number of different industries and applications, such as conveyor diverting, indexing, and pick-and-place, among others. The fully potted and sealed motor coils and rod deliver an IP67 rating, enabling it to handle harsh, wash-down applications. md

QUIET MOTION.



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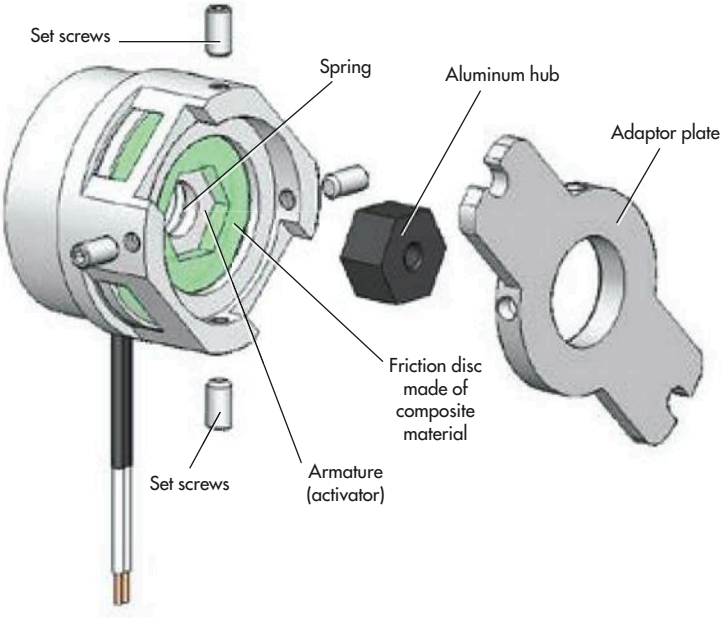

IF SPACE IS limited and saving weight is critical, the XS Series of brakes from Warner Electric (*www.warnerelectric.com*), New Hartford, Conn., are good options for reliable, statically engaged/disengaged brakes. These spring-set holding brakes are said to be the smallest on the market, with a holding performance of 1.5 to 50 N-cm of holding torque. The composite friction material used in the brakes was a key to keeping them small in size.

The brakes are spring-set applied and electrically released, so they remain engaged despite power failures. This makes them suitable in applications that must maintain holding force. They can also be used in low cycle-rate applications, such as seat adjustments on planes or trains.

The springs that supply the holding force replace the heavier and more expensive magnets usually found in brakes. Extensive testing by Warner Electric engineers proved that the springs offer the same static torque capacity and make the brakes lighter.

The six XS brakes weigh from 30 to 100 gm, are powered by 12 or 24 V, and have external diameters that range from 22 to 33.5 mm.

Components for the brake are precisely cut and assembled with equipment that lets technicians set the air gap while mounting the housing onto the shell. Components were also optimized to fit in the small housing. md

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News

HIGH-EFFICIENCY TRANSFORMER

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After recently taking ownership of the worldwide license and marketing rights for PowerWinding E Transformers, InventionShare is now looking to offer an exclusive license with sub-licensing rights to a single partner. It's also offering sub-licenses to non-competing transformer manufacturers in vertical and geographical markets. The transformers are claimed to achieve high energy efficiency for high- and low-power applications while using fewer materials than standard transformers, thus lowering manufacturing costs.

Bench tests show a 35% decrease in iron-core and winding materials to get the same output as standard transformers in the same application. Due to a shorter winding length for the same output, the transformers feature increased capacity and reduce losses. Yuanxun Evan Wang, UCLA professor of engineering, obtained the same result in a Maxwell software simulation: Efficiency vs. input voltage increased by 5.74%, and the output-power-to-input-voltage average ratio surpasses that of standard transformers by 63.7%.

The design dissipates less energy to heat, suiting it for the micro-transformer market. InventionShare and the two inventors of the design will continue research to bring the design into the grid transformer market.

Patent and test results are available to interested parties by contacting Kensel J. Tracy, VP, Invention Catalyst. ■

Though the transformer technology currently targets micro transformers, InventionShare anticipates that further developments will make it useful in large grid transformers.

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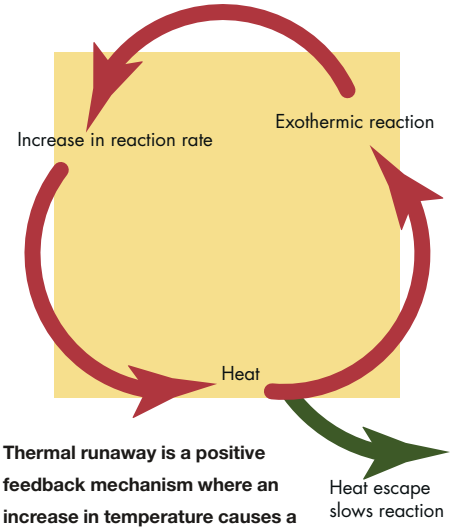
INTERNAL SHORT-CIRCUIT DEVICE Paves Way to Safer Li-Ion Battery Testing

THE NATIONAL RENEWABLE Energy Lab (NREL) says its newly developed internal short-circuit (ISC) device should help improve the safety of lithium-ion batteries in space gear and electric-drive vehicles. The advance is, ironically, in response to the Li-ion battery's inherent efficiency—its long life, high energy capacity, and rechargeability over thousands of cycles also make the battery prone to unexpected shorts that induce thermal runaway. Thus, engineers are wary about having Li-ion batteries become the standard in electronic and hybrid vehicles. The NREL's patented ISC assuages those fears by enabling reliable testing of the thermal-runaway effects of Li-ion-battery shorts.



Thermal runaway is a positive feedback mechanism where an increase in temperature causes a further increase at a faster rate.

The statistics for shorts occurring in Li-ion batteries is one to ten in a million, according to Matthew Keyser, NREL senior engineer. A short may be caused by an impurity in the battery, likely introduced in the manufacturing process.

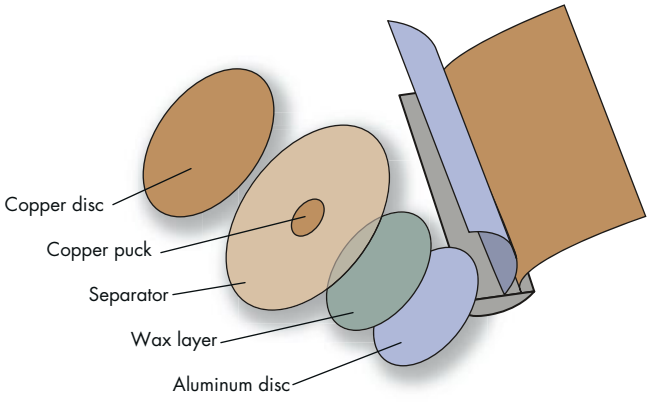
However, the intensity of thermal runaway is far worse than in regular batteries. As a result, Li-ion batteries are effectively more dangerous than regular batteries.

Tests with NASA have produced reproducible and consistent results, allowing engineers to devise mechanisms that counteract thermal runaway, or else contain it in a single battery so that it doesn't spread to the rest of the pack. Previous methods of

testing short-circuit effects include piercing a battery with a nail or rod, crushing it, applying high voltage, or increasing its temperature. Unfortunately, these different methods are not consistent enough to validate their use in electric cars and space applications.

The ISC, on the other hand, is placed within the cell, acting as an internal thermal switch to produce all four types of shorts. In order from benign to severe, these include electrode to electrode, electrode to cathode, electrode to anode, and cathode to anode. This highly controlled method enables scientists to come up with more accurate and reproducible solutions.

The device is a small, layered disc constructed out of copper and aluminum with a copper puck, a polyethylene or polypropylene separator, and a thin layer of wax. It is implanted in the cell and then exposed to a higher temperature to melt the thin wax layer. The remaining metal components then come into contact to induce an internal short while sensors record the cell's reactions.

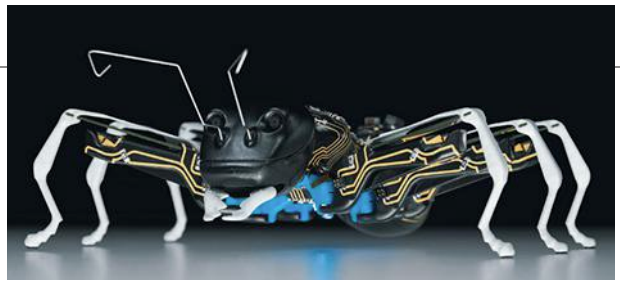


The device is a small, layered disc that is implanted in the cell. Copper and aluminum layers are interfaced with a polyethylene separator that contains a copper puck and a wax layer that melts to activate the device when exposed to a higher temperature.

The NREL and NASA plan to use the device for spacesuit battery safety. The NREL hopes to mass-produce the ISC device, especially for testing of Li-ion batteries in electric cars. ■

BIONICANTS WORK TOGETHER
in Swarm Artificial Intelligence

FESTO'S BIO-INSPIRED BIONICANT robots, which replicate the form and function of worker ants, are the company's latest entries into the Industry 4.0 movement and robotic revolution. They embody the main themes of swarm artificial intelligence (AI), acting autonomously while communicating and collaborating with the other ants to devise a strategy to reach a final goal. In addition, the BionicANTS feature 3D-molded interconnect device (3D MID) technology on 3D-printed structures. Festo also incorporates non-conventional use of piezo-ceramic actuators that are mechanically coupled with hinges for motion in miniature robotics.



The pincers and legs use piezoelectric actuators coupled with levers for strong movements. The ant will walk itself to a charging station, where its antennas come in contact with a power source.

EXTERNAL CIRCUITRY

The legs and body of the BionicANTs are 3D-printed via selective laser sintering (SLS) with a polyamide powder. As 3D MIDs, they feature laser-etched conductive tracts for compact functionality. Festo received the 2015 MID Innovation Award from the Research Association Molded Interconnect Devices 3-D MID e.V., for its design and use of 3D MID technology on 3D-printed parts.

Festo employs a laser-direct-structuring (LDS) machine to laser-etch the tracts and apply conductive metal coatings of gold, nickel, copper, or a mix. The external circuitry adheres to the curves of the ant's body segments, eliminating the need for bulky wiring, since components can be directly soldered to the devices at the intended terminals. Minimal internal circuitry is needed, contributing to the compactness of the design.

ALGORITHMS AND COMMUNICATIONS

Each BionicANT works as a component of a multi-agent system (MAS) to perform heavy lifting-and-carrying tasks. They are programmed according to a distributed catalogue of rules created from mathematical model-building and simulations. These regulation algorithms govern their motions and enable the ants to alter their behavior as a response to environmental cues and

RF signals generated by the other ants. For example, a simple regulation algorithm prevents collision by ensuring that the ants do not try to occupy the same space.

Communication generates from the RF chip in the ant's posterior body segment. Also located on the posterior segment is a Cortex-M4 microprocessor (MPU), which processes RF signals and environmental cues. In addition, the MPU sends voltage signals to the piezo-actuators in the pincers and legs.

VISUAL SENSING

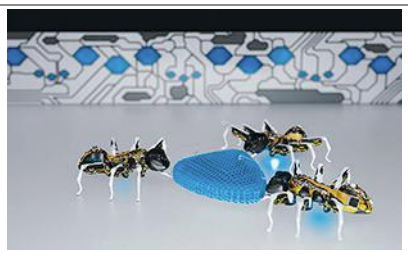
A complex system of algorithms allows the ants to process visuals, using landmarks in the arena to indicate location. It employs a stereoscopic camera to generate two images at different angles, similar to the way our eyes work to process a 3D visual. Thanks to camera sensing, the ant can locate the object targeted for transport and process landmarks; it then uses RF signals to communicate this data to the other ants. In addition, a laser sensor at its abdomen senses the texture of the floor beneath it to determine location, walking speed, and proximity.

PIEZO-CERAMIC MECHANICALLY COUPLED HINGES

The legs and pincers employ piezo-ceramic bending transducers that are soldered to the external circuitry and coupled with hinges to enable powerful walking and grasping movements. The piezo ceramics provide a quick response to increased voltage signals by contracting and bending for further activation of the hinge. They serve as compact local transducers for movement. In the pincer, two piezo-ceramic bending transducers mechanically induce motion of the gripping jaws.

In the legs, three local piezo transducers respond to voltage signals for forward/backward and up/down motions. The robotic ants use 8.4-V rechargeable lithium-polymer (LiPo) batteries, and transformers are employed to generate 300 V for piezo actuation.

The ants demonstrate decentralized intelligence, equally contributing to arrive at a strategy to move the object. They even walk themselves to a recharge station when they detect low battery life for fully autonomous performance. By applying similar technologies used in the autonomous and collaborative robots, perhaps every automated factory floor can buzz with the efficiency of worker ants. ■



Ants communicate via RF signals to achieve a common task.

JEFF KERNS | Technology Editor
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How to Spot TECH TRENDS

What are the main factors in generating an accurate forecast for new or in-development technologies?

It's that time of year when everyone, *Machine Design* included, is going to tell you what you can expect to happen over the next year or later. It may be hard to differentiate the hype from that which is based on sound advice, though. Oftentimes, incremental products or innovations are difficult to track, and sometimes end up being more marketing than truth. Whether you plan on investing, trying to stay competitive, or are simply interested in what's next, determining an accurate technology forecast is possible if you focus on several key factors discussed here.

The Smithsonian displays a group of technologies that has shaped our culture. A trend in the United States is the ability to make technology mobile—a trend we see today with the popularity of the cloud and IoT.

QUALITATIVE VS. QUANTITATIVE INFORMATION

To formulate an accurate forecast, you must first have accurate information. Data generally comes in two forms—qualitative and quantitative. Engineers might jump right to the quantitative numbers and statistics, but Melissa Schilling, professor of strategy at New York University, points out, "There are many ways that quantitative data can be manipulated or misread. There are other strategic concerns for project investment.

"For example, when sales are up on a product, it is tempting to reinvest in the same factors that made the product successful. However, those factors might be generating diminishing returns—you need to think about where the big opportunities for improvement that customers will value are," she says. "This is one of the areas where qualitative information might generate more accurate ideas about what will happen in the market."

A diminishing return is illustrated in the S-curve diagram. It's a sigmoid function on a graph that looks like an elongated "S"-like curve. This indicates that, initially, improving a product is difficult because it's not well understood. Then, as it becomes better understood, less effort is needed to increase its performance. However, many technologies eventually reach a limit where effort and investment yield smaller performance gains. In other words, it enters a state of diminishing returns.

Also, certain dimensions of improvement might have more payoff for customers than others. Some companies learned the hard way that data provided from, say, an S-curve diagram might explain why, when quantitative numbers look good, it

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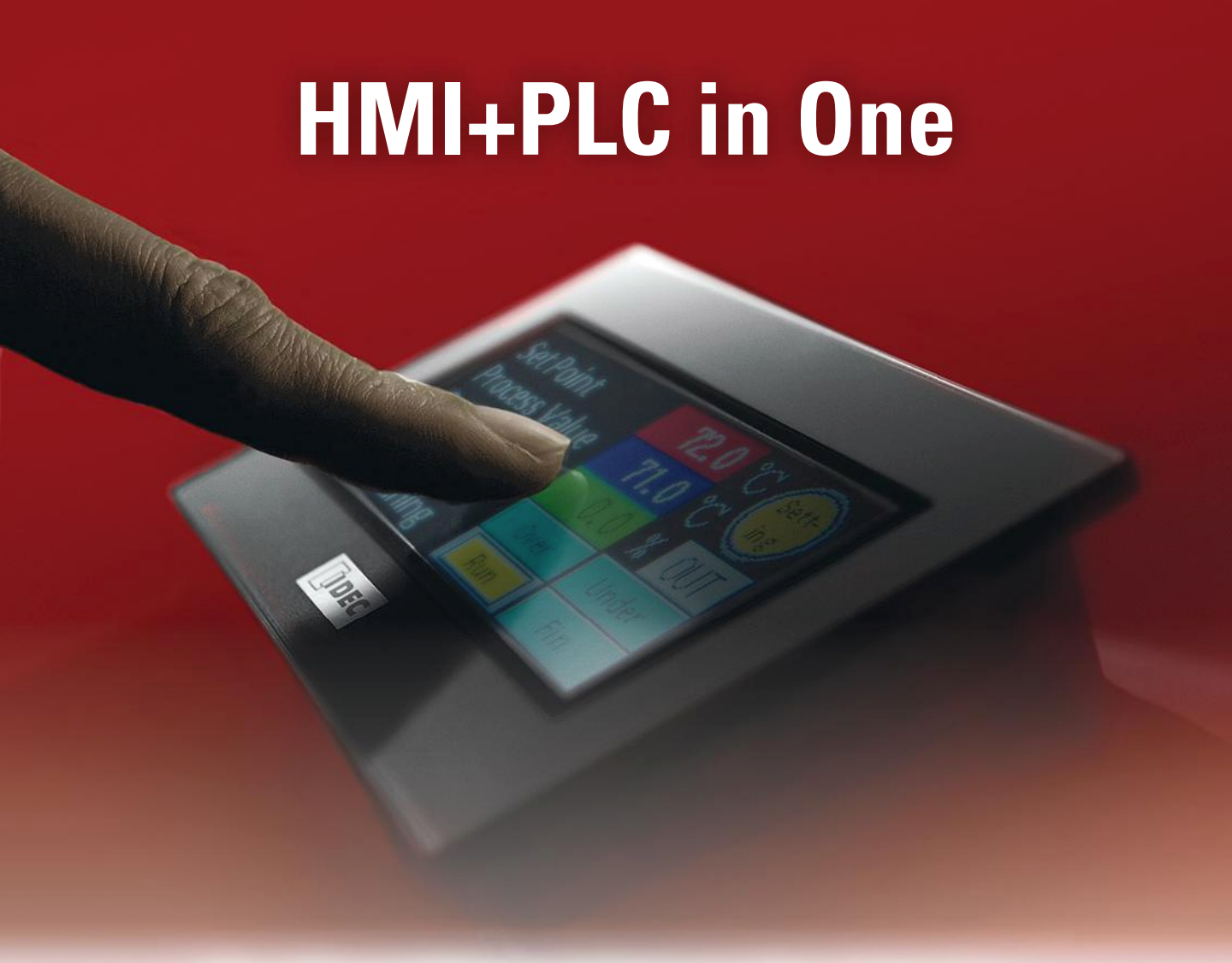

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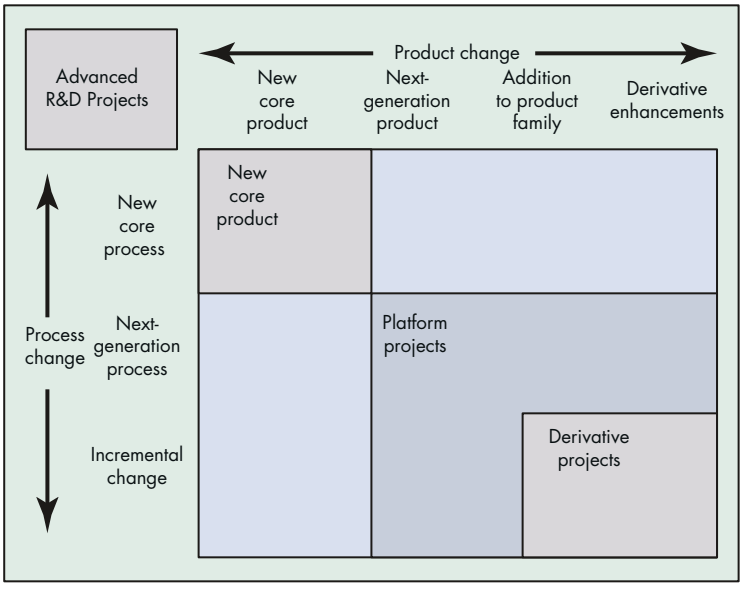
may not be wise to invest more into a type of technology.

"For example, Sony invested in improving their technology of Super Audio CD at a time when they believed customers cared about every increasing fidelity," says Schilling. "Unfortunately, we were already nearly at the limits of human hearing in terms of audio fidelity, so the payoff to increasing fidelity wasn't very big. While Super Audio CD and HD Audio were competing to be the highest-fidelity audio formats, the MP3 format offered customers something they valued more—portability—and wiped Super Audio and HD Audio off the map."

Sony is still around, but it's no longer the same company from years past. Another example is Kodak and its innovative process for developing film. The company was extremely invested in chemical photography, developed tunnel vision, and despite inventing the first digital camera in 1975, didn't make the jump to the new digital technology. Qualitative information can help pinpoint a diminishing return and be used as a red flag for any products based on that technology.

Ray Zinn, retired CEO of Micrel, adds, "Under-



Project maps can be a handy tool for managers to define the level of risk, resources, and commitment required by a company for different projects. It's important to understand that a company has invested the time and resources necessary to present new technology properly, and could be used to gain perspective for a more accurate forecast.

standing product cycles is the key to spotting trends. I know from experience that product cycles in the semiconductor industry tend to be around five years, give or take a year or so. By knowing when that product cycle started, you can easily determine whether your company is facing the beginning or the end of that product cycle."

Understanding a technology's S-curve and where it's currently located on that curve is crucial: It will help you forecast if the next year or two will continue to reap and expand current technology incrementally, or if a different technology is getting ready to disrupt it and take over.

To clarify, not all technology is disruptive. A new feature added to current technology or new machines added into a family of products are considered derivative projects or incremental technologies. Disruptive technology tends to be the next generation of technology that will provide a new platform for incremental innovations to stand on. Also, disruptive technology normally signifies a need for new equipment, such as, for example, the switch from VHS to DVD.

INCENTIVES AND ABILITIES

Everyone wants to know which technology will win, and forecasting entails the consideration of many factors; even natural resources must be analyzed. Green and sustainable technology has increased and, according to Dr. Alberto Maria Sacchi, CEO of the Meccano Group, it will continue to grow due to the simple fact that natural resources are limited, and with a growing population, green technologies will be an important focus.

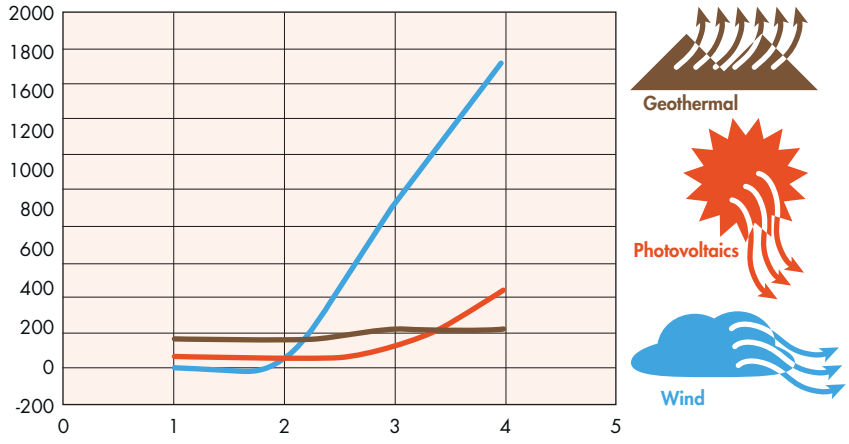
Schilling of NYU says, "The type of green technology that firms invest in is strongly influenced by their existing capabilities. For example, analyzing the performance improvement in several renewable energies, a team and I found that geothermal was offering the highest current efficiency and the greatest improvement per dollar of investment. However, we hadn't even heard of this technology until we did this research. It wasn't in the news. This is where qualitative reasoning and watching where incentives lay can help collect information for an accurate forecast.

"Firms that already use silicon (for example, computer firms) or electronics are more interested in solar photovoltaics, which also use silicon and are based on electronics," she adds. "Firms that build dynamos and turbines (for example, Siemens and GE) gravitate toward wind power, which is based on the same technology. However, geothermal is based on land survey, drilling, and pumping, and the companies that have this knowledge and the resources to tap this market are oil companies. Oil, however, is still profitable. There

isn't much incentive for these companies to expand geothermal technologies."

With no incentive, there's little to no motivation. But even if a company wanted to promote a new technology, it still needs the ability. New technologies can be expensive to integrate into an existing company.

For instance, in the automotive industry, Ford invested $1 billion into its Dearborn stamping and assembly plant to make an aluminum-intensive F-150. U.S. Steel invested $500 million to upgrade its production to make new, advanced, high-strength steels. While the benefits and technology are there, the cost to make the switch can impede a technology's expansion.



The S-curve is often used to track the performance of a technology or product to show indicators that a technology or product is reaching a point of diminishing return. Such information helps companies decide when to invest in a current or new technology or product.

Danny Schaeffler, president of Engineering Quality Solutions, explains, "Just think of the volumes necessary to justify the $500 million investment for a product that sells for about $1 per pound." Few companies would have this kind of capital and ability.

Flexibility is important because it better enables a company to move quickly to a new technology. Capital still plays a large role in flexibility, making it possible to invest in the necessary infrastructure to gain a competitive edge. For example, the new Carbon3D technology could take a portion of the stereolithography 3D printing market, but how do we know? When big companies like Ford and Autodesk backed Carbon3D, it was apparent the technology offered value and was not going to disappear anytime soon.

Backing companies with capital can give new technolo-

gies the boost they need. However, a larger company can be resistant to change, or have high overhead that can stifle new innovations. It's imperative to watch out for acquisitions and mergers that form a mutually beneficial partnership. Without proper management, even the greatest technologies will fail.

ADOPTION RATE

A fast adoption rate sounds great, but some technologies are like a bottle rocket—they take off and expire quickly. These technologies might have a large marketing budget and venture capitalists pumping tons of money into them, yet might not generate long-term returns. Some of these bottle-rocket types of technologies are simply inflated incremental innovations that benefit from extra marketing, but don't have staying power.

To keep from following the wrong technology, look at the factors driving the adoption rate (again more qualitative and quantitative information). Most disruptive or breakthrough technologies with staying power will be tested rigorously, and they will progress at a controlled rate that's inflated by market value—not hype.

Another problem often faced by new technologies when entering the market revolves around trust. The old technology has a tested foundation that's comfortable. New technology requires a shift that can provoke lots of resistance. Open- and closed-source strategies play a large role in the adoption rate of new technology. Determining what strategy is better can be difficult, though.

"Closed-source wins more often than open-source, because a technology often needs a 'guardian' that promotes it and helps to keep everyone pushing in the same direction," says NYU's Schilling. "Open technologies are cheap and easy for firms to adopt, but without anyone managing their development, they can become fragmented with lots of incompatible versions. Furthermore, no one has the incentive to invest large amounts of money or effort in their improvement. Instead, a hybrid technology can be better."

Schilling continues, "Android is a good example of a hybrid source. While Android does own intellectual property and manages its development, they allow others to use it. This strategy allows Android to hold the keys, but still enables others to develop the technology as long as they follow some rules. These strategies will become more important to watch in the industrial industry as software will play an ever more important role with the growth of IoT and 'smart' devices."

Rockwell Automation is adopting a hybrid approach. Daniel DeYoung from Rockwell marketing development explains: "Rockwell's Studio 5000 is open as it relates to enabling and integrating a wide array of not only Rockwell Automation products and technologies, but also third-party products. This is achieved by leveraging open standards such as common industrial protocol. A device must simply be available on one of these networks and provide a corresponding configuration file. In addition, devices that are available on most any other protocol can be integrated through collaboration with a number of our Encompass partners, which offer interfaces to these protocols."

Market momentum can be another driver that affects the adoption rate. In the case of closed versus open technology, once a few large players in the market start using a particular software, hardware, etc., others may adopt the same technology in order to remain compatible, and that can lead to an exponential climb in the adoption rate.

Another major factor for the adoption of new technologies will be the effort and investment needed to implement the new technology—any new infrastructure, employee training, or even changes in customer behavior that are required to efficiently use it. On the other hand, the larger a utility gap with a technology (the degree to which it offers something much better than what existed before), the more willing customers will be to make the effort to adopt it, thus speeding up the adoption process.

LARGE TECHNOLOGY MOVERS

Gaining quality information about incentives, abilities, adoption rates, and dimensions that customers care about for a technology will help formulate a more accurate forecast. More factors might be outside the company's control, though. *Finding skilled labor*, *suppliers*, and *government* are other large drivers of technology that a company needs to navigate to make accurate decisions, and are necessary to consider for accurate forecasts.

Education, skills, and *people who can do the work* are often technology drivers. Some industries can't find qualified people. The need for quality technical abilities is one of the drivers behind IoT and automation technology. In a forecast, it's valuable to know if the labor force that drives the technology needs a year or more as a learning curve for something new, when (or if) the technology starts to take off.

Supply chain and *logistics* also play a role with new technology. If a technology has a concentrated region that's difficult to ship to or from, it can prove problematic. One technology benefiting from this is 3D printing. Some com-

panies are investing in new types of additive manufacturing to eliminate or reduce supply-chain problems. However, 3D printing cannot solve all supply-chain problems, and it's imperative that companies are able to ship their technology to where it's intended, and be used in an appropriate time frame.

One of the companies succeeding at this is Rittal, which specializes in enclosures. It offers 48-hour delivery of its products. By leveraging local partners to customize modular enclosures and make alterations for customers, it's possible to have a few strategic large distributors cover a vast area while maintaining competitive delivery times. In forecasting, supply chain and logistics can demonstrate the potential for quick growth, depending on how fast a company can move technology. A technology can grow slower, but not faster, than its ability to deliver.

In addition, technology-concentrated regions that can facilitate a global strategic structure to promote their products will find favor. "Cloud design facilitates offshoring," says former Micrel CEO Zinn. "For now, the labor-rate differential is attractive, though coordinating the interaction between designers scattered around the globe is a challenge. But the cloud will offer companies an opportunity to bring manufacturing back, to onshore their technology."

Zinn adds, "Automation will also be a driver. By eliminating human activity—manpower—in manufacturing, the more sense onshoring will make. If the labor content of a product drops below 20%, it could cause companies to rethink offshoring their manufacturing."

Supply chain and logistics will continue to be important, as onshoring could increase and grow technology-concentrated regions. Delivering a new technology on time for a competitive cost is just the first step to building confidence in a new technology.

Government regulation, whether in support of or against, regarding technologies, taxes, labor, and environmental concerns has proven to be a large deciding factor in the success, failure, or geographic location preference of different technologies. The government will play a large role in onshoring.

"The question is if the government will get out of the way and let onshoring happen," says Zinn. "These interrelated issues—labor, taxes, total cost of design and manufacturing—are what politicians should be debating most as they are the greatest impediments to reviving American manufacturing."

Another key factor to consider is intellectual-property (IP) law. IP will play a large role in stifling or accelerating technology in its respective countries. md

2016 FORECAST ISSUE

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CHOOSING THE RIGHT DEVICES FOR IoT Connected Systems

As the Internet of Things takes stronger hold of the engineering world, here's a look at key devices enabling IoT systems to connect.

The Internet of Things (IoT) is bringing the power of connected systems to engineering. This wave of technology is powering future devices to have the latest and multiple connection points. Many products are using the power of Ethernet to enable their connections as it becomes the main method of communication between devices. Companies are also introducing faster and more powerful wireless connections. This will provide mobile and remote access to systems. Being able to harness plant systems via smartphones and tablets will offer manufacturers a new level of productivity.

The RSG920P was designed to be compact, 154 x 152 x 176 mm, to fit in most cabinet systems. The RSG 920P comes with a compact high-density switch with 20-Gb ports, including four PoE ports and four SFP slots.

RUGGEDCOM RSG920P

The RUGGEDCOM RSG920P is a small-form-factor Layer 2 switch from Siemens. The networking switch connects devices together, sending and receiving data only to connected devices that require the data. The switch has a rugged design and Power-over-Ethernet (PoE) capability. The device can handle various PoE devices like cameras, intercom devices, Wireless LAN access points, and Bluetooth sensors.

The design of the switch is compact for space-limited cabinets. The RSG920P has high bandwidth capabilities and 20-Gb ports including four Small Form-Factor Pluggable (SFP) Gigabit/Fast Ethernet slots and four PoE ports supporting 802.3af/ 802.3at with up 30 W/port. The switch is built to handle extreme temperature (-40 to 85°C), vibration (IEC 60255-21-1, Class 2), humidity (IEC 60068-2-30, up to 95% relative humidity), and shock conditions (IEC 60255-21-2, Class 2) found in industrial applications such as transportation and oil/gas systems.

The RSG920P also has several security features set in place at the local-area-network level, including:

- Passwords—support for separate credentials multiple access levels
- SSH/SSL—extends capability of encryption of passwords and data
- Enable/disable ports—capability to disable ports to disable unauthorized connected devices
- SNMPv3—encrypted authentication and access security
- HTTPS—secure access to the Web interface
- 802.1x—ensures only permitted devices can connect to the device
- MAC address authentication—control access to devices that do not support the operating system

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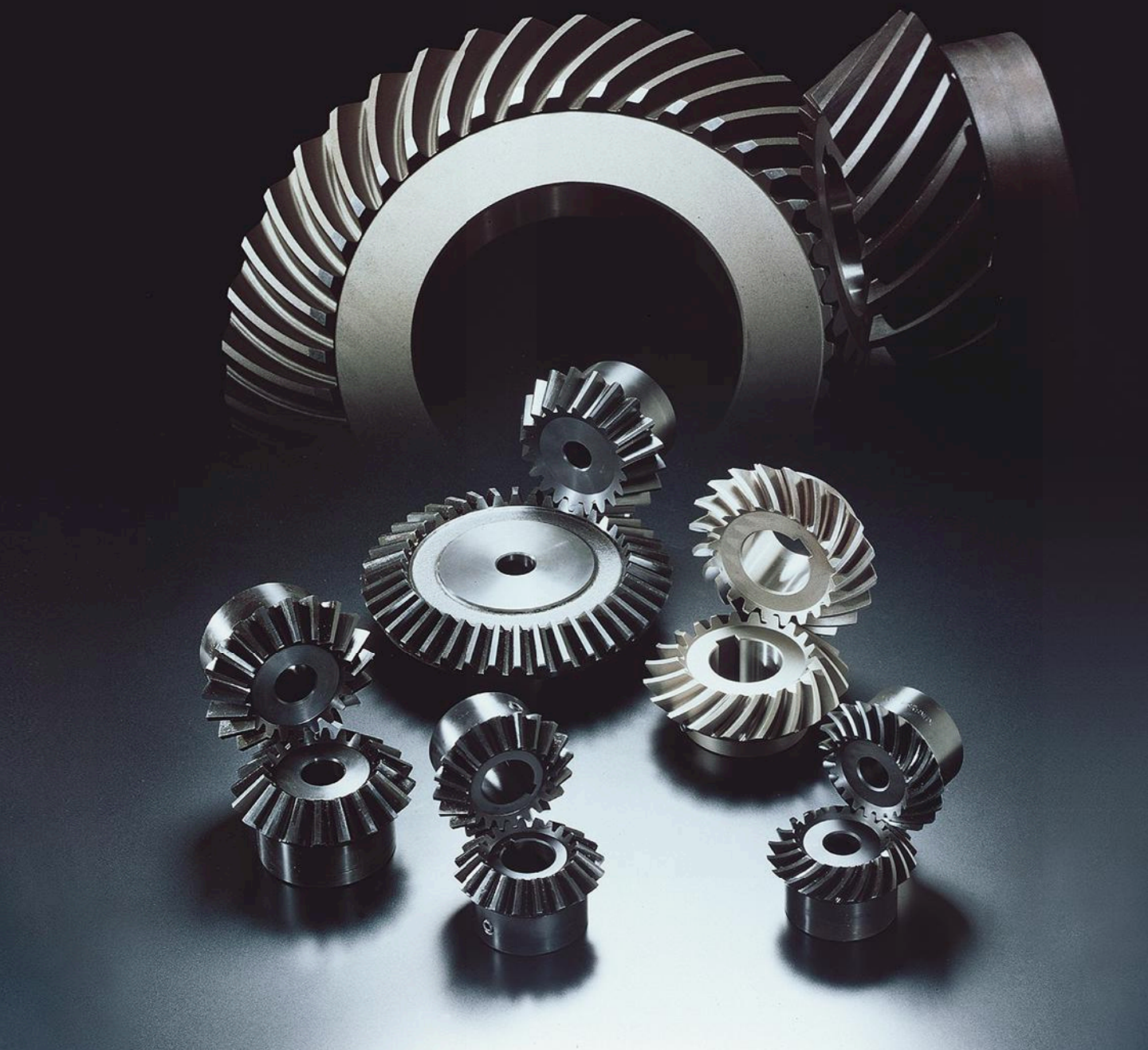

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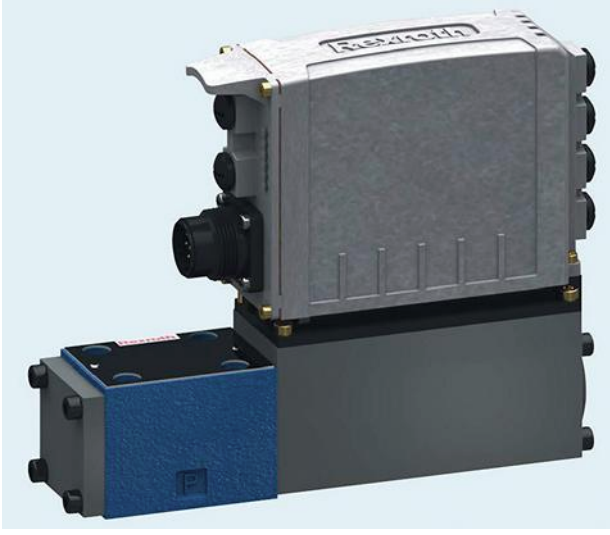
BOSCH REXROTH IAC-MULTI-ETHERNET

Ethernet connections are becoming the standard in automation and leading the way in IoT connected systems. Ethernet has 10 to 100 times higher data-throughput rates than with fieldbuses, is a widespread technology, cost-comparable to analog interfaces, based on industry standards, and is flexible and compatible with current automation systems. As industrial Ethernet is becoming the standard for automation connections, devices like the IAC-Multi-Ethernet axis controller allow for multiple Ethernet connections.



IAC-Multi-Ethernet axis controllers have position, pressure, and alternating control capabilities. The IAC-Multi-Ethernet platform has multiple Ethernet connections, allowing manufacturers to choose between sercos, EtherCAT, Ethernet IP, PROFINET RT, and Varan.

The IAC-Multi-Ethernet axis controller is used on hydraulic systems, providing direct control on high-response valves used in servos. The 4WRPDH valve used with the controller is available in a size 6 or 10, has a max operating pressure of 315 bar, maximum volume flow of 100 l/min, two configurable analog sensors for current and voltage, one linear-position measuring system, and integrated digital axis-control functionality. The way this axis controller is enabling higher-level control network connections is that it functions on multiple levels of Ethernet connectivity. It can connect via sercos, EtherCAT, EtherNET/IP, or PROFINET RT. This allows for the control architecture to remain intact. The control axis is independent of machine control by using a separate motion function and data processing of sensors via direct sensor connections.

POSITAL ABSOLUTE ROTARY ENCODERS

The encoders by Posital are also designed to keep up with IoT world. Posital offers absolute rotary encoders that rotate precisely without losing track of their position even if power is lost. Absolute rotary encoders provide unique position values by detecting the position of a coded element with each position corresponding to a unique code. Single-turn encoders offer 360 deg. of rotation measurement range in one turn while multi-turn encoders provide a measurement range greater than 360 deg. by measuring the number of revolutions. They have a resolution of up to 16 bits. The encoders can connect to networks in many different ways. The new standard of Ethernet is possible via EtherCAT, Ethernet/IP, ProfiNet, and Modbus+Ethernet TCP. The encoders are also available with analog, CANopen, Profibus, DeviceNet, J1939, Interbus, Powerlink, and SSI connections. The absolute encoders have a protection class up to IP69K for stainless steel and are ATEX-certified for safety in explosive environments. The encoders are programmable via the wireless hub designed by Posital, allowing for portable devices interfaces. They can be used in medical equipment, factory automation, oil, gas, and renewable-energy industries.

Using Ethernet-connected encoders, such as the Posital encoder above, provides connections between Industrial Ethernet and office Ethernet. This helps simplify the integration of production and management of parts by providing easier access.

POSITAL PROGRAMMABLE ENCODER 2.0

Wireless connections are playing a major part in automation facilities. As more machines get connected to network systems, devices will become more wireless. The Programmable Encoder 2.0 from Posital provides new capabilities to program its series of IXARC rotary encoders. The encoders can be programmed via any device connected to the network

The UBIFAST tool has built-in Wi-Fi hotspot and Web server capability. Once connected to the tool, any Wi-Fi-enabled device can connect to the UBIFAST hotspot and configure the tool in a standard Web browser.

The RUGGEDCOM WIN7200 wireless base station provides high-bandwidth mobile connections and is designed for harsh conditions. These products handle environments such as electrical power substations, oil refineries, military applications, and roadside traffic control cabinets.

whether it is a laptop, tablet, or smartphone. The measurement characteristics that can be modified via the application include five different rotation measurement modes (incremental, SSI single-turn, SSI multi-turn, SSI single-turn + incremental, and multi-turn + incremental) and absolute encoder parameters (single-turn resolution, multi-turn range, code gray, code binary, and clockwise or counterclockwise code sequence). The adjust range of the resolution of the incremental encoder signals is 1 to 16384 PPR. The UBIFAST Configuration tool is needed to configure the encoders wirelessly. The UBIFAST is connected to the encoders and then establishes its own hotspot. Then any laptop or portable device can log on to the Wi-Fi transmitted by the UBIFAST and have access to the encoders' programming settings. This is done through the Web browser; no app or software is required. Posital offers more than 2,900 encoders that can be programmed using UBIFAST.

RUGGEDCOM WIN7200

Siemens offers the ability to make connected devices mobile by connecting the WIN7200. The WIN7200 is a lightweight, broadband wireless base station. The device complies with the IEEE 802.16e standard and is designed for use in unlicensed or lightly licensed frequency bands operating in harsh environments. The wireless base is a single-sector lightweight station so that it can be easily installed on poles or walls. A single PoE connection is enough to

power and connect the device reducing cost and complexity. It is powered by OFDMA radio technology that enables Non-Line-Of-Sight operation. The device is designed for harsh environments meeting the IEEE 1613, IEC 61850-3, Class 1 Div 2/ATEX Zone 2 requirements, as well as the MIL-STD 810F, MIL-STD 509.4 requirements for salt fog. The robust hardware has temperature limits of -40 to 75°C. The WIN7200 supports the following WiMAX connections at 2.5, 3.5, 3.65, 4.9, and 5.8 GHz bands. The device is also Mobile WIMAX-compliant based on IEEE 802.16e standard and WIMAX Forum Wave 2 profiles.

The WAVE Communications mobile app turns your Apple or Android smartphone or tablet into a network-independent push-to-talk device (PTT). Users can communicate and connect to any device networked within the cloud PTT over 3G, 4G LTE, or Wi-Fi network.

MOTOROLA WAVE 5000

The advantage of an established IoT network is advanced communication. Ethernet provides the ability for these

systems to be connected to the Internet. Users with mobile devices or who are remote can receive information about their systems that before would have required on-site access. Motorola WAVE 5000 updates push-to-talk (PTT) technology by providing different apps and Web clients connecting portable devices and computer systems to PTT networks. Any smartphone or computer can be used as a PTT device simply by installing an application.

By using WAVE 5000 in conjunction with WAVE Connections, a cloud-based PTT, factory plants can notify users remotely. Essentially, if you have an automation line and the sensors are tripped, causing a production stop or failure, the alarm is pushed through the connected network and uses the cloud PTT to alert the end user via their mobile device. The connection is fully secure with AES 256-bit encryption and is scalable for up to 2,000 users.

WITTENSTEIN ONLINE SERVICE PORTAL

The access to the Internet adds the benefit of resources. The ability to obtain information quickly is a pillar of Internet access. Wittenstein, a motion-control company that produces gearboxes, motors, actuators, and rack-and-pinion systems, recently introduced its Online Service Portal. The parts will have a QR code as part of the label.

This QR can be scanned by any QR code app on a smartphone or tablet. The QR code, once scanned, will provide the user access to all of the relevant information of that part via the online portal. The Online Service Portal contains installation information, reference documentation, maintenance documents, and diagnostic services for their parts. Besides being on the part label, a QR sticker can be placed on the machine, cabinet, desk, or any other location so that the code can be quickly scanned. md

The Wittenstein QR code, once scanned from the part label, provides direct access to the Wittenstein Online Service Portal. From the portal, the user gains access to installation information and diagnostics service for that particular part.

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WHAT'S THE DIFFERENCE Between Types of Wear?

Learn these key factors in reducing wear that leads to costly damage to machinery.

Engineers who build components to last are naturally concerned with wear. There are different types of wear, and some engineers may induce wear purposely for varying reasons. Three types of wear are abrasion, adhesion, and corrosion. Each type has inherent problems and benefits that can be affected by materials, lubrication, and surface finish.

Abrasive wear can have benefits, such as water jetting. Water jetting has the ability to cut through metal with relative ease. This can reduce property changes that can occur with other processes that generate excessive heat while cutting.

ABRASIVE

There are two common types of abrasive wear: two-body and three-body abrasion. Two-body abrasion refers to surfaces that slide across each other where the one (hard) material will dig in and remove some of the other (soft) material. An example of two-body abrasion is using a file to shape a workpiece. Three-body abrasion is where particles between the two surfaces remove material from one or both surfaces. The tumbling process is an example of this type.

Tumbling involves using particles to sand and polish the surface of a part. The particles that cause abrasion are often called contaminants. Contaminants are anything that enters a system that creates abrasion. While lubrication is imperative, an active lubrication system can introduce contaminants that cause abrasion. Filters remove contaminants and are one of the reasons why proper maintenance and replacement of filters is important. However, the lubrication, or the additives in it, can react with the metal, creating a thin monolayer of contaminants. For this reason, the selection of proper lubrication is important in reducing wear to your equipment.

Surface roughness is another important variable for wear. Two-body abrasion is reduced by having smoother surface roughness. For example, a journal or sleeve bearing made out of a softer material will slide against a harder drive shaft with little to no abrasion due to the surface finish. Using materials with similar hardness is generally not advised. The reason for the softer bearing material is to further reduce wear. Con-

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taminants can become embedded into the softer materials and stop three-body abrasion from occurring. This technique might damage the bearing, but is preferred as it is designed to be relatively easy and more cost-effective to replace than a drive shaft. The rougher surfaces can increase the coefficient of friction and micro-peaks can break off, contributing to contaminants that are related to abrasion.

ADHESION

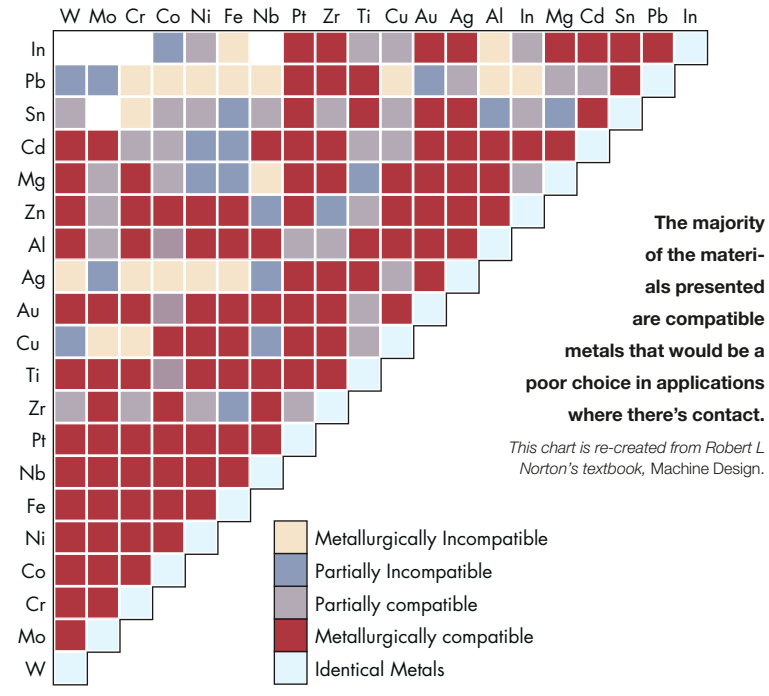
Surface roughness also contributes to adhesion. For this type of wear, a material's compatibility will be important. Compatibility does not mean materials that work well together; rather, that the materials "like" each other, causing them to stick together. This compatibility forms a bond, causing parts to seize and even become cold-welded together. There are a few general rules to follow for material selection to make sure unwanted adhesive wear doesn't occur. Materials that make contact with one another, in general, should:

- Not dissolve in the other.
- Not, in given environment and other conditions, form into an alloy.
- Not be identical (e.g., an aluminum shaft with an aluminum bearing).
- Have at least one metal from the B-subgroup (e.g., elements to the right of nickel, palladium, and platinum on the periodic table).

Adhesion is possible to calculate. The adhesion and abrasive wear calculations share the same formula; however, it can vary by as much as ±20%. This inaccuracy is due to constant changing surface conditions and lubrication during operation. It may be better than no data, but designers need to be aware of the limitations and accuracy of the formula. Trying to calculate or predict wear is made more difficult if components have non-conforming geometries, such as when gear teeth and cams are involved. These components can have difficulty staying properly lubricated. To reduce adhesive wear, sometimes corrosive wear is purposely induced.

CORROSIVE

Chlorides, phosphates, or sulfides can be added to induce corrosion and reduce a more destructive adhesive wear. Corrosive wear is more often thought of as something you want to prevent. Rust, or oxidation, is the leading form of corrosive wear. Lubrication, material selection, and surface finish (including coatings, as in abrasive and adhesive wear), are the main factors to consider.



The majority of the materials presented are compatible metals that would be a poor choice in applications where there's contact.

This chart is re-created from Robert L Norton's textbook, Machine Design.

Noble materials are noted for having non-corrosive properties. Gold is used in electronics as a coating due to corrosion resistance. Noble materials are often used sparingly or in minimal waste processes due to cost. Other materials are self-anodizing. Aluminum will react with oxygen to form a layer of aluminum oxide that prevents oxidation.

Iron and ferrous materials are prone to rust and can flake off, exposing another layer that allows the oxidation to continue the degradation process. For self-anodizing materials, slight abrasions or even stresses can cause crack propagation or scrape off the aluminum oxide, furthering the corrosive wear.

Stress affects corrosive wear. Stress corrosion and corrosion fatigue will significantly accelerate corrosive wear. The difference is the loading situation. Static loads cause stress corrosion where more dynamic loading, such as cyclic loads, will cause corrosion fatigue. md

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CITE: World's First "Ghost Town" for Testing New Technologies

A New Mexico city is being built exclusively to test, evaluate, and commercialize new devices, networks, and technologies. But no one will live there.

Computer modeling and simulation are great tools for testing and evaluating new devices, technologies, and products. But the ultimate test is the real-world marketplace, where customers will use (and abuse) products in ways their inventors and developers never imagined. Unfortunately, going to market is an extremely expensive and risky form of product testing.

In an effort to extend the capabilities of product and technology testing—and take some of the risk out of bringing them to the marketplace—the Pegasus Global Holdings LLC, plans to construct a privately owned city near Deming and Las Cruces, N.M. It will be sized for 35,000 residents, complete with a power plant, buildings for housing, commercial activities, and factories, as well as telecommunication and transportation networks.

But there will be no residents living in this city, nor output from its factories, and no students graduating from its school nor worshippers gathering in its church. Instead, the city, currently called the Center for Innovation Testing and Evaluation (CITE), will let clients deploy new technologies and products in full-scale urban, suburban, and rural settings and give them a thorough evaluation. And if a specific research project

It will look like a city, complete with a power plant and room for a wind farm, according to this conceptual illustration…but it won't house a single citizen. Instead it will serve as a testbed for new technologies, products, and services.

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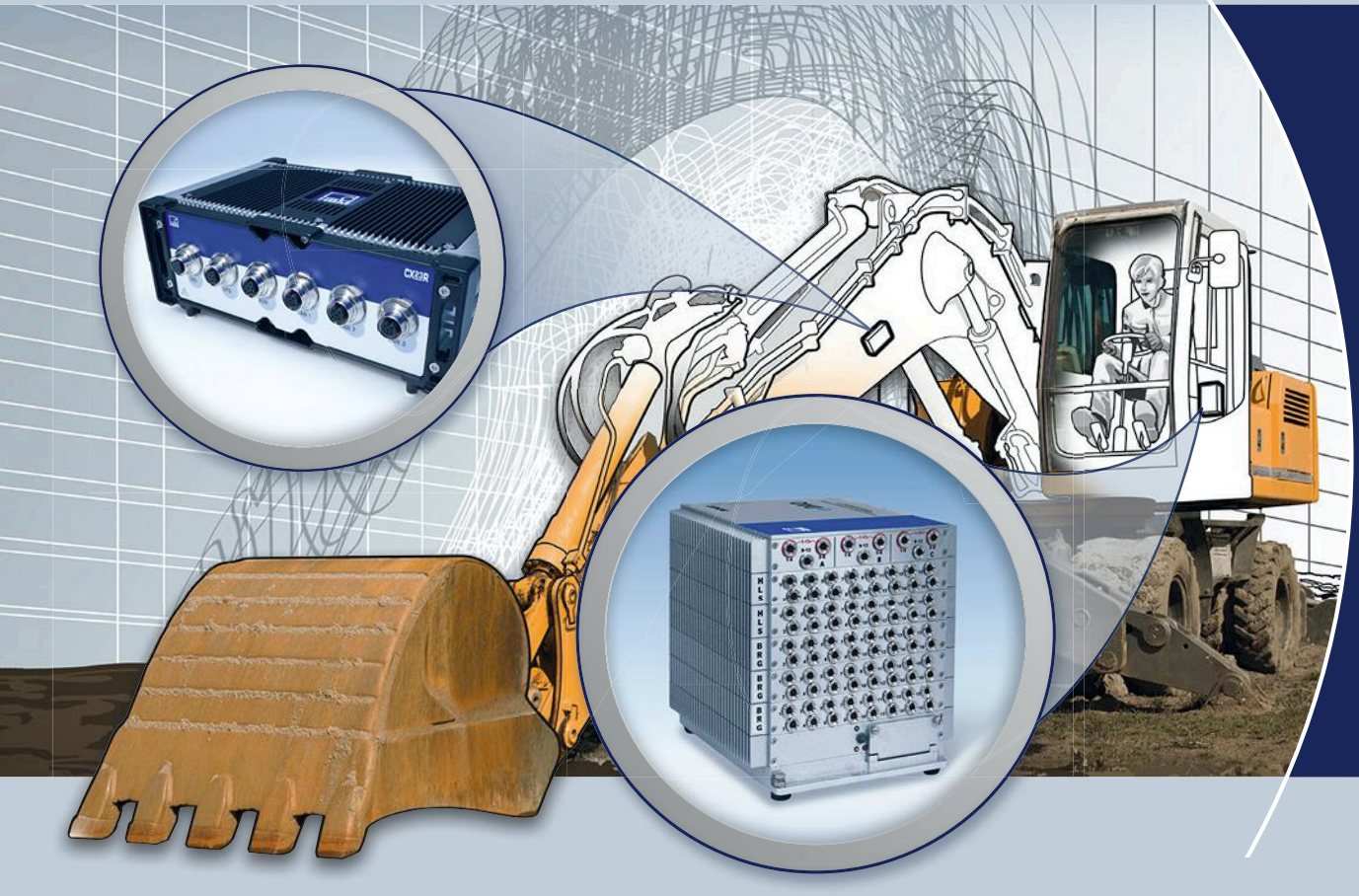

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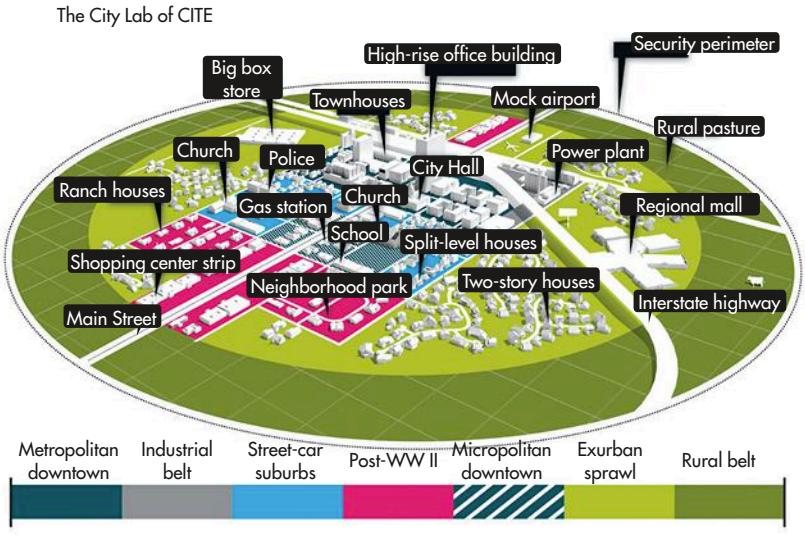
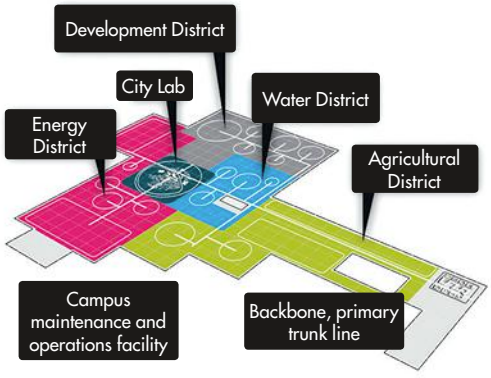


The City Lab in CITE will include commercial, civic, and residential areas. It will have the capacity to generate power and desalinate ground water. It will also have a transportation infrastructure that includes a highway, urban streets, light rail, and a mock airport.



The uninhabited City Lab will be surrounded by several districts designed to test different types of technology (energy, water, and agricultural). A backbone, or trunk line, will connect them so that data can be gathered, shared, and stored. A campus area of offices will serves as the entry point to CITE.

requires the temporary inclusion of people in the city, CITE can easily accommodate such a request.

THE CITE LAYOUT

CITE, which will take four years to build (and will be built in phases), will center on a six-square-mile City Lab. It will contain almost all of the infrastructure needed for the 35,000 hypothetical citizens, including highways and streets, a light-rail system, a downtown area, and a big-box store and mall, as well as a variety of different housing and commercial structures.

Buildings will be fully equipped and built to the local codes of New Mexico. Houses will have lights and appliances, offices will have computers, copiers, and other equipment, and the hospital will even have an X-ray machine and other medical devices. "It will not be built as a futuristic 'smart' city," says Robert Brumley, a senior director at Pegasus, a Washington D.C. firm with over a decade of experience in developing intellectual property, including extensive experience in testing and evaluating new technologies at federal sites. "Instead, it will represent a turn-of-the-century slice of America."

Brumley points out that most cities in the U.S. are a long way's off from being smart

WHY NEW MEXICO?

THOUGH CITE IS loosely based on a North Carolina city of 35,000 residents, it will be built in New Mexico—and for several good reasons. One of the most important of these is that Pegasus has the enthusiastic support and endorsement of the New Mexico state government, which has entered into an exclusive development agreement for the project through its Economic Development Department. It's also an advantage that the state has an extensive and cost-effective infrastructure for power, water, transportation, and communications. In addition, the state boasts a well-educated population and hosts several major universities and research facilities, such as Sandia National Laboratory.

"The state has lots of open land for use that is close enough to significant population centers from which to draw employees, but still sufficiently remote to ensure no public safety issues or interference from test activities," says Brumley.

NEW MEXICO'S TECHNICAL RESOURCES

ACADEMIC
Eastern New Mexico University
New Mexico Institute of Mining and Technology
New Mexico State University
University of New Mexico/ New Mexico Advanced Computing Center
University of the Southwest
Western New Mexico University

GOVERNMENT/DEFENSE DEPT.
Cannon Air Force Base
Holloman Air Force Base
White Sands Missile Base
Kirtland Air Force Base/ Air Force Research Laboratory
Los Alamos National Laboratory
New Mexico Center for Energy Policy
Playas Training Center
Sandia National Laboratories
Waste Isolation Pilot Project
White Sands Missile Range

PRIVATE ENTERPRISES
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Ethicon
K-Tech
Hewlett Packard
Honeywell
Intel
Public Service Company of New Mexico
Schott Solar
Urenco

Visitors and clients of the CITE will first pass through a campus. It will house offices and labs for researchers and clients, as well as meeting rooms and other administrative offices.

cities, which is why the technologies and devices that will be tested at CITE will be targeted at typical U.S. cities.

CITE will also have a functioning power plant—likely a natural gas plant. It will generate 10 MW of power for the city. A desalination plant in the adjacent Water District on CITE will explore bioremediation methods and new ways to make brackish water potable. (New Mexico sits atop 15 billion acre-feet of brackish or saline water.) There will also be a wastewater treatment facility. The electric and water plants will be enough to supply a city of 35,000. If there is excess electricity or fresh water—almost a certainty, given there are no residents—Pegasus plans on selling it to New Mexico utilities and feeding it into their local water and power grids. This would provide an additional revenue stream independent from those created by clients paying to use the CITE facilities.

Other areas surrounding the City Lab include the Energy District, where solar, wind, hydrogen, thorium, geothermal, and other green energy plants generating up to 85 MW of electricity can be set up. The plants will run at their rated power, and possibly higher as technicians "stress" the technology and engineering.

The Agricultural District will be where crop production, plant genetics, and drought/disease-resistant schemes can be tested, as well as new farming methods. And the Development District will be set up to evaluate air-quality equipment, aging infrastructure issues, and urban security devices and plans. All of the districts will have field labs set up as workspaces for researchers, clients, and monitoring equipment.

For the City Lab, the workspaces and offices and workspaces for 350 CITE employees and clients will be underground.

They will monitor tests and experiments, making sure data is properly recorded and stored, while not interfering with the test conditions.

At the entrance to CITE, Pegasus plans on building a research campus to house more labs and collaborative spaces, along with an administration center to manage CITE. A data center located in the campus will be used by CITE, and like power and water, excess data-handling capabilities will be leased to commercial and government entities. The campus will also serve as a security gate between CITE and the outside world. CITE will have significant, strict access restrictions and procedures for storing and transmitting data, says Brumley.

To tie the entire city together, a telecommunications and data-transmission backbone will connect all of the labs and campus. IT will be shielded against electromagnetic interference.

POTENTIAL CITE TEST SCENARIOS

WHILE THE RANGE of testing scenarios that could be done at CITE are virtually unlimited, IoT-related technologies are a prime example of what could be tested. In recognition of this, London-based Total Telecom recently named CITE the recipient of its distinguished Internet of Things Awards (IOTA), owing to its contributions to the IoT infrastructure.

Brumley and his team at Pegasus have also outlined several potential test scenarios that revolve around security.

For example, a handful of companies are developing and using equipment that takes acoustical and other data collected from a network of widely separated sites to triangulate and locate the source of gunshots. Those firms could test and certify their equipment in CITE, a realistic representation of a city or suburb, complete with echo-inducing buildings and urban "canyons." They would be free to fire different types and calibers of weapons at any time of day and in

This artist's conception shows that CITE will be relatively isolated from public interference, meaning that what goes on inside CITE shouldn't interfere with the outside world, either.

WHAT IT WILL OFFER

Clients, which will include small and large companies, universities, and governments, will pay a range of fees to access the world's largest testing and evaluating center. CITE's criteria for selecting and scheduling clients' tests will be partially based on whether the technology, product, or service is tied to a significant potential growth sector of the U.S. economy; whether the testing needs the resources of CITE's large-scale, any weather, without worrying about hurting or alarming the public.

Sensors for detecting biological and chemical attacks, as well as the equipment and tactics used to combat them, could also be tested and evaluated. Those attacks could be carried out against high-rises, schools, or even CITE's highways and mock airport. Researchers could track the spread of the biological or chemical agents as they make their way from single or multiple release points, and are subject to real-world airflows and weather in downtown or suburban areas.

They could also test HVAC systems designed to keep out chemical agents or render them harmless. Events could occur simultaneously with hostage-taking assaults that confuse security forces while cyber-attacks try to overcome security software and hardware.

Security forces and the companies that make weapons and tools for them could try out their new techniques and technologies in actual downtown or commercial settings. This would include advanced electro-optical and infrared detections systems and non-lethal weapons. Another possibility is testing new emergency communication devices in combination with others to ensure there is no interference.

Transmission and reception testing could easily include a host of different-sized buildings and environments, including weather. Researchers could closely monitor a fleet of them as they went about a series of simple and complicated tasks and interactions, all without endangering pedestrians. Communications schemes between autonomous vehicles using sensors and transmission equipment from various companies could be tested together to ensure interoperability, guaranteeing they won't interfere with each other.

Other IoT-related tests could include:

- Demonstrating the usefulness and reliability of autonomous robots to maintain and repair urban infrastructure, such as underground pipelines.
- Testing machine-to-machine (M2M) wireless and wired connections for industrial automation, logistics, smart energy and transport grids, healthcare, and defense.

real-world facility; and if the test could lead to new products or devices being marketed in the real world with no major upgrades in infrastructure. The fee structure for CITE testing has yet to be determined, but CITE planners would have to set them competitively to draw clients.

Because CITE will be run privately, it will not have security, scheduling issues, and other limitations common at Federal labs and large corporate test labs. Nor will there be issues or red tape with keeping intellectual property secret and under wraps, which is a constant concern to inventors who take new ideas to large companies, as well as at university labs and facilities. CITE also plans to offer lower fees to companies and universities that partner with them in building and developing the test city.

Once CITE is up and running, which should be sometime in 2020, it will help companies and individuals take new ideas from prototype to a fully vetted and tested commercial product. To this end, CITE will provide a wide array of services. These include:

Innovation support. CITE personnel would help commercialize new technologies or product ideas and help clients find partners. They would also help in defining capabilities, developing a business plan, and handling marketing, packaging, and delivery.

Test design. The facility will provide technicians to run tests, if needed, or simply assist in planning and designing the tests. This would include developing test objectives, plus designing and building physical test rigs. The facility could also help check and analyze test results and make recommendations for the next round of testing, if necessary.

Data distribution. A CITE cloud will let clients configure, monitor, and assess tests remotely at their facilities, as well as at their office spaces leased on the CITE campus.

Consulting services. CITE will also offer clients an opportunity to work with America's leading firms and innovative startups to expose them to the skills, processes, organizational structures, and disciplines that will let them leverage their capabilities in meeting customer needs and becoming market leaders.

The Pegasus team has yet to acquire regulatory licensing (a key to CITE's operating system), and it needs to finalize financing (which depends on licensing). It will take four years to build the CITE core, but Pegasus believes it can shave six months off that timeline by starting construction on the City Lab and underlying infrastructure for the entire CITE at the same time, and that depends on the availability of workers, permits, and capital. It's also possible CITE could host tests before the complex is fully built.

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Where Do We Stand with the IoT?

Industry leaders discuss issues surrounding the current state and growth of the Internet of Things (IoT).

A group of industry leaders talked with *Machine Design* about some of the issues and questions surrounding the Internet of Things. Here's what they had to say:

What are the most important benefits IoT offers business, individuals, and society? Will the middle and lower classes be shut out of the IoT due to the high cost of it?

Luca Difalco: The IoT offers a wealth of benefits to all tiers on the social spectrum. Businesses and society will realize substantial improvements in efficiency and productivity while individuals will benefit from greater productivity and convenience. Costs should be appropriately allocated based on who receives the benefits, which means some IoT costs should be borne by society.

Brett Wilkerson: Tax dollars should not finance this as the private sector has proven that if there are benefits to be gained from new technology, those in the private sector will invest and grow the technology to reap those benefits.

Steve Spatig: With the IoT, costs associated with the wiring and maintaining traditional analog-based systems are reduced, letting anyone with a wireless, smart-device connect. Therefore, IoT offers infinite possibilities for connectivity, making it widely accessible to the general population.

Dieter Michalkowski: IoT strongly supports factors needed for the megatrends of safety, energy efficiency, and customized products (made in lot sizes of one). In production, the focus is on lowering the total cost of ownership by reducing downtimes and increasing production flexibility. The IoT is driven by the benefits it can create, a much more effective driver than tax financing.

Are there any insurmountable challenges to establishing the IoT? Lack of standards? Security? Overcrowded RF spectrum?

Wilkerson: We don't believe the challenges are insurmountable, but as more devices and "things" are added to the global network, there will have to be improvements to infrastructure at all levels. The security aspect is an ongoing concern and is ever-evolving. The standards aspect may best be guided by those within certain industry segments that are looking to invest heavily in IoT.

Difalco: The Internet is already well established and there are lots of things connected to it. The issues you raise are all important, but none of them are deal breakers. In fact, ST is working hard on many fronts with many other industry leaders to create additional useful standards and better security. These efforts will expand the IoT and make people, businesses, and society more comfortable and confident in it; this is progress on an already solid foundation.

Spatig: The IoT opens up new opportunities for physical security, in that it provides a better and more simplified means of controlling and monitoring access to devices, systems, and equipment. In equipment-level access applications, for

OUR PANEL OF EXPERTS

LUCA DIFALCO, vice president of Smart Power and IoT Marketing and Application, at one of the world's largest semiconductor companies, STMicroelectronics (*www.st.com*), Huntsville, Ala.

DIETER MICHALKOWSKI, international industry sector and global account manager, Aventics (www.aventics.us), a global manufacturer of pneumatic components and systems based in Latzen, Germany.

STEVE SPATIG, general manager, Electronic Access Solutions business unit, Southco (www.southco.com), a global leader in Engineered Access Hardware based in Concordville, Pa.

ALLEN TUBBS, product manager, Electric Drives and Controls, Bosch-Rexroth Corp. (www.boschrexroth-us.com), one of the leading specialists in drive and control technologies, with U.S. offices in Charlotte, N.C.

BRETT WILKERSON, RFID Business Development, at MSM Solutions , a leader in RFID and barcode technology, based in Memphis, Tenn.

instance, the IoT can be used to provide real-time monitoring of equipment status, in addition to feedback on maintenance and physical security, optimization, and efficiency of connected systems.

However, standardization around communication protocols is critical to the overall growth of the IoT. Device designers will require standardized communication modules to allow for streamlined integration with connected systems. The Bluetooth Special Interest Group (SIG) is an excellent example of global standardization and optimization of a technology that supports IoT.

Allen Tubbs: Industry 4.0/IoT/IIoT (Industrial Intent of Things) are ongoing realities. Some technologies and processes that will make it possible are already in place. Others that are needed for a fully networked, digitized industry are under development. Also, nearly everyone has different definition for the term "Industry 4.0," so they may think it's simply too complicated and not for them. They don't understand the benefits that might result. The important thing is to work toward implementing production systems, processes, and technologies that can be used today to make that future possible.

The industrial embrace of IIoT will benefit everyone, including consumers, by making production more efficient and lowering costs. As for consumer products that are IoT-enabled, it is difficult for us to comment as an industrial company. But if you consider how appliances, tools, and other consumer goods have evolved over the years, it is likely that these products will also quickly become widely available. Companies might be able to save money by implementing IoT. What is the driving factor for consumers to make the leap?

Spatig: Consumers will benefit from the convenience IoT offers. A leading design factor in the development of remote, wirelessly operated systems is their ability to be controlled via smartphone, tablet, or any other wireless personal device. When connected with the IoT, consumers will have more opportunities to control, track, and monitor their devices from one central point.

Wilkerson: The benefits for individuals appeal more to tech-savvy consumers who will embrace the connected world and use the technology to simplify certain tasks in their life.

Difalco: IoT adoption is driven by the benefits it produces. Whether these benefits are lower costs, greater convenience and safety, or better and faster access to information, consumers and business will move only if (and when) they see value in it. A few consumer benefits of IoT include: better, more economical

health-care outcomes from remote patient monitoring; efficient scheduling and use of household appliances that consider utility tariffs and loads; and greater convenience as a result of infrastructure-enabled traffic management.

Michalkowski: Consumers are also looking for flexibility and comfort. And to be welcomed by a home that saves energy over the day, but is the right temperature when the owner comes back is a nice argument.

There seems to be lack of IoT standards for hardware, software, security, and data transmission and communication protocols. Should those issues be decided by the marketplace or by government? How do you think those issues will be decided? Will there be standards?

Michalkowski: Common standards have to be defined, as many products from different suppliers have to communicate with each other. To set the standards is a common task of the marketplace, government, and non-industrial organizations.

Wilkerson: Standards development should be left to the marketplace, but in reality it will most likely be a mix of government-defined regulation and industry-specific standards. Due to the massive scale of devices and information that will make up the IoT, standards need to be developed to protect consumers and businesses.

Spatig: Standards are best handled by market-based associations, such as Bluetooth SIG, that have direct experience with industry market requirements and the technology, and should be looked to for guidance as the IoT continues to evolve.

Tubbs: Bosch Rexroth is committed to "open standards" and believes they are an essential element for the success of Industry 4.0. Industry 4.0 calls for industry-wide standards with regard to information sharing. A variety of industry groups exist to help define these standards, and we, along with many other companies and interested parties, are participating actively in them. Nevertheless, opportunities exist now, and we are pushing "openness" as a critical element in helping manufacturing companies take advantage of them. Our Open Core Interface, for example, lets users access drive or control systems with standard IT languages. We are committed to using open standards to make our products, including hydraulics, especially well-suited to Industry 4.0.

Difalco: There will be standards—there are, already. And ultimately, future standards, like those already in place, must be accepted by the marketplace, even if governments get involved and dictate or contribute. Ultimately, if the marketplace

doesn't accept a standard, it will have a limited audience.

If a company designs and builds something such as industrial motors, large blades for wind turbines, or linear actuators, should the company be more focused on embedding IoT technology into their products or in the processes they use to make the products? Why?

Tubbs: Most manufacturers will do both. If there is cost-effective information that can be collected from the product for the end-user, then it makes sense for the manufacturer to design that benefit into their product at the production stage. At the same time, if the manufacturer sees the benefit in providing such information to their own customer, it probably sees the benefit of using similar data in its own manufacturing processes. At Bosch, we implement many of our solutions at our own manufacturing plants as a first step, to learn about and optimize the solution for the broader marketplace.

Michalkowski: Both! If IoT is only implemented in the process to make the components, then this is only half of the way. Components makers must also help customers become more efficient and this means IoT must be integrated into products so users can benefit too. In production, IoT will help companies be flexible in making product s that meet market requirements. IoT will also help users be more flexible and effective.

Difalco: Successful companies focus their attention on serving their customers. Whether they do that by building the most reliable, fastest, or least expensive product is part of the product and marketing strategy. Not to minimize the magic of the IoT, but embedding IoT technology into their product or process is simply a "feature" question the company and its engineers answer as part of their cost/benefit analysis.

Wilkerson: We think there is benefit to both. There is potential intelligence, process improvement, labor savings, traceability metrics, and more that can be derived from the process and product side of the equation.

Spatig: Companies should be more focused on the product and processes within their areas of expertise, as this is where they can add the most value. IoT technology should follow standards that allow for simple integration into any device, system, or piece of equipment. Device manufacturers should focus on their core competencies, and IoT system and network providers should focus on standardizing and optimizing IoT technology to best support the growth of the industry.

How will U.S. companies deal with all the new information they glean from the IoT? How will they ramp up their

Big Data analytical capabilities? And is there a guarantee they will all profit from the results?

Michalkowski: Looking at Amazon, Google, and so on, Big Data analytical capabilities already exist. The next step is to use this knowledge also for industrial applications . But there is never a guarantee for success.

Difalco: Sir Francis Bacon said, "Knowledge is Power" in 1597. It remains so today. Still, companies will need to decide how to use that knowledge—and there are no guarantees that they will do so successfully.

Wilkerson: There are no guarantees; but most businesses will benefit from more reliable real-time information that can be gleaned from the connected world. How the influx of data will be managed will be different from company to company; the businesses or industries that can more quickly scale their resources to put the data to use will obviously benefit the most.

Spatig: Data collected from the IoT will require new analytics that let companies best leverage the increased information. Companies will need to shift from traditional methods of data gathering, such as spreadsheets and manual data entry, to software or cloud-based Internet data analysis and monitoring. Though there is no guarantee of profit, one of the key benefits of applying the IoT is that it helps companies become more efficient by reducing costs and improving productivity, which should ultimately lead to increased profits.

For example, wireless, Web-based access controls could significantly reduce costs associated with installation, maintenance, and administration of traditional wired systems in building and equipment access applications. Security administrators can then easily add and remove access-control credentials, which can be managed remotely through cloud-based Web portals.

Tubbs: The real profits will come by creating and gathering data around identified problems. This usually means starting small and solving one problem at a time. The infrastructure will build up as more profitable data-analysis systems are needed and built. It isn't necessary to have an expensive data collection system in place before beginning to solve problems. The analysis and profit analysis come at the beginning of the process, when a problem is identified and defined. At that point, sensors, servers, and analytics are designed in according to the anticipated profits of solving the problem surrounding the process.

Will there be any losers in the race to IoT?

Difalco: Any competitive market will

always have winners and losers.

Wilkerson: There are winners and losers in everything. If sizable businesses are interested in growth and gaining market share, then they must be prepared. With the IoT, planning is now and if you're not investing for the future and making use of the technology at hand, you stand a strong chance of getting left behind.

Spatig: Legacy solutions like traditional wired, analog-based control systems may be left behind. Wireless devices require less hardware and less maintenance, which could potentially lead to the elimination of layers of installation and maintenance requirements. Service and technology providers will need to embrace this new paradigm to keep up with the market.

Michalkowski: The ones who do not fulfill the requirements of the market will suffer, but this is not related to only IoT.

Tubbs: Only those who don't pay attention. It is tantamount to refusing to know your competition. In some respects, the IoT is just a new name for gathering data to stay competitive.

What is a likely timeline for IoT implementation?

Difalco: If we agree that the Internet is already well established and there are lots and lots of things connected to it, then there may be a timeline for connection of a particular application or "thing" to the IoT, but there is no timeline for IoT implementation.

Wilkerson: As for the overall timeline, we have years ahead of us before the masses realize the full benefits. In the short term, there are plenty of businesses putting pieces into place that will continually grow into much larger connected events or "things."

Spatig: IoT implementation is currently underway and will continue to evolve and grow into new areas. For example, on the access-control side, there is an existing legacy infrastructure in place that will require a shift from these systems, to a new way of thinking—especially with regard to how these new devices network and communicate with each other. As the IoT becomes more prevalent, there will be an evolving process to accommodate the paradigm shift from individual wired devices to a wireless network of connected devices.

Michalkowski: Looking at social networks, you can see the implementation has already started, and will be going on for years. It is not a revolution, but an evolutionary process. A lot of applications exist today, but they are insulated. The timeline of implementation is therefore very much affected by the realization of the easy and simple communication between the different applications. md

VICTORIA FRAZA KICKHAM | DISTRIBUTION EDITOR victoria.kickham@penton.com

Image courtesy of Thinkstock

Industry Outlook: A Challenging Yet Promising 2016

It's a good time to be a buyer of electronic components, as distributors and manufacturers step up their IoT capabilities, improve service levels, and broaden product offerings.

JOE NOWLAN | CONTRIBUTING EDITOR

IN 2016, DISTRIBUTORS AND manufacturers will need to show versatility in their product offerings as well as their menu of value-added services—and being able to adapt on the fly has become essential.

"[Customers] are increasingly expecting distributors they buy from to adapt to their needs. Those distributors who just continue to offer a mass production, assembly-line model are going to lose out," explains Sagar Jethani, global head of content at electronic components distributor element14. "The ones who are able to offer custom services at a good price and in a scalable manner are going to gain market share."

As an example, element14 customers have benefitted from its online community of engineers, says Chris Breslin, chief product officer at Premier Farnell, the Britain-based distributor of which element 14 is a subsidiary.

"Many distributors end up competing on price and delivery in the production space. We really feel that we provide a competitive advantage at the front end of the customer design cycle," says Breslin. "We have great access to information and technical sales support, supported by the largest online community [of engineers] in the industry."

Jethani notes that element14 can tap into that community of nearly 400,000 engineers.

"By engaging with thousands of peers around the world, engineers can stay sharp across a wide array of disciplines and discover new applications and ways of doing things they might not necessarily get in their day jobs," he says.

Breslin adds that customers will justifiably expect other comparable value-added services for 2016.

"Today, you need to provide customers with real-time product content and data to enable faster decisions," says Breslin.

PRODUCT KNOWLEDGE AND THE IoT

Product expertise will be more essential than ever in 2016. That is mainly due to the multitude of new and growing technologies, which includes the Internet of Things (IoT).

Hans Landin, vice president of power transmission products at bearing manufacturer Timken, says he views the impact and influence of the IoT on two levels.

"On one hand, we are seeing growth in online interactions—everything from downloading CAD models, getting technical support, and purchasing more bearings from our stores, where users can check availability and track delivery," says Landin. "To that end, we

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"...we are doing a lot to leverage our ERP system, such as integrating our engineering tools and CRM to put the information customers need literally at their fingertips." —Hans Landin, The Timken Co.

are doing a lot to leverage our ERP system, such as integrating our engineering tools and CRM to put the information customers need literally at their fingertips."

This, in turn, gives Landin and his colleagues at Timken instant and more detailed customer information.

"The data we collect from these tools helps us anticipate customer needs and serve them better. We continue to work face-to-face with our customers, collaborating to solve their problems," he says.

Also in 2016, Landin says he expects the IoT to enable a part that's as fundamentally common as a bearing to become more sophisticated.

"[That] touches on 'smart' bearings and the potential for them to be equipped with sensors and transmitters that relay data to improve the performance of industrial machines," explains Landin.

The increasing sophistication, and resulting customer demand, is something that many in the industry will be watching in the New Year.

"While most heavy industrial markets are in the early stages of exploration and adoption, we anticipate growing interest in intelligent solutions," says Landin.

As a result, distributors and other suppliers will need to be on top of emerging trends, says Jethani.

"If an engineer needs assistance coming up with a good IoT framework or automobile application, they should be able to get that assistance from the distributor they're buying from," Jethani explains.

"It's no longer enough to sell product," he continues. "You really have to support that product with deep expertise… There's one side to the IoT that involves consumer-facing applications. But there's also the side of the IoT that will affect engineers as customers."

In an analysis, "The Internet of Things: Industrie 4.0 vs. the Industrial Internet," written for the Manufacturers Alliance for Productivity and Innovation (MAPI), Director of Economic Studies Kris Bledowski looked at the IoT and its global impact.

"Industry worldwide is waking up to the importance of Internet integration, big data, and ever-faster processing," wrote Bledowski. "All of these innovations are shaking up standardized production and distribution techniques…A fast pace of innovation is instilling some fear among market participants—the fear of being left behind the competition."

"If an engineer needs assistance coming up with a good IoT framework or automobile application, they should be able to get that assistance from the distributor they're buying from." —Sagar Jethani, element14

PRODUCT AVAILABILITY RULES

Inventory will be another issue in 2016.

"[We are] a high-service distributor. One of the things we do differently is provide a large number of SKUs at smaller volumes," says Matt Clark, global head of e-commerce, Newark element14, also a Premier Farnell company. "Others are doing the opposite, providing a smaller number of SKUs at larger volumes."

Timken has taken a similar approach, says Landin. "Our customers look for solutions beyond bearings to ensure they have reliable and productive operations. That is why we are investing in a broadened product portfolio to serve them better."

Customer expectations can be more challenging than ever—but potentially more profitable—for 2016.

"Everyone in the industry needs to significantly elevate the customer experience. The bar is being set and will continue to be set at a higher level than B2B merchants are used to," says Clark. "The B2C momentum is not going to stop in 2016. Solving problems that go beyond filling an order is critical to becoming a high-service distributor."

Some concerns came up when discussing the New Year ahead. At Timken, Landin and his colleagues have cast a watchful eye on energy sectors, especially oil and gas and what those markets may hold.

"The health of the energy sector is reflected in the drop in the level of drilling activity, and it's having a downstream impact because more land-based rigs are sitting idle," says Landin. "Operators are cannibalizing these idle rigs to rebuild and repair their active rigs rather than purchase new parts. [But] we remain confident in the long-term value Timken brings to these market sectors."

With more product lines and relevant technologies in 2016, a degree of specialization can emerge. Jethani expresses concern that too much specialization could result.

"The complexity of emerging technologies is forcing engineers to choose a hyper-specialization. The danger is that, if they're not careful, they will find themselves learning more and more about less and less," he explains.

Overall, though, there is an enthusiastic outlook for 2016.

"It will fall on distributors to offer new kinds of transparency to engineers and buyers about the orders they place," says Jethani. "The market is getting more competitive for their business, and the existing players will need to do more than ever before to win that customer's loyalty. It's a great time to be an electronics purchaser." ■

Socket Enables Accurate Flex-Device Testing

THE SBT-FLEX-7000 FLEX SOCKET requires zero insertion force and addresses high-performance requirements for testing Flex devices. It is operated by sliding the Flex device into the socket slot, which leverages a compression screw to apply downward pressure on the Flex device. The device extends from the socket to interconnect a printed circuit board with the testing device. The contactor is a stamped spring pin with 31 grams of actuation force per ball and cycle life of 125,000 insertions. Self-inductance of the contactor is rated at 0.88 nH, with an insertion loss of less than 1 dB at 15.7 GHz. Its capacitance is 0.097 pF. Each contactor has a current capacity of 4 A at 30˚C rise. The socket temperature may range from –55 to 180˚C. A floating guide may also be used for precise lead-to-pin alignment.
IRONWOOD ELECTRONICS, 1335 Eagandale Ct., Eagan, MN 55121, (800) 404-0204

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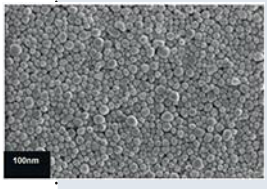
MINNESOTA RUBBER AND PLASTICS, 1100 Xenium Ln. N., Minneapolis, MN 55441, (952) 927-1400

Conductive Digital Ink Targets 3D-Printed Electronics



DESIGNED FOR inexpensive inkjet printing technologies and low-temperature sintering applications, Sicrys 150TM-119 is a conductive digital ink that uses single-crystal silver nanoparticles in triethylene glycol monomethyl ether (TGME). With silver loading as high as 50% w/w, its conductive behavior and workability makes it useful in 3D-printed electronics. Its viscosity is as low as 34 cP and surface tension is 30 dyne/cm, as determined by the Du Noüy Ring Method. The ink has a long shelf life and can be used to create printed patterns. It adheres to a wide range of substrates, including indium tin oxide, glass, PET, and Kapton, even in humid and aqueous environments.
PV NANO CELL LTD., 8 Hamasger St., P.O. Box 236, Migdal Ha'Emek, 2310102 Israel, info@pvnanocell.com

Encoders Achieve 5-nm Resolution

MEASURING 11.4 x 13 x 3.7 mm, the MicroE Optira series of encoders provides 5-nm resolution with automatic gain control, interpolation, and signal processing operated in the sensor head. Wide-alignment tolerances and proprietary PurePrecision optical technology makes it easy to set up. It comes with two mounting options and a standard FFC connector. It has a low power rating, and a 3.3-V dc version can be used in used in battery-powered precision instruments. They can be universally used with MicroE linear glass scales to ±1 µm/m accuracy, linear metal tape scales to ±5 µm/m for Optira, and rotary scales to ±2 arc-seconds.

CELERA MOTION, 125 Middlesex Tpke., Bedford, MA 01730, (781) 266-5700

Intelligent Service Unit Saves Money in Pneumatic Systems

THE MSE6-E2M, OR E2M for short, is an intelligent service unit that puts compressed air on standby when pneumatic machinery is idle. All parameters can be programmed by the user, including the thresholds of pressure and flow sensors on the E2M solenoid valve to sense leaks. The service unit provides communication with operators, alerting personnel of leaks and providing flow rate, air consumption, and pressure values in real time. While plans to introduce Ethernet/IP and PROFINET communication options are set for 2016, the current model features a Profibus node to connect the E2M to a programmable logic controller (PLC).

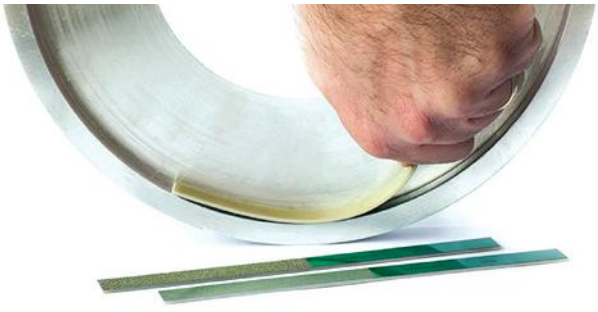
The solenoid valve, which handles flows up to 5,000 liters of compressed air per minute, is able to connect to MS-series air preparation units. It also can be retrofitted to older machines.

FESTO, 395 Moreland Rd., Hauppauge, NY 11788, (800) 993-3786

Electrohydraulic Actuator Internalizes Control and Steering

THE OSPE INTELLIGENT steering unit provides an option to incorporate both steering and safety control into the PVED-CLS electrohydraulic actuator. This combination eliminates the need for external controllers to monitor the electrohydraulic section of the steering valve. It connects directly with GPS to allow automatic steering for a wide array of off-highway machinery, including tractors, combines, and sprayers. It leverages a SASA sensor to detect the absolute position and speed of the steering wheel. This enables variable ratio, or "Quick Steering" performance in off-highway conditions, and allows drivers to use joystick or mini-wheel steering.

DANFOSS POWER SOLUTIONS, 2800 E 13th St., Ames, IA 50010, (515) 239-6000



Flexible Diamond Filers Reach Remote Components

COMPOSITE FLEXIBLE diamond-finishing files feature dot-matrix plating for removal of material and a uniform surface finish. They can be used to finish difficult-to-reach components such as extrusion dies and aircraft components. They work with an assortment of materials, including tungsten carbide, stone and marble, composite materials, industrial ceramics, reinforced plastics, fiberglass, ferrite materials, non-ferrous materials, rubber, and glass.

The files measure 7.08 in. × 0.50 in. They are constructed out of composite metal for strength and are flexible for use in narrow slots. Nine models of different thicknesses ranging from 0.006 to 0.035 in. are available. Grit sizes also vary between models.

TITAN TOOL SUPPLY, 68 Comet Ave, Buffalo, NY 14216, (716) 873-9907

Rotary Encoders Offer Harsh-Environment Safety Options

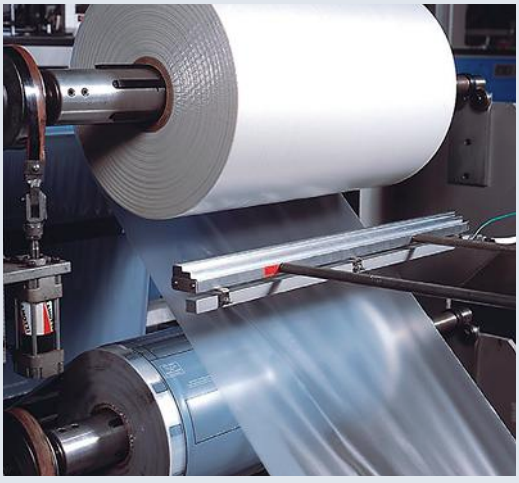
THE LP SERIES OF heavy-duty rotary encoders target harsh-environment applications. Encapsulated electronics protect against humidity and vibrations up to 200 m/s^2 at 55 to 2,000 Hz. In addition, the encoders are shock-resistant up to 3000 m/s^2 at 5 ms half-sine, and able to operate in extreme temperatures between –40 to +100°C.

Compact, terminal-box, and explosion-proof models are available with incremental or absolute-single-turn outputs. The compact version includes either cable or connector terminals. The terminal-box version includes enhanced electronics that reduce wiring errors and provide overvoltage protection up to 60 V. The terminal-box version also includes enhanced drive capabilities to ensure a strong signal over long cable runs. For all versions, there is a range of housing variations available with shaft options that include solid shaft, through shaft, blind shaft, and integrated coupling.

BEI SENSORS, 1461 Lawrence Dr., Thousand Oaks, CA 91320, (805) 968-0782

Ionizing Air Knife Prevents Static Shock

THE IONIZING Air Knife neutralizes static to prohibit dust and contaminants from collecting on moving webs, film, sheets, strips, auto bodies,



and other large assemblies and objects. It also prevents static discharge, which can damage electronic equipment and increase the risk of shock. It employs a static-neutralizing bar that generates positive and negative ions so that they may be carried to the target by a uniform sheet of amplified air. The air amplifier requires filtered compressed air; the Ionizing Air Knives require a voltage supply of 115 V ac at 50/60 Hz. Airflow can be adjusted via interchangeable shims. Two- or four-cable models are available, depending on the number of ionizing bars that are needed, and available lengths include 6, 12, 18, and 24 in.

VORTEC, 10125 Carver Road, Cincinnati, OH 45242, (800) 441-7475

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THE GO-FORM LINE OF all-electric press brakes targets small parts thinner than 0.25-in. and weigh less than 50 lbs It can apply 40 tons of force and leverages high-resolution incremental encoders to ensure ram repeatability for accurate shape forming. It has a 10-in. stroke and a 17-in. open height for jobs requiring tall tools and adapters. Its heavy-duty frame allows for multi-shift operation and full tonnage with minimal deflection, while the six-axis backgage enables accurate machining of complex shapes. The drive system uses satellite roller-screw actuators to reduce heat and wear over numerous cycles.

The unit can be moved with a forklift or overhead crane. It has a small footprint and will function without requiring any attachment to the floor. In addition, it can be configured to American, WT/New Standard, and European tooling styles. The holder uses a full-length clamp to allow for the use of segmented dies anywhere along the length of the bed. It uses a PC-based control system.

CINCINNATI INC., 7420 Kilby Rd. Harrison, OH 45030, (513) 367-7100

Power Supply Targets Isolation Amplifiers and Signal Conditioners

THE EPSITRON 787-2852 POWER supply is designed for isolation amplifiers and signal conditioners. In particular, it shares a common profile with Jumpflex 857 and 2857 Series signal conditioners so that output voltage can be directly commoned to the conditioners without the need for additional wiring. Its nominal output voltage may be 0 V or 24 V dc with a capacity of 24 W and an output current of 1 A. The nominal input voltage ranges from 100 to 264 V ac at frequencies ranging from 47 to 63 Hz. Pluggable picoMAX female connectors enable pre-wiring. In addition to integrated short-circuit protection, it is no-load-proof and includes an integrated redundancy diode to ensure power transfer when supplies are connected in parallel.

WAGO CORP., N120 W19129 Freistadt Road, Germantown, WI 53022, (800) DIN-RAIL

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SHA-CG ROTARY actuators feature a compact, hollow shaft for versatility in many different designs. With a surface run-out of less than 10 microns, positional accuracy is more than 1 arc-minute and repeatability is ±5 arc-second. The actuators can be used in machine tool applications to provide up to 3,400 N-m of torque for fast acceleration and positioning. They are composed of a Harmonic Drive CSG zero-backlash gear and a brushless servomotor. Encoder resolution at the output may be up to 20,971,520 pulses per revolution. They are available with or without a brake and come with several different gear ratios.

HARMONIC DRIVE LLC, 247 Lynnfield St., Peabody, MA 01960, (800) 921-3332

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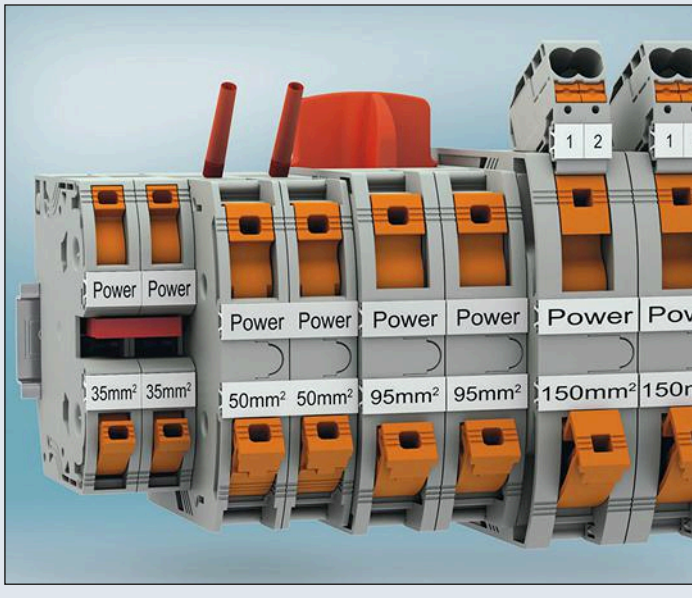

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PHOENIX CONTACT, 586 Fulling Mill Rd., Middletown, PA 17057, (800) 322-3225, info@phoenixcon.com

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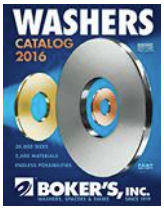

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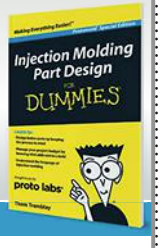

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Top 12 Trends in the Science of Managing R&D and Product Development: Part One

There are lots of trends and new ideas when it comes to the science of managing R&D. Some got started when a technological advance changed the best way to manage or make decisions. Others arose from new thinking in management science in the light of macro changes taking place in business and political structures, practices, and economics.

Below are six of the top 12 of these trends. As you read through the trends, keep "Big Data" in mind. It is a "macro trend" that will affect every industry and segment of the globe. It underlies more than half of the trends discussed, and, to a lesser extent, it will affect all 12. As an exercise, give some thought as to whether each trend is technology-driven or thinking-driven. In some cases, it's both.

Trend 1. Rapid Prototyping (aka 3D printing): This is an example of a technology driving a change in management. It pulls certain activities like design reviews and some tactical and operational product decisions to the beginning of the development process. In a few more years, when the size/shape, material, and speed of 3D printing improve further, it will eliminate certain segments within industries. When "the death of operations" manifests, activities and decision-making will surely be different.

Portfolio management, for example, was a transformational trend in the late 1990s. It resulted from new management thinking about competing based on a better basket of goods than one's competitors. Shortly thereafter, portfolio-management software and know-how from the investment banking and insurance industries were adapted to the needs of corporate product and project portfolios.

Trend 2. Strategy: Globalization and shorter cycle times were the first salvos that began driving companies to be more flexible in the determination and deployment of strategy. Now natural events, politics, and economics are adding impetus. The U.S. Army coined "VUCA strategy," which stands for volatility, uncertainty, complexity, and ambiguity. VUCA is now making its way into business (*Harvard Business Review*, Jan.-Feb. 2014).

Trend 3. Product Definition: Focus groups are proving increasingly inaccurate. Studies now show that what people say only loosely ties to what they finally decide. Decisions on product features are shown to be more accurate when based on monitoring the biological activity of the brain. Some consumer-goods companies are already making decisions based on people's actual thoughts and desires.

Trend 4. Organic Innovation and Growth: Challenging economic conditions that have lasted consistently across three to five product-development cycles led to a 50% decline in R&D spending, which has elevated risk ("Creating Bold Innovation In Mature Markets," reference paper by Robert G. Cooper, Product Development Institute Inc. and Stage-Gate International). Open innovation, alliances, and M&A activity have filled the voids for many. The organic inventory of "evolving and newly realized intellectual assets" will be rejuvenated in many industries, because this era competes on knowledge.

Trend 5. Search and Synthesis: The quest for a semantic web is coming ever closer to fruition. At some point in the next five-plus years, it will start to change corporations. Technical studies and market research that once took months will be reduced to days or hours. Confidence in the findings will also improve. Much more information will be available during early analysis and decision-making. Just as drafting departments changed with the advent of solid modeling, so too will the structure of technical research and analysis change with semantic technology.

Trend 6. Core and Functional Competencies: Core competencies are the few things a company knows how to do that permeate its value in the marketplace. Functional competencies are the dozens of specific technical and business skill sets across marketing, engineering, materials, and production that get a product out the door. Both are changing. Every company will learn to add technology into its product and position new capabilities "above" its products to maximize the connection and resultant value to its customers. Michael Porter's two *Harvard Business Review* articles make the point nicely (Nov. 2014 and Oct. 2015). Industry is paying attention to this framework.

The remaining six trends will be addressed and elaborated upon in my next column. md

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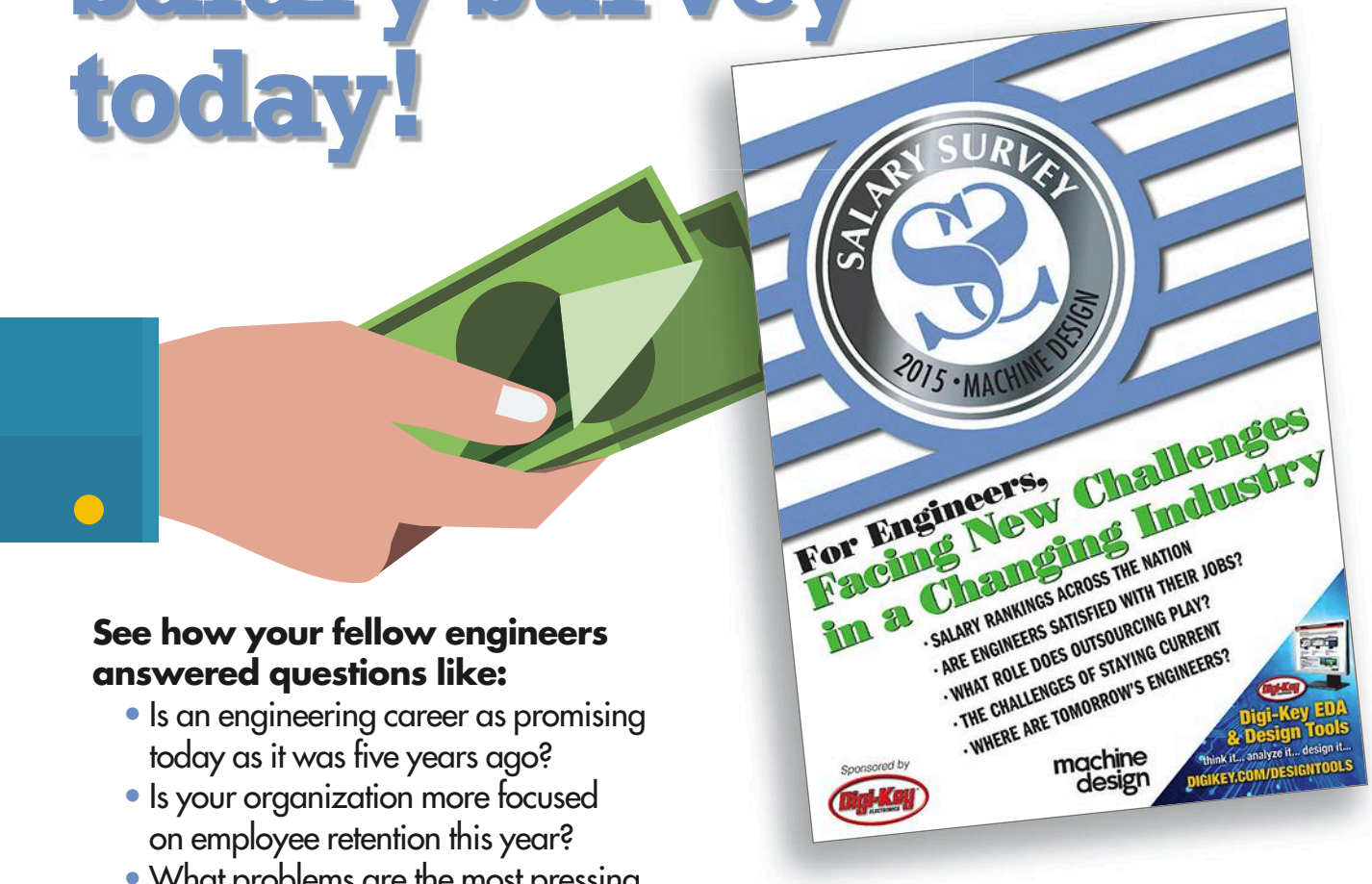

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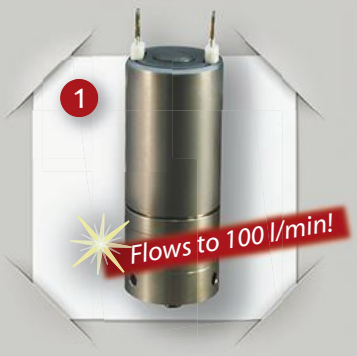

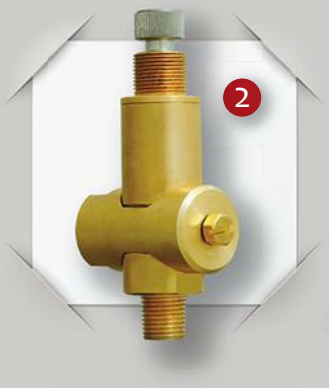

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