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CONTROL

Features

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Miscellaneous Manufacturers	3,222	Total Circulation	60,020

Control joins Endeavor portfolio

Putman Media now backed by one of business media's biggest players

KEITH LARSON
Editor in Chief
klarson@putman.net

"Now, as part of an organization an order of magnitude larger, we'll also have access to deeper resources and greater support to continue to fulfill our mission of serving the process automation community's information needs."

IT was a crazy week at Putman Media's Schaumburg, Ill., offices. A series of low-key management meetings to wrap up the month of April turned into an emotional roller coaster, as our longtime leader and CEO John Cappelletti announced to the team the company's May 1 purchase by Endeavor Business Media, a large and rapidly growing business-to-business media company with more than 550 employees, 6,000 customers and a database of over 9 million business professionals—all totals that are likely already outdated.

I'm delighted for John—and the rest of the Cappellettis—that he can take a well-deserved rest from four decades on the job, most of them in the CEO hotseat, guiding a relatively small, family-run media business through several recessions—including a Great one—the invention of the World Wide Web, and the mobile communications and social media revolutions. I, for one, will greatly miss his keen intellect, sharp instincts and generosity of spirt; building a business that supported the productive well-being of hundreds of individuals over the years I know brought him tremendous satisfaction.

New resources, new challenges

But, as they say, life goes on. I'm happy to have had the opportunity to work with John and the rest of his family, but also excited to see what's next. My new CEO seems a smart, stand-up guy, and the rest of the team has been very welcoming. Now, as part of an organization an order of magnitude larger, we'll also have access to deeper resources and greater support to continue to fulfill our mission of serving the process automation community's information needs. We also join a number of very complementary titles within Endeavor's Manufacturing, Processing and Design & Engineering groups, such as *Industry Week, Processing, Process Instrumentation,* and *Plastics, Machinery & Manufacturing* among others.

"We are pleased to welcome the Putman Media family to Endeavor Business Media and are excited to expand our reach in the manufacturing market with these highly-respected brands and the teams who work on them," said Chris Ferrell, CEO of Endeavor Business Media, in a press release announcing the acquisition. "We are committed to growing our information and marketing solutions offerings for the engineering, automation and manufacturing professionals that Putman Media has served for the last 80 years, and are honored that Endeavor has been trusted to carry these brands forward."

In addition to *Control,* the other titles joining the Endeavor Business Media portfolio include *Chemical Processing, Control Design, Food Processing, Pharma Manufacturing, Plant Services, Smart Industry*, and *The Journal*.

The more things change

Things are totally different around here. But at the same time, nothing has really changed.

Collectively, we'll continue to serve the world's largest audience of engineers, processors, maintenance, reliability and automation professionals, reaching more than 2 million global processing professionals each year in print and online. In fact, the change of ownership was so late-breaking that we haven't even had time to fully change over our emails or redesign the magazine. So, for now you'll still see signs of Putman Media throughout the magazine—and the website, too.

"The acquisition of Putman Media by Endeavor is an exciting opportunity for these market-leading brands," added Cappelletti. "Leveraging the resources, audience reach and industry expertise across Endeavor's existing portfolio provides substantial growth opportunities, so that we may continue to serve our readers and customers with the highest quality of content, information and solutions."

Couldn't have said it better myself. ∞

China enters the mRNA arena

MRNA was the key breakthrough in vaccine production technology that allowed the first COVID-19 vaccines to be produced in 10 months—compared with four years for the previous record-holder.

Pioneers of the technology saw cycle times reduced from two weeks to five or six days. Digital workflows eliminated unproductive waiting time, reducing variability in turn. Batch-record review went much more quickly, and manual error rates were cut by 80%. Further, digitalization reduced operator labor by 30-40%.

And now, China's Walvax Biotechnology is poised to build the world's most populous country's first COVID-19 production facility based on its own mRNA technology, developed in cooperation with Suzhou Abogen Biosciences (AbogenBio).

And to help ensure the facility achieves a world-class level of safe, reliable and intelligent operations, Walvax has chosen Honeywell to provide the automation, building and energy management solutions required of this highly digital process.

The plant is to be built in the Vaccine Industrial Park of Yuxi High-Tech Zone in Yunnan Province. The Honeywell solutions deployed will promote quality and consistency, while also optimizing production and accelerating time to market. The project also enables production management visualization by monitoring assets and processes through the employment of technologies such as digital twins and dynamic modeling.

"The completion and delivery of Walvax Biotech's COVID-19 mRNA vaccine plant is a key step in the industrialization of mRNA vaccines," says Huang Zhen, chairman of Yuxi Walvax Biotech Co., Ltd. "Working with Honeywell means we can achieve superior production, operations and management to ultimately provide world-class, high-quality production conditions for COVID-19 vaccines, jointly advance the digitalization and intelligent development of the vaccine production industry, and build a state-of-the-art vaccine production base, propelling Walvax Biotech to become a top-tier enterprise in vaccine R&D and production."

"Providing digital and intelligent solutions for Walvax Biotech's COVID-19 mRNA vaccine plant is another important achievement for Honeywell in expanding our reach throughout the life sciences industry," says Shawn Opatka, vice president - life sciences, Honeywell Process Solutions. "Honeywell's automation control and smart-connected plant solutions optimize plant manufacturing operations in terms of production, quality, compliance and operations to realize sustainable, full lifecycle management."

A move toward globalization

Opatka also believes that mRNA's expansion into China signals a globalization of the technology that will also make the world better equipped to respond more rapidly to new viruses in the future.

Another convergent trend is the movement of pharmaceutical manufacturing from batch to continuous processes, further ramping up productivity and product quality as well. "There's some really positive research in this area indicating that mRNA may well benefit from a continuous manufacturing modality," Opatka says.

Automation that removes the apparent complexity of sophisticated manufacturing processes can also help promulgate its use in many parts of the developing world, Opatka adds. "We're solving a lot of the problems today that will make it easier for companies to upskill a workforce to make more complex products."

The Walvax Biotechnology COVID-19 mRNA vaccine recently obtained the approval of Phase III clinical trials issued by the drug regulatory authorities of Mexico, Indonesia and Nepal pharmaceutical supervision departments, respectively, indicating that the COVID-19 mRNA vaccine has entered the phase III clinical trial stage in the three aforementioned countries. ∞

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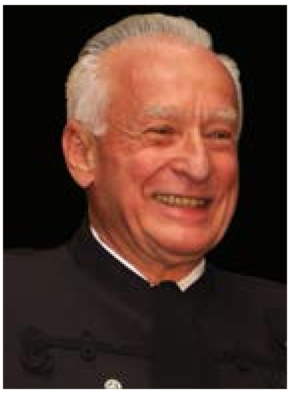
The larger cost of Putin's war

Our own Béla Lipták was there to resist Russia's 'liberation' of Hungary in 1956



BÉLA LIPTÁK
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"Our leaders should have learned that the appetite of dictators is never satisfied, that they will never stop swallowing up other nations until they are stopped by force. The sooner that force is applied, the less of it is needed to stop them."

IN this column, I usually write about process control systems—often, designs that contain some errors—so their correction gives me an opportunity to show what we can learn from the past mistakes of others. In contrast, this month I intend to discuss what we should learn from our past handling of large historical processes, those having the potential to trigger world wars. One example of inaction was when we tolerated Hitler's swallowing up of Czechoslovakia in 1939. And an example of keeping a historical process under control was when we didn't tolerate Khrushchev's placement of Soviet nuclear missiles in Cuba in 1962. It seems to me the inaction of 1939 helped triggered WWII, while our action in 1962 helped prevent WWIII.

From these historical events, our leaders should have learned that the appetite of dictators is never satisfied, that they will never stop swallowing up other nations until they're stopped by force. Force is the only language they understand, and the sooner that force is applied, the less of it is needed to stop them. Today, while Putin "liberates" Ukraine, all that would be needed to stop him would be for the EU to close the Ukrainian air space to all Russian planes.

Is history repeating itself?

Being a former Hungarian freedom fighter, I would like to share with you some 66-year-old memories of what it's like to be "liberated" by the Russians. Then we'll return to the present crisis.

After appearing to withdraw from Hungary in 1956, the Russians secretly brought in fresh troops, while at the same time inviting a delegation of the free Hungarian government to their headquarters to discuss the details of the total Russian withdrawal from Hungary.

They only asked for Hungary not to join NATO, and offered to work out the details of the withdrawal with the military leaders of Hungary at the Russian headquarters. Upon the arrival of our delegation at the Russian headquarters, they were arrested and the second invasion started against a nation left without military leaders. The average Hungarians just watched as the endless columns of Russian tanks entered Budapest.

Naturally, we still put up a fight, during which I was captured, but later managed to escape. When I was saying goodbye to the family, it was the only time I've seen my father cry. Later, in 1958, the Prime Minister of our 1,000-year-old European nation, Imre Nagy, was hanged. When the hood was pulled over his head, his eyeglasses fell to the ground and he calmly asked the hangman, "Please put back my glasses." I just hope that the Western democracies—particularly Volodymyr Zelenskyy and his family—will learn from that lesson.

HUNGARIAN FREEDOM FIGHTERS
"Our fight for freedom started with this march of the engineering students at my university." (Our author Béla Lipták is second from the left in the first row.)

Human future is at stake

The consequences of the Ukraine crisis are more serious than any earlier ones because they're diverting our attention from other challenges that mankind has never faced before. This summer, ISA is publishing a book of mine titled, "*Controlling the Future.*" In that book, I show that humankind has reached a fork on the evolutionary road because, from now on, our evolution is no longer directed by nature alone but also by our own decisions. This is a drastic change because now we can change both our cultural and physical environments. It's critical that at this point we select the right road and we do it in time because the

sign on the other road reads "Dead End." We must shake off complacency, stop living in delusion, and face the threat that's the size of civilized life itself.

In this new book, I provide detailed calculations showing that our cultural and physical environments are at risk as they evolve out of control and in the wrong direction. I show that some of the presently operating "control loops" are actually reverse acting, and that some of the secondary processes that are triggered have positive feedbacks, are self-accelerating and are approaching their tipping points. On the other hand, I also show that we have only about one decade to convert to a both culturally and physically sustainable future. We know how to do it, but we must not allow the "Putin War" to distract our attention.

AI impacting our cultural environment

At the same time, artificial intelligence (AI) has opened a new chapter in human history. Today, the development of this new tool is completely out of control. And, though it could take us into a better future, if left uncontrolled, it could also take us onto the slippery slope of self-destruction.

Over the last centuries, human culture started to recognize that constitutions are needed to protect society from the self-serving depravities of autocratic leaders. We were guided to the formation of democracies, which on the one hand satisfy the most powerful human thirst—the thirst for liberty—and on the other hand accepts Jefferson's view that "*all men are created equal,*" so each vote must have the same weight. This goal was further broadened, when the Statue of Liberty invited to our shores *"the huddled masses"* of the world, who are "*yearning to breathe free."*

So, what does this have to do with AI and with the evolution of "truthless" culture on our planet? Unfortunately, the answer is simple, AI in the wrong hands can make us vulnerable, not only to cybercriminals attacking our critical infrastructure, electric grid, energy pipelines, water supplies, mass transit, nuclear power plants or breaking into government and private servers, but it can be used (as in Ukraine) to guide autonomous drones or missiles that can attack targets with or without human supervision or control.

Our cultural environment must also be protected. The time has arrived for another Geneva Convention to set the legal limits for the allowable use and applications of AI. Global institutions, regulations and enforcement structures are needed to protect us from Orwell's Big Brother or from Vladimir Putin, who said, “Whoever masters AI will become the ruler of the world.”

'Truthless' culture can't fight climate change

Global warming represents an existential risk for us all and we can't stop it without a total global effort. Yet, a global effort can't be waged if societies can be brainwashed to the point where their confidence in the judgments of their own scientific institutions and even in their democratically elected leaders is destroyed. The worst consequence of Putin's war is that it distracts attention and resources from fighting climate change. It creates an atmosphere in which our resources aren't invested in financing the conversion into a solar-hydrogen energy economy, but are wasted on buying weapons and on paying skyrocketing prices for oil and gas.

In this truthless age, it's possible to call natural gas (a greenhouse gas more powerful than carbon dioxide) a "transitional fuel," or promote electric cars, as if their batteries weren't recharged by coal-burning power plants. It's also possible for a single U.S. senator to make millions of dollars by keeping coal-burning power plants in operation, or make it possible for an ex-chancellor of Germany to make millions by supporting the northern gas pipeline that keeps Germany hooked on Russian natural gas.

Fortunately, I also know that the "Putins of history" can't stop progress. I'm optimistic because the educated young of today understand what it will take to get rid of fossil fuels and convert to a solar-hydrogen energy economy. I also know that, even if individually we feel as powerless as snowflakes, together we can create an avalanche that erases this truthless age. ∞

CSIA members support integrators in Ukraine

Autoware calls on system integrators to donate time to fellow professionals

THE Control System Integrators Association (CSIA, www.controlsys.org) reported Apr. 28 that its members are seeking ways to help their fellow SIs and end users in Ukraine, who are trying to keep processes and plants running despite the continuing devastation caused by Russia's recent invasion.

CSIA members and counterparts from the Manufacturing Enterprise Solutions Association (MESA), International Society of Automation (ISA) and other participants worldwide attended a webinar on Apr. 13 about the Professionals4Ukraine initiative, learned about the state of its industrial and system integration market, and heard from SIs who desperately need support.

“Some of the SI companies on the webinar had offices in Kyiv and Mariupol. Those cities were heavily bombed, so they had to relocate because their offices were destroyed,” said Luigi De Bernardini, CEO of Autoware S.R.L. (www.autoware.it), a CSIA-certified SI in Vicenza, Italy. “A man from one of the SI businesses, who was presenting his company’s projects told us he is back at work after finishing three weeks serving in Ukraine's army. They fight for a period, then return to their business, so you can imagine how terrible it is for these people. They have to bomb and kill people, and then go back to work.”

Give time during wartime

CSIA is also encouraging its members to provide humanitarian support to Ukraine. For example, Autoware is also piloting its One Hour for Ukraine (1H4U) program, which encourages its staff to donate work hours. Their contributions are matched twofold by Autoware, which makes periodic donations to the Association of Industrial Automation of Ukraine (appau.org.ua/en).

Bernardini added the intention is for other SIs to replicate its model or assist Ukraine however they choose. “All of us were touched by what's happening in Ukraine,” said Bernardini, who's also a past CSIA board chair. “We Europeans are probably more sensitive since it's happening so close to us and we can sometimes feel powerless.

Alexandre Yurchak, CEO of the Association of Industrial Automation of Ukraine, added, “It's a big honor and a great opportunity for our community to have such a relationship with CSIA. Our best engineering companies and system integrators are ready to work with their counterparts around the world. And we really need this work as never before."

Yurchak has led the Ukrainian side of the SIs' collaboration as part of his efforts to help his members deal with their wartime economy. “What we appreciate even more is the friendly and fast response of CSIA to our situation," added Yurchak. "It shows a new kind professional solidarity that drives our community to be together and hold the line on the economic front.”

Relationships for rebuilding

In addition, CSIA's board voted unanimously Apr. 19 to award complimentary memberships for 2022-23 to the Association of Industrial Automation of Ukraine. “Our goal is to provide the space for Ukrainian members to network with other CSIA members and explore possible outsourcing opportunities,” said Jose Rivera, CEO of CSIA. “The war in Ukraine has disrupted regular local peacetime work opportunities. This contrasts with the explosive business growth benefiting SIs in many other locations. Outsourcing can also help other SIs alleviate the serious talent shortages they're experiencing,”

Beyond outsourcing, CSIA hopes its new relationships will help Ukraine's SIs rebuild their industries. “Several Ukrainian SIs and engineering companies have worked with Western companies and delivered projects beyond their borders,” noted Rivera. “A few have offices in Germany, the U.S. and the United Arab Emirates. Language doesn't create a barrier.”

Bernardini added, “Everyone has their own reasons for supporting the Ukrainian people. Where I believe we have a lot of room to improve is in leveraging the power of our professional associations and acting as professionals supporting colleagues. That's why we decided to donate time and effort and not just money. If our colleagues in any part of the world are in trouble, we can help as professionals. This is something that I don’t see happening many times, and I thought this was a good opportunity to start. If we put our efforts together, we can do a lot. From professionals to professionals!”

Emerson achieves first FDI host registration

FieldComm Group (www.fieldcommgroup.org) announced Apr. 27 that Emerson’s AMS Device Manager software has successfully completed conformance requirements testing under the group's Field Device Interface (FDI) Technology Host Registration Policy. This makes AMS Device Manager the first FDI host system to earn the right to display the FDI registration logo in product marketing materials.

By pairing a registered FDI device package with a registered FDI host, users are assured of achieving multi-vendor interoperability, fulfilling FDI's promise of “One Device–One Package–All Tools.” In practice, this means any HART device supporting FDI will communicate seamlessly with AMS Device Manager and with future host systems as they become registered.

“This is a monumental achievement for FDI technology and Emerson,” said Ted Masters, president and CEO of FieldComm

Group. "So far, we've registered more than 100 FDI device packages. However, the requirements for host registration are extremely rigorous to ensure compatibility among devices and hosts, making this advancement by Emerson very significant."

Registration is conformance

There are several steps required when preparing host systems for conformance testing against current standards. An FDI host must conform to at least the HART protocol test specification for host systems as well as the FDI specifications. FieldComm Group claims end users benefit because FDI is the preferred path to digital transformation in the process industry, and conforming host systems provide everything needed to advance existing HART process automation infrastructure into the 21st century, while delivering the latest offerings of new instrumentation with data rich FDI device packages.

"End users and automation suppliers benefit from host registration. Similar to the current device registration process, host registration strengthens interoperability and device integration," said Stephen Mitschke, director of standards development and technical services at FieldComm Group. "Facets covered in the test specifications include FDI UIPs, menu layouts and offline configuration. The suite of host test specifications encompasses FDI and HART with more than 1,100 test cases combined."

Oracle, Festo open skills lab

Oracle (www.oracle.com) and Festo Didactic (www.festo.com) joined forces Apr. 29 to open the 30,000-sq-ft Oracle Industry Lab in Chicago. The facility provides hands-on, simulated industry settings that let users experiment, learn, and develop technologies.

For instance, lab visitors can interact with Festo's Learning Factory, which is used worldwide in training and workforce development programs. It models Industry 4.0 production facilities, and provides students with a holistic platform for understanding smart manufacturing. The Learning Factory's automated machines use sensors, controllers and software to produce "Lot size one" simulated cell phones. Students learn and follow the process from order entry through production and distribution. ∞

SIGNALS AND INDICATORS

- **Harting** (www.harting.com) reported April 21 that the new edition of IEC 61918:2018/AMD1:2022, Amendment 1, "Industrial communication networks—installation of communication networks in industrial premises" (webstore.iec.ch/publication/74769) was published in March 2022. It describes installing communication networks in industrial plants, machines and automation islands, and this version covers cabling structures based on single-pair Ethernet (SPE).
- **UniversalAutomation.Org** (UAO, universalautomation.org) welcomed **ExxonMobil** (www.exxon.com) as a member on Apr. 27. The company is using the IEC 61499 runtime platform/environment as part of its Open Process Automation (OPA) test bed. Their collaboration will enable development of portable, interoperable, plug-and-produce solutions.
- To meet increasing demand, **Galco Industrial Electronics** (Galco.com) celebrated the grand opening on Apr. 26 of its new product distribution center that's twice as big as its predecessor and also located next to its global headquarters in Madison Heights, Mich. The new facility accommodates Galco's growing inventory, which includes more than 350 authorized product lines from more than 670 brands.
- **Endress+Hauser** (endress.com) reported Apr. 29 that it's expanded its center of competence for pressure sensors in Stahnsdorf, Germany, near Berlin, by adding a more than 12-million-euro production hall to its existing facility. The addition doubles the site's floor space to just under 11,000 m^2.
- **PTC** (ptc.com) announced Apr. 20 that it's agreed to buy **Intland Software** (intland.com) for approximately $280 million. Intland produces Codebeamer application lifecycle management (ALM) software.
- **Bentley Systems Inc.** (www.bentley.com) announced Apr. 7 that it's acquired **Adina R&D Inc.** (adina.com), which develops finite element analysis software for diverse engineering fields. Adina was founded in 1986 by Dr. Klaus-Jürgen Bathe, professor of mechanical engineering at the MIT.

FDT for the Industry 4.0 era

STEVE BIEGACKI
Managing Director,
FDT Group

FDTGroup.org

THE FDT integration standard first came into being as a means to deal with all aspects of device configuration and diagnostic data generated by smart process instruments—and to help end users better manage a diverse range of increasingly intelligent assets. And while FDT originally stood simply for "Field Device Tool," over the past 20 years it has evolved in both scope and functionality.

In its current iteration as FDT UE, for Unified Environment, based on FDT version 3.0, it provides a platform-independent, web-enabled environment for managing and monitoring instrumentation and all manner of Industrial IoT devices across process, hybrid and discrete manufacturing domains. To better understand the ongoing evolution of FDT and its increased relevance in the age of Industry 4.0, *Control* caught up with Steve Biegacki, FDT Group managing director.

Q: FDT is viewed as the *de facto* industry standard for industrial device integration, configuration and monitoring with millions of DTMs, or Device Type Managers, delivering data access to FDT host environments via FDT 1.2 and 2.0 iterations of the standard. How can users be confident that the current FDT 3.0—the foundation for FDT Unified Environment—is the right standard for Industrial Internet of Things (IIoT) and Industry 4.0 applications?

A: One of the biggest reasons is that the Unified Environment—and FDT 3.0 on which it's based—were developed centered on user input. It's not a vendor-driven standard; the requirements came from the user community. As a result, FDT UE represents an open, future-proof architecture for not just process instruments but for the IIoT. Older versions of the standard operated more like a digital screwdriver, providing a single user view and the ability to configure process instruments. But the new FDT UE is a server-based, distributed architecture that's operating system, device and network connection agnostic. It enables true integration of diverse products from multiple vendors across multiple networks using digital tools based on a variety of operating systems.

Central to the FDT UE offering is a server that effectively glues the IT and OT worlds together. On the "top" side are services that speak OPC UA to IT systems, as well as web services (such as HTML5) to mobile devices. And on the "bottom" side are services that speak the full range of OT field network protocols needed to communicate with today's mix of instruments and IIoT devices.

Another challenge we heard about was how many different places users had to go to find DTMs (Device Type Managers) for their different devices. Users want an experience that today more closely resembles connecting a PC to a new printer. So, FDT*hub* provides a behind-the-scenes repository of all the necessary DTMs that contain all the device parameters. When a new device is connected, the necessary DTM driver and other parameters are automatically and transparently installed. It's just a much more contemporary way to approach things.

Q: How do end users go about bringing legacy systems forward to FDT UE, and what's the value proposition for doing so?

A: One of the great things about FDT's legacy is that there are tens of millions of DTMs installed out there, devices designed to communicate according to FDT 1.2 or 2.0. The good news is, as people see benefits in moving forward to the Unified Environment, all those DTMs out there today will work in the new environment. You don't have to change out the devices to have them work. Then, it's up to the user to decide when they want to take advantage of mobility or the enhanced security that's part of the Unified Environment. So, nobody is forced to do anything. It's a migration path that makes new things possible—and can be pursued when the time is right.

Q: Integration, configuration and monitoring are some of the core strengths of FDT. How do these features differ, or how have they evolved with FDT UE?

A: One of the most noticeable changes is to the user interface. It's now browser-based, allowing a common, consistent look-and-feel no matter what type of device you're on. So, if you have a maintenance person out in the field with a tablet and somebody back in the control room looking at the operator console, they're going to see the same information in real-time. The new FDT UE standardizes mobility.

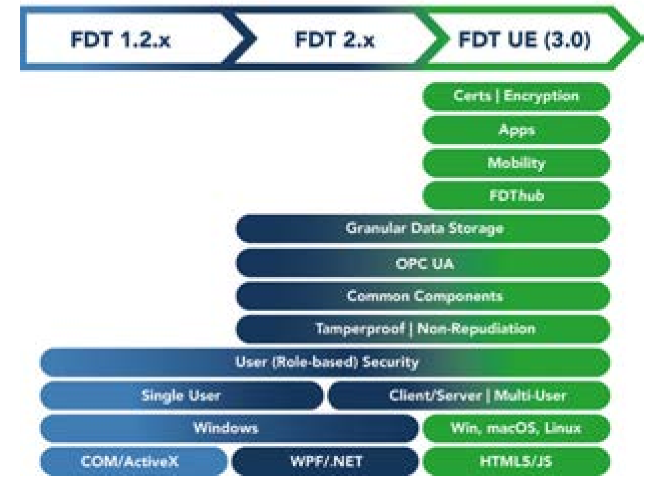
I think the other big difference is that data coming from the devices themselves is now more readily available to the IT world. The FDT Server includes an embedded OPC UA server and OPC for FDT Universal Information Model that can publish and serve uniform data to higher-level systems used for asset management, manufacturing execution or other purposes. Live FDT data can also be served to other applications such as AI-assisted analytics.

Q: FDT's original market sector of focus is process automation, where integration, configuration and monitoring are central concerns. Are there other strengths of FDT that make it appealing to factory automation environments?

A: We focused on three areas with specific relevance to factory automation in the 3.0 specification for end-users as well as device developers in this arena. One is a focus on configuring intelligent devices used in factory automation, via intelligent photo-eyes or variable-frequency drives, for example. We can provide DTMs that describe how those devices work. We also enable hybrid environments where process and factory automation systems work together. The third area is configuring devices that are independent of any network or device representation. The standard now addresses a whole alphabet soup of different data descriptors created by other standards at one time or another. So again, truly providing a unified environment.

Q: When specifying a universal device management solution as part of a project, how do users go about specifying FDT UE when requesting proposals?

A: It's actually pretty simple. As they do their design work, they should specify that they'd like their devices and/or their system to be FDT 3-compatible to get the benefits of the UE environment.



FDT TECHNOLOGY EVOLUTION
Since its advent 20 years ago, the FDT standard has evolved from a single-view "digital screwdriver" focused on device configuration and diagnostics to a server-based device management and IIoT platform that is device, network and OS agnostic.

Q: Some of FDT Group's messaging is that FDT UE "empowers innovative business models for smart manufacturing." All buzzwords aside, what does this really mean to system and device vendors? And what are the innovative outcomes for end users?

A: First, the FDT Unified Environment allows device vendors to provide more services and more value to their end-user customers. The vendors themselves can facilitate predictive analysis based on the health of their devices, and be more proactive about helping users manage plant uptime and utilization. From an end-user standpoint, they can now use DTMs to shorten the cycle time from system concept through design and operations. Plus, they can use a device's DTM to effectively model its performance before they buy a piece of hardware. Building a digital twin based on DTM data can help optimize system designs and bring them to reality more quickly. ∞

Great Expectations

As the supplier community finalizes Ethernet-APL conformance tests and readies products for market, P&G puts early devices through their paces

BY JIM MONTAGUE

MANY businesses and industries scaled back or shut down during COVID-19, but consumer packaged goods (CPG) didn't, and often expanded operations because so many people spent more time at home during the pandemic and needed more CPG products. As one of the world's CPG cornerstones, the Procter & Gamble Co. (www.pg.com) also needed to maintain and frequently ramp up production to meet recent increases in demand.

"We generally performed well during COVID-19. We kept our staff safe, continued serving consumers, and contributed to our communities," says Paul Maurath, technical section head, Power, Control and Information Systems, Corporate Engineering Technologies, P&G. "This means relying on many types of automation for operating sophisticated, high-speed machines and packaging equipment for bottles, boxes and bags."

To continue accomplishing its performance objectives, Maurath reports P&G began talking 18 months ago with its suppliers that are members of the Ethernet-Advanced Physical Layer (APL, www.ethernet-apl.org) organization about developing an Ethernet-APL demonstration project at the company's Corporate Engineering Technology Lab (CETL) in West Chester, Ohio. The demo was implemented on the lab's Smart Process Cell (SPC), which researches and evaluates pressure, temperature, flow and other process technologies.

"We asked them to show us what they had, began installs in late 2021, and have a system that's been up and running for a few months," says Maurath. "We're planning on sharing what we learn, including how to address challenges for the global supply chain, and what other users need to implement Ethernet-APL technologies."

Maurath presented "It's not enough to be smart: a user's perspective on smart process instrumentation and networks" on the second day of the ODVA Industry Conference and 21st annual meeting on March 10 in San Diego.

Networks fall short

Maurath explains that he and his P&G colleagues were inspired to investigate Ethernet-APL to improve on the capabilities of existing process instrumentation networks in CPG applications. These networks are typically:

- Dominated by conventional I/O that's highly distributed on an Ethernet backbone;
- Employ discrete, simple, on/off devices;
- Provide widely available HART protocol for analog devices, though it isn't used much; and
- Usually run on an isolated private network.

"Ethernet is becoming more important, penetrating further down into network architectures, and taking over distributed I/O, all kinds of drives, and complex, multivariable, four-wire instruments," says Maurath. "We commonly have applications of this scale that include maintenance systems. They typically have about 80 devices, 25 flowmeters and 25 drives, as well as remote I/O, HMI, controller, historian, server, load cells and numerous switches."

Maurath adds that P&G also wanted to investigate Ethernet-APL because "smarter" devices such as Coriolis flowmeters, pH transmitters, radar level gauges and pressure transmitters have more data to share, more upper-level

P&G TESTS ETHERNET-APL

Figure 1: The Ethernet-APL demonstration on the Smart Process Cell (SPC) at Procter & Gamble's CET lab in West Chester, Ohio, includes four tanks from 375 to 500 kg, six pumps with flowmeters, and three units performing continuous and batch operations. It runs water as its process fluid, and it's completely self-contained and remotely operated.
Source: ODVA and P&G

ETHERNET-APL: THE SUPPLY-SIDE UPDATE

BY KEITH LARSON

It's been almost a year since the final specifications for the Ethernet Advanced Physical Layer (Ethernet-APL) standard were announced, and the supplier community—which is represented by the 12 instrumentation and control system supplier and four standards development organization (SDO) members of the Ethernet-APL Project—have made substantial progress towards their ultimate goal of creating an ecosystem of commercially available instrumentation, infrastructure and host devices, which can work together to make the promised benefits of the new field network a reality.

That said, things haven't proceeded as quickly as one might have hoped, in no small part due to the same constrictions in silicon and printed-circuit-board supply chains that have plagued other sectors of the global economy. Further, as of press time, only the necessary protocol conformance tests for HART-IP had been finalized, and were still under development for Profinet and EtherNet/IP.

And beyond protocol testing, new Ethernet-APL products must also clear independent intrinsic safety certification for deployment in hazardous environments, another hurdle likely to add months to a new product's formal release cycle. Switch suppliers (for whom protocol considerations are secondary) including Pepperl+Fuchs, Phoenix Contact and R. Stahl are early out of the gate with announced products. Meanwhile, progressive users such as P&G and BASF are kicking the tires primarily on prototype products; supplier members of the Ethernet Project, too, are freely swapping prototype products to verify interoperability as well.

Despite the hurdles, supporting suppliers and SDOs have planned an ambitious, coordinated display at this summer's ACHEMA trade show, to be held Aug. 22-26 in Frankfurt, Germany. Endress+Hauser, for example, intends to display its first portfolio of commercially available products to be released yet this summer. Included are eight flow, level, temperature and pressure instruments as well as Ethernet-APL support for its FieldCare, Field Xpert and Netilion system offerings.

systems such as maintenance and data analytics want that information, and they all need more effective networking to do it. Likewise, many on/off valve controls are networking with IO-Link (io-link.com) field device protocol and delivering even more data.

"However, these key process industry needs aren't met by mainstream, IT-based Ethernet technologies," says Maurath. "We see random shutdowns caused by communications failures, which are traced to places where Ethernet cables that got into places that were too tight, and were bent and damaged. We need multi-conductor wiring that isn't so fragile, longer distance cabling that doesn't have to be fiber-optic, and wire than can better serve loop-powered devices and in electrically classified areas."

APL to the rescue

Because it was developed as single-pair, two-wire, intrinsically safe standard, Ethernet-APL can fulfill process industry requirements for twisted-pair cabling, deployabilty in electrically classified and hazardous areas, reaching longer distances, easier-to-handle technology, connectors for harsh conditions, and loop-powered devices. Ethernet-APL is based on IEEE 802.3cg-2019 for 10BASE-T1L, IEC 60079 and IEC61158 standards, and is independent of communication protocols.

These capabilities allowed P&G and its partners to design an architecture for their Ethernet-APL demo on the smart process cell in the CETL, learn what's needed to implement and maintain Ethernet-APL, and assess its potential benefits for the company. The SPC demo's equipment includes four tanks from 375 to 500 kg, six pumps with flowmeters, and three units performing continuous and batch operations. It runs water as its process fluid, and it's completely self-contained and remotely operated, so users can check on it from their desks or from home (Figure 1).

Maurath adds that P&G also wanted to use the demo to learn about:

- Basic installation and wiring of Ethernet-APL switches and instruments;
- Instrument configuration and replacement;
- Network and switch configuration and management;

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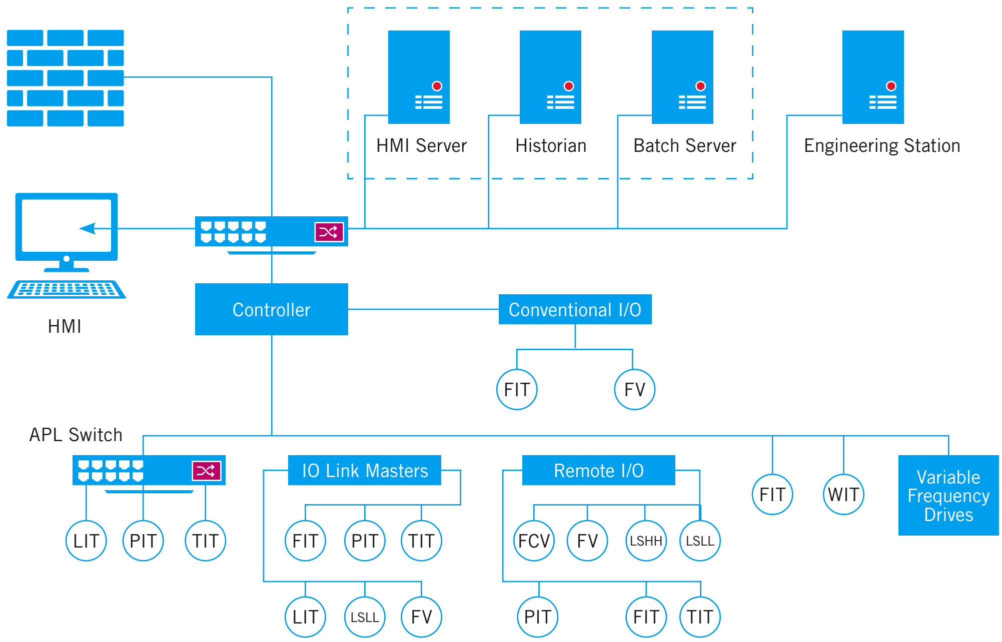


APL INSTRUMENTS, FIELD SWITCH ADDED

Figure 2: P&G's Smart Process Cell already had a controller, HMI and server, historian, batch server, engineering station, conventional and remote I/O, and variable frequency drives. Its new items consist mainly of an Ethernet-APL field switch and many more IO-Link devices, which can bring in added radar level, pressure and temperature modules. Source: ODVA and P&G

- Interoperability between switches and instruments from multiple vendors;
- Instrument update rates and impact of faster communications compared to HART;
- Access to multiple variables and diagnostic information;
- Potential impact of higher power availability when converting from four-wire components to two-wire; and
- Comparing Ethernet-APL to other protocols such as 4-20 mA HART and IO-Link.

"We did a similar demonstration project a few years ago to evaluate Foundation Fieldbus, and we did a hands-on build, but concluded it wasn't a good fit for our processes," says Maurath. "APL is attractive because of its speed compared to HART. Plus, we can get more power by converting to two-wire Ethernet from four-wire devices, and it can also interact with 4-20 mA HART and IO-Link. For example, if we're trying to get an echo curve from a radar level transmitter, it takes HART a long time to get that curve back, but it's a lot faster with APL."

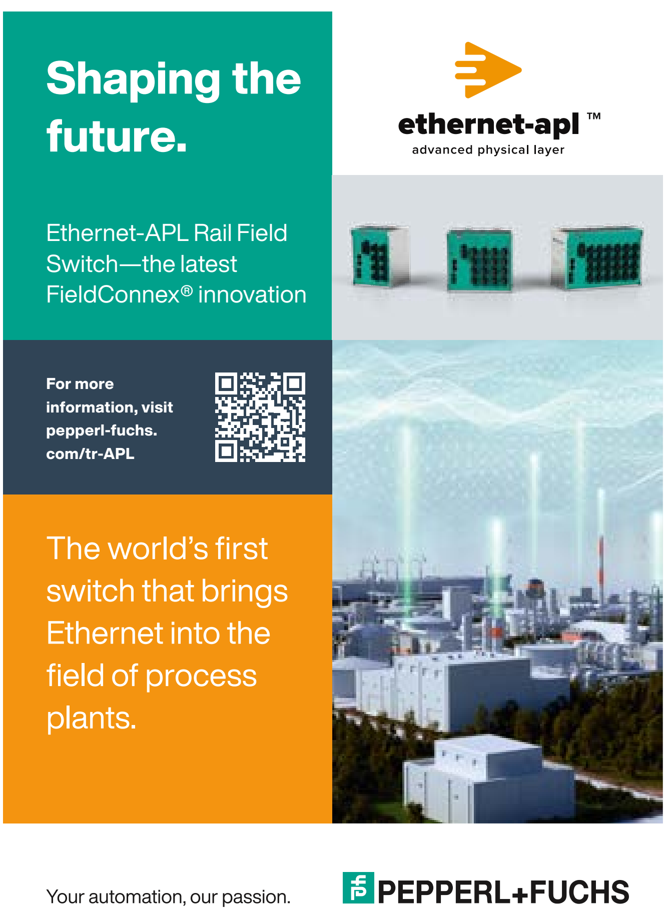
While much of the SPC's automation network is the same as it was in 2019, implementing Ethernet-APL meant deploy-

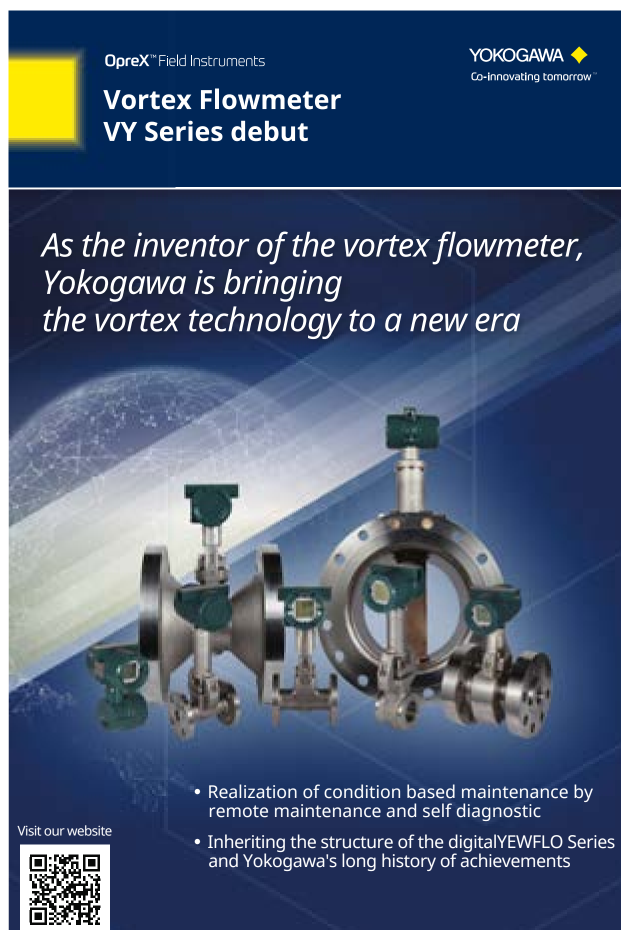
ing several new components. The SPC already had a controller, HMI and server, historian, batch server, engineering station, conventional and remote I/O, and variable frequency drives. Its new items consist mainly of an APL field switch and many more IO-Link devices, which can bring in added radar level, pressure and temperature modules (Figure 2).

"The SPC has the same types of full-sized flowmeters and level, pressure and temperature devices that we use in regular operations," says Marath. "Our initial benchtop tests used EtherNet/IP for communications, which were established with the SPC's existing controller after importing EDS files. We found that the biggest barrier was assigning Internet protocol (IP) addresses. We also 'bricked' three prototype devices, so they had to be sent back their manufacturers."

Smart cell demo results

Maurath reports that field tests on the SPC included straightforward wiring, replacing 4-20 mA HART instruments, and parallel testing of multiple IO-Link devices. "We found that Ethernet-APL was completely 'invisible' to the controller, and that





devices on the network looked like any other EtherNet/IP devices," says Maurath. "We learned that basic, robust wiring was the best approach. And, overall, our result with Ethernet-APL is that it works, and does what it advertises."

Maurath adds that P&G was pleased with what it learned about installation and wiring between Ethernet-APL switches and instruments, and interoperability between components from different vendors. It was also happy with its access to multiple variables and diagnostic information. However, results were mixed on instrument update rates and the impact of faster communications compared to HART. The jury is still out on its other learning objectives

Help wanted with complexity

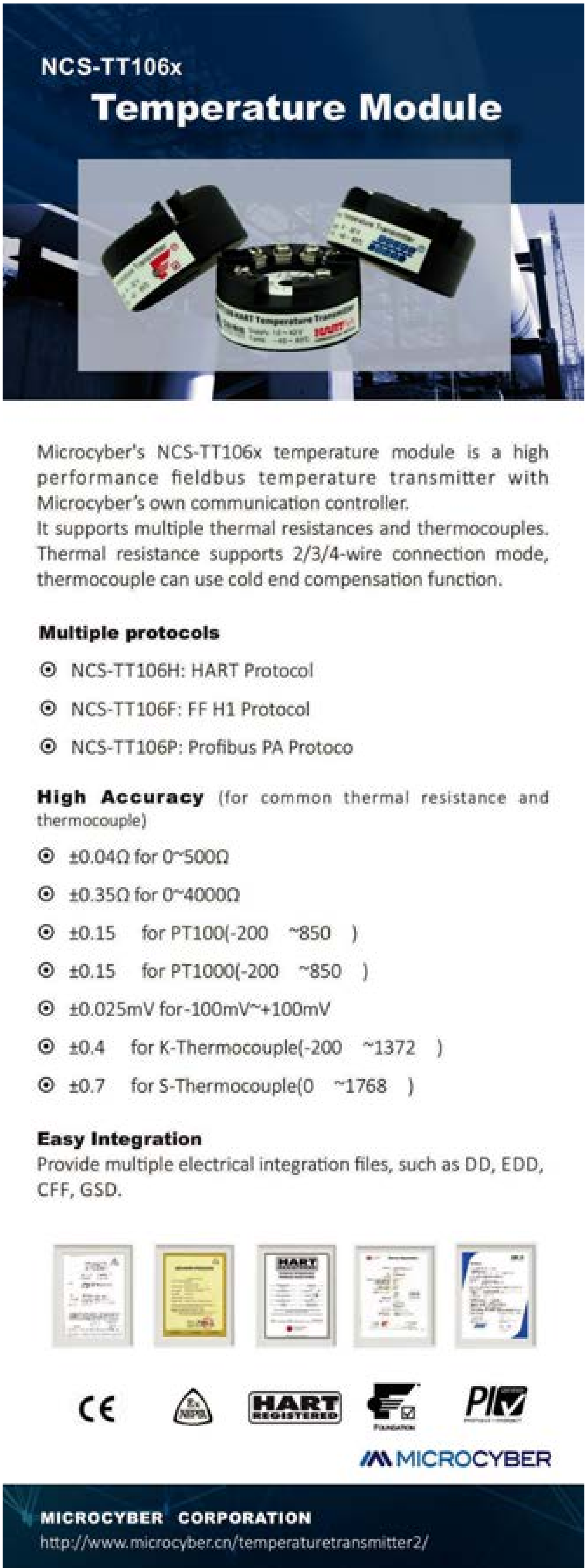
The SPC demo of Ethernet-APL at P&G also revealed some added challenges and tasks for the protocol and its developers.

"We couldn't always get the access we needed when we put EtherNet/IP on top of the network, so sometimes we had to use a laptop PC to connect to the local subnet, and use specific HART IP connections. However, many of these devices are prototypes, so their issues will likely get straightened out later," explains Maurath. "My greatest request as a result of our demo project is 'help us manage complexity.' "

For example, if E&I technicians on the 3 a.m. Sunday shift at P&G have a problem with a regular 4-20 mA device, they can do a lot to handle it with their usual hand tools, digital voltmeter (DVM) and HART communications. However, if they're working with a smart device, they may have to deal with items they're not prepared for, such as Internet protocols like BootP or dynamic host configuration protocols (DHCP), I/O device descriptions for IO-Link, electric data sheets (EDS), device profiles, firmware revisions and data models.

"Many of these issues can't be dealt with until Monday, which means the plant manager will be unhappy, " says Maurath. "This means it's unlikely these technologies will get used again."

Likewise, when replacing a 4-20 mA HART pressure transmitter in the field, the old one is removed, the new one is connected, and its range is configured. Meanwhile, the application/controller loses its connection to the old transmitter, gets a valid connection to the new one, checks scaling and begins to get

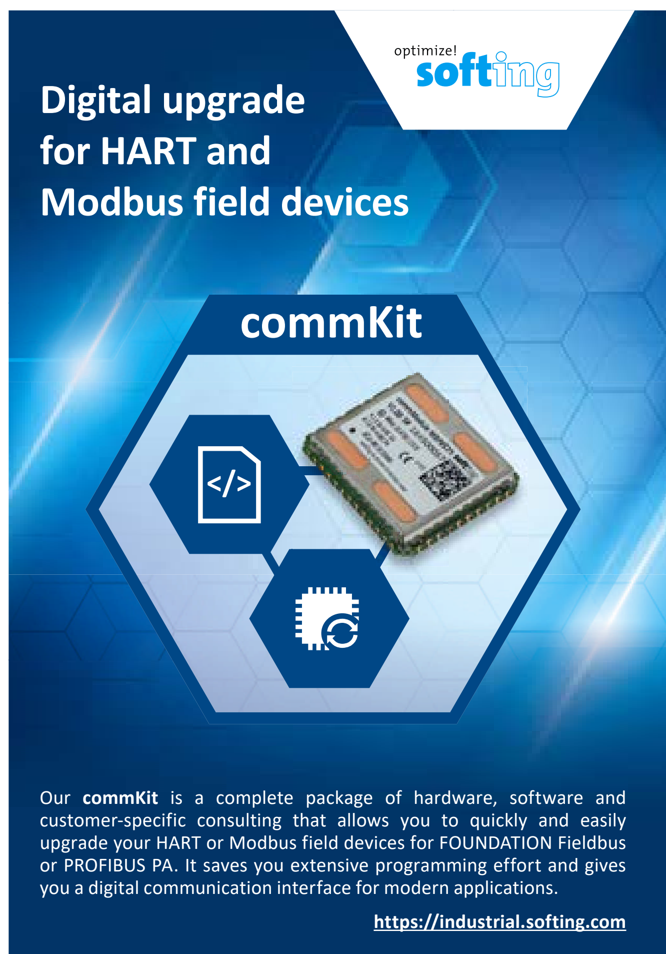


a valid signal from it. "Once the controller sees the new device and checks scaling, variables can be set in the new transmitter, and the process can be back up in a short time," adds Maurath. "Most importantly, the E&I tech can do all this with existing tools, and know the new device probably works."

However, replacing a smart pressure transmitter or other device linked to and communicating via EtherNet/IP or IO-Link still means removing the old device and connecting the new one. However, its communications must also be configured, and this means making answering several new questions:

- How does the new device communicate?
- Is its new configuration file available?
- Does the controller have to be restarted or reloaded to reach the new device?
- Is the data structure the same for the new device, or does application code have to be changed?
- How long will it take to get these tasks done and get the process back up?

"To add or replace smart devices, users have to configure communications and do a lot of other steps, such as adding IP



addresses, or finding out if they need a new configuration files or EDS, and they can't really be sure it works until they do," explains Maurath. "If a new device was in storage, can it use the same firmware, or is a revision needed? Or, what level of change is needed for it to reach the controller? Were the names of key variables changed in the firmware revision? And, what skills do the E&I techs need to perform these installations and complete these configurations, so they can get up and running?"

Reduce configuration confusion

Maurath reports that P&G and other end users need help with communications, notably IP address assignments, which includes how to handle DHCP, BootP, local displays, dip switches and selector wheels. They also need assistance with EDS, IODD and other configuration files and drivers, as well making it easier to replace "like for like" components.

"Assigning IP addresses is a pain, but it's even more of a problem for E&I techs on that 3 a.m. shift," he explains. "They may have a laptop PC, but if it doesn't have the files they need for a new device, they're dead in the water. It's got to be made easier than it is today to import files and get them to live in the controller."

Maurath adds that configuring smart transmitters and other devices is also confusing because there are so many ways and places to do it, such as on local displays, field communicators, controller programming software, asset management systems or web-based interfaces. "Do they all show the same information? Not today. So who has the master copy?" asks Maurath. "There's no easy way for controllers to upload configurations for field devices. Consequently, if a technician adds a filter to a device, a master controller may come along later and wipe out those changes.

"We have a lot of fog-type computing at P&G with local VMware servers or stacks, so we're aware about the move to cloud computing and less controller-centric applications that use different protocols," adds Maurath. "Smart devices are complicating our world, so it's critical for us to have standards that allow them to work together despite their alphabet soup of protocols. The market will decide which standards succeed, but we still need simple, functional technologies that are easier to implement, maintain and migrate over time." ∞

SURF'S UP, POWER UP

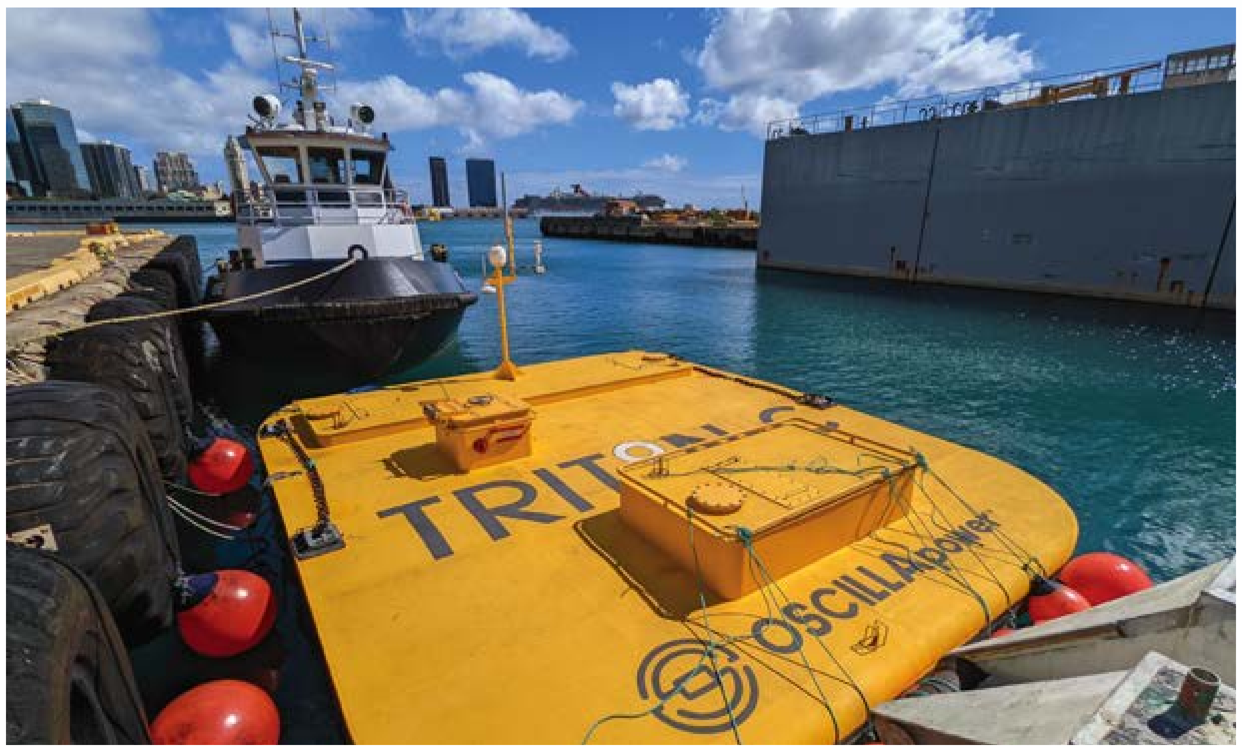
Oscilla's wave energy converting vessel uses cable-driven generators and motor-control algorithms to capture power for use onshore

by Jim Montague

THE natural world produces vast amounts of power, but as usual, the trick is capturing and converting it for people to use. This used to mean extracting and burning hydrocarbons, but even though human civilizations are moving to alternative energy sources, this underlying challenge remains the same. Wind and solar, and even nuclear and geothermal, must each be tamed, controlled, managed in their own ways, and made accessible to overall grids and consumers. Even an emerging source like wave energy conversion (WEC) is no exception to this rule.

For instance, many players have tried to generate electricity from offshore waves in much the same way that today's wind farms produce power from prevailing winds. However, increasingly sophisticated process controls are needed to make these sources as efficient and consistent as their fossil forebears.

One of the most promising of these proposed solutions is by Oscilla Power (www.oscillapower.com) in Seattle. It's developed a WEC system with six degrees of freedom, which can harvest energy by using the relative displacement between a floating vessel on the surface and a submerged, stable, inertial ring. These two parts are connected by three tendons that rotate internal drums as the vessel moves up and down on the waves, turning generators to produce electricity that can be delivered onshore. While similar devices only have two degrees of freedom and only move vertically, this new 33 x 25 foot (10 x 7 meter), 100-kilowatt (kW) Triton-C prototype from Oscilla can move in X, Y and Z planes, and capture energy from pitch, roll, yaw, heave, sway and surge (Figure 1).



VOLTAGE VESSEL

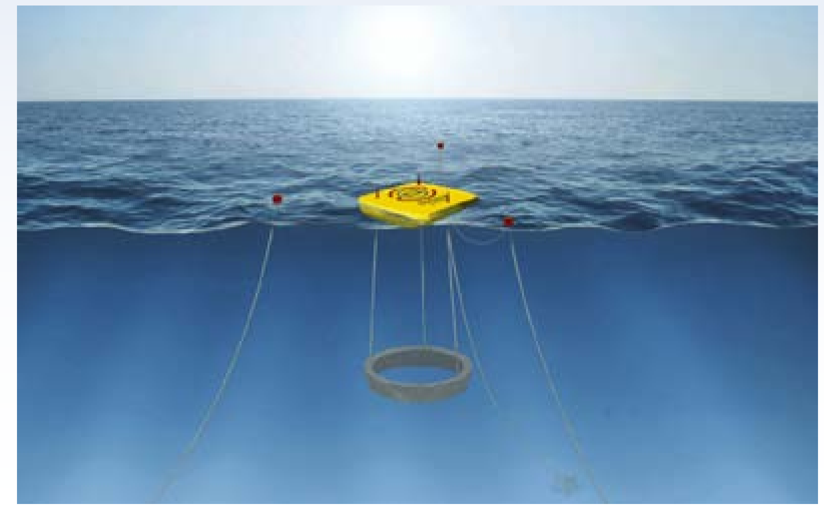
Figure 1: The 33 x 25 foot Triton-C wave energy converting (WEC) vessel waits in the water in Honolulu to be towed to its testing site in nearby Kaneohe Bay for a yearlong trial. Developed by Oscilla Power, Triton-C can move in six degrees of freedom and uses three generators to turn wave energy into 100 kilowatts (kW) that can be delivered to an onshore grid. A future system is expected to provide 1 megawatt (MW) to utilities and users. Source: Oscilla Power

Triton-C was launched in Honolulu harbor last October, and is currently completing final integration. It's expected to be installed soon at its offshore site in nearby Kaneohe Bay for a yearlong trial. Experimenting with the prototype is expected to give Oscilla the data and experience it needs to build a larger, 1-megawatt (MW) version of Triton that can deliver utility-scale power.

Finding the rhythm

Oscilla was inspired to pursue Triton because more than 70% of the Earth's surface is covered by water, and waves are a potentially enormous source of renewable energy. It cites estimates by the U.S. Energy Information Administration (www.eia.gov) that the theoretical annual energy potential of waves off the U.S. coasts is as much as 2.64 trillion kWh, which is the equivalent of about 64% the electricity generated by the U.S. in 2019.

"The architecture we're following is the well-known, two-body point absorber, which has the advantage of surviving better in storms because it's more independent of water depth. However, we're adapting this concept by using three tendons to connect the two bodies, which makes Triton a multi-mode absorber," says Tim Mundon, CTO at Oscilla. "We've shown this concept to be highly efficient at extracting energy, and we've incorporated a survival strategy that allows Triton to submerge and be protected in the case of large storms."



CABLES TO STABLE RING

Figure 2: Triton-C harvests energy by using the relative displacement between a floating vessel on the surface and a submerged, stable, inertial ring. These two parts are connected by three tendons that wrap around drums and drive three generators. Generators and drive controllers are managed by an on-vessel Simatic S7 PLC with an IPC and customized optimization algorithms. Power is conditioned with supercapacitors, inverters, and onboard battery. All these parts combine to provide up to 100 kW of regular, steady-state 720 VDC to shore. Source: Oscilla Power

Ocean current to electric current

To maintain six degrees of freedom and operate as a multi-mode WEC, Triton's three tendons are mechanically connected to the vessel floating on the surface, where they're wrapped around three drums that turn as the vessel moves in relation to the ring below. However, this arrangement isn't enough to produce electricity, so each winch is also connected to a hydraulic system with gas bottles, which applies a constant torque to each winch and cable. This constant torque supports the ring hanging below, so that as the waves move the vessel, it causes a changing torque on the drum and drives three permanent-magnet generators to produce power. The generators are controlled by velocity, while the hydraulic system is also tunable, and the system can autonomously change parameters to those that provide the best performance in different conditions (Figure 2).

Not surprisingly, Triton's drums, hydraulics, generators and power electronics require some sophisticated coordination and management for motion control, motion-to-grid conversion and supervisory control. Oscilla began working several years ago with Applied Control Engineering (www.ACE-net.com), a system integrator in Newark, Del., on defining the control system requirements for its base architecture. ACE developed the control and configuration design for Triton, as well as its high-availability, secure communications network.

"Triton is controlled by a PLC system from ACE, which includes a central, on-vessel PLC in a central cabinet and three remote, satellite cabinets, one for each drivetrain. The PLC is updated on a sub-second basis to make sure the right amount of torque is applied to each of the three generators and their cables," explains Mundon. "This system uses fast lookup tables and fast communications for specifying values and applying them quickly. Triton wouldn't be able to function without these controls."

For its Triton-C prototype, ACE implemented a Simatic PLC with Totally Integrated Automation (TIA) and WinCC RunTime Professional front-end software from Siemens (www.siemens.com). This control platform also includes hardwired communications with a cellular backup. A single Simatic industrial PC (IPC) collects data every 20 milliseconds, gathers historical information, performs local visualization, and mirrors its data onshore for backup purposes and easier access.

Controlling the generators

To further manage each of the three generators and the power coming from them, Oscilla also worked with Siemens Digital Industries (SDI) and the company's OEM division, and with system integrator Applied Motion Systems (AMS, appliedmotionsystems.com) in Vancouver, Wa., which is also a Siemens solution partner.

"These generators can produce large peak currents during energetic sea states, and these peaks are interspersed with periods of inactivity when no energy is produced. Peaks are captured in a super-capacitor bank combined with lithium-ion battery storage. The batteries operate at 310 VDC for local power needs and smoothing of export power" says Ken Brown, founder and CEO of AMS. "Power is exported to shore at a steady-state 720 VDC. This will let the Triton-C prototype deliver a maximum of 100 kW continuous to the grid onshore, while the full-sized Triton being developed will deliver about 1 MW to shore."

Brown reports that Siemens inverters manage power from the generators by way of a Sinamics CU320-2 drive controller. This controller manages inverter commutation algorithms, current (torque) limits and generator velocities for maximum energy production for any given sea state. A second controller manages WEC auxiliary loads and vessel monitoring tasks. These controllers also interface with the vessel's SCADA system developed by ACE where they report vessel and power system status.

"The super-capacitor bank stores a huge amount of energy, so it's important to make it and Triton safe during maintenance operations by discharging this energy in a controlled fashion. This is managed using large resistors and fans to dissipate energy when needed." explains Brown. "Meanwhile, the batteries are maintained at 310 VDC for black start capability through the DC/DC converter system. In addition, the physical mountings for these components are designed for an energetic, marine environment, where they'll obviously be tossed around a lot."

Brown adds that AMS has done some energy-recovery projects before, and this experience helped its work on Triton. "For instance, Lucid Energy added turbines to municipal water pipes in Portland, where the reservoir is much higher than the city," says Brown. "Because pipe pressure increases with decreasing altitude, this system has been deployed in place of pressure-reducing valves, and has been producing energy for several years, while lowering water pressure to acceptable levels. We've been able to reuse some of the generator control code from that project for the Triton-C generators. Another useful benefit of using Siemens devices includes a well-integrated DC/DC converter that allows us to deal with a wide range of DC voltages from Triton, while maintaining that nice, steady 720 VDC to shore.

"The engineering challenge with these projects has been creating custom algorithms that can control voltage and current simultaneously. Our team developed software algorithms to optimize voltage and current for energy production using software created in the starter program that runs in the CU320. Also, using this software and hardware combination allowed a seamless connection between the SCADA system and the generator and battery energy management system."

Accessories, HMI and analytics

Similarly, ACE reports that TIA Portal also integrates between the PLC and a Siemens motor control center (MCC), which lets users configure Triton's motors, HMI and PLC in the same platform. Beyond these control and monitoring functions, ACE also set up interfaces for TIA Portal to communicate with external systems, including:

- Speedgoat real-time hardware simulation machine via Modbus protocol;
- GPS system to make sure the float is correctly positioned, also via Modbus;
- Monitoring system to check the health of the primary capacitor bank via CAN-bus protocol; and
- Win911 alert and alarm system via wireless/cellular network, which provides real-time text and email notifications when abnormal conditions are detected on the unmanned vessel.

ACE adds that Speedgoat performs advanced calculations to determine the ideal torque for the generators that will maximize energy from incoming waves. The system integrator also wrote a custom Python software script, which collects a combination of data, such as web-based weather and satellite information, wave data from remote buoys and local measurements at the float, and pushes that data to the PLC, where Speedgoat can access it via Modbus protocol. Speedgoat uses all this data to calculate the most efficient torque for the generators, and passes that information back to the control system, which signals the MCC. This enables real-time adjustments to be made to Triton's parameters to maximize wave energy captured and power produced. Because of limited space on the vessel, its local IPC not only collects data and serves graphics for the local HMI, but it also runs the data-gathering Python script, and hosts a virtual machine from Canary Labs that's dedicated to the historian.

Finally, ACE developed custom PLC function blocks and HMI faceplates to meet Oscilla's needs. While the HMI runs on locally Triton, it's also accessible onshore. To make it easier for users monitoring these vessels, especially as they're expected to multiply in the future, ACE adhered to ISA-101 guidelines for situational awareness. It used grayscale graphics with color reserved for alerts, and developed an intuitive, single-click navigation, so operators can quickly identify and mitigate potential issues. ∞

DATA ANALYTICS

Machine learning unlocked

by Nimet Sterneberg, Clariant

How process engineers and other non-statisticians are leveraging the power of self-service analytics at specialty chemicals maker Clariant

CHEMICAL engineers usually understand their production processes well. But when anomalies occur, they sometimes struggle to find the root cause, and are ill-equipped to bring statistics and data analytics to bear.

But pure data scientists are scarce and often don't know enough about specific processes to interpret their own analyses. Rather than spending time explaining the ins and outs of production processes to a data scientist, more chemical engineers and chemists—including those at Clariant—are finding ways to run these analyses themselves. They've seen that self-service data analysis tools have long-reaching benefits, such as greater sustainability and improved operational performance.

Clariant, a maker of specialty chemicals, has one central department of professionals responsible for data analytics, but we don't really follow a classic data analysis approach. Instead, almost everyone in the data science department is a chemist or chemical engineer.

Becoming data-driven

When Clariant first started exploring self-service data analytics, the company's data science team knew it needed to choose a partner that would help guide its digitalization journey. It settled on TrendMiner and its web-based self-service solution, which is designed to allow non-statisticians to analyze time-series data without the help of a data scientist.

Clariant started using the data analytics solution at its German plants several years ago. Since then, it's rolled out the software at production sites worldwide. The company has found the solution break down silos at individual sites and lets us compare process behavior across the entire organization. Getting a full picture of Clariant's processes wasn't previously possible.

Originally, Clariant invested in the solution to accomplish two things:

- Decrease the amount of raw material used globally in its production processes, and
- Reduce cycle times of batch processes.

The solution also helped bring people and cultures together to work on global projects. Engineers could see the results of using advanced, self-service data analytics to solve daily problems they were unable to figure out on their own.

Five phases of digital maturity

Clariant's digital maturity is advanced. The company has evolved its plants into highly efficient, data-driven operations. Before it began its advanced analytics journey, Clariant defined five phases of digital maturity. While the first two steps incorporate monitoring and reporting, the last three encompass advanced, or cognitive, analytics. Clariant's five analytics phases are:

- Descriptive: what has happened?
- Diagnostic: why did it happen?
- Predictive: what will happen next?
- Prescriptive: what actions will make it happen again?
- Cognitive: what did we learn about the best practices of this approach?

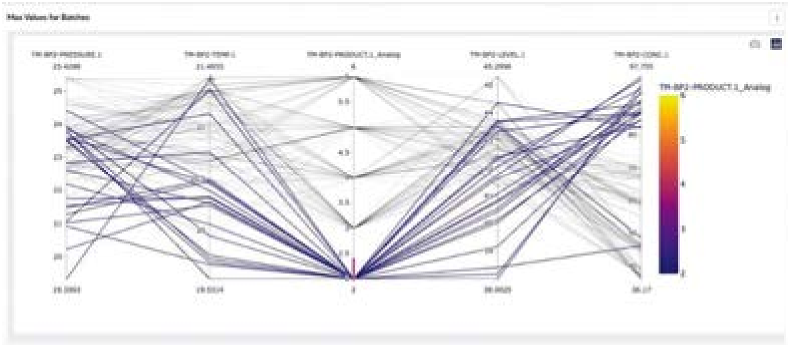
The company has reached the predictive phase of digital maturity. It's beginning to look at what it will need to reach the prescriptive phase, and—in an ideal world—the cognitive phase in the future.

Clariant established a cloud-based, data-lake model that takes information from manufacturing execution systems and edge devices, as well as systems for laboratory information and production management. The raw data from these sources goes to two places: a historian, where its data analytics platform is connected, and an organized and trusted database, where data filters to a sandbox, and eventually is made available to everyone in the company.

Clariant recently decided to intensify its data analytics capabilities. To accomplish this, it determined it needed to identify site needs and create a user community; provide learning packages in conjunction with the solution provider, but also from its own use cases; track and realize the benefits of the solution; and maintain momentum throughout the journey.

Each site gets a custom training package to address specific needs identified in the first step of Clariant's data analytics model. This includes analysis, adaptation and rollout, site-specific coaching, tracking use cases, and building a community to share experiences. The sites also have a unique person assigned as the "core" team member to provide tailored support for that site.

The data analytics software helps us identify ideal process parameters, which is known as the "golden fingerprint." It can also detect anomalies in process behavior.



MACHINE LEARNING APPLIED

Clariant's chemical engineers applied machine learning with the help of Trendminer's Python notebooks feature to identify an acceptable range for a particular process temperature. This allows experts to create a stronger fingerprint of acceptable recipe parameters, and monitor and alert for temperatures that fall outside this range.

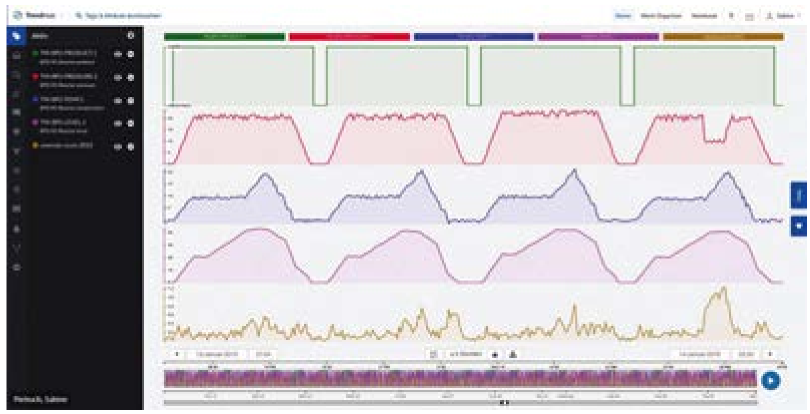
Now, Clariant uses a recently introduced application feature to evaluate its toughest cases: Python notebooks. The notebook feature uses the popular computer language to help chemical engineers apply machine learning (ML) models for an even deeper dive into process behavior.

Machine learning and Python

Clariant engineers learned that determining the root cause of abnormal process behavior was more difficult in some situations than others. Straightforward statistical analysis could find the root cause of process anomalies about 85% of the time. But to learn the root cause of the remaining 15% of its process issues, Clariant used the integrated Python notebook feature to apply ML.

Chemical engineers use the self-service solution to gather time-series data out of its historian. They then apply their own algorithms and the company's data

www.controlglobal.com



SEEING THROUGH NOISE

This time-series data with a lot of noise hid a batch anomaly. Once the patterns were smoothed out, process experts could visualize the anomaly in the trend lines. They then used machine learning tags, represented by the golden line at the bottom, to see how temperature affected the process during the same timeframe. Process experts can use this information to see that a rise in temperature will have an adverse effect on the product.

science platform. Finally, they create analytics on top of that model, discuss the results, and get opinions for the next steps to take to correct the problem.

Chemical engineers typically don't write computer programs as part of their jobs. Computer languages often require a strong learning curve that's outside the scope of an engineer's training. Clariant engineers discovered, however, that learning to write ML code wasn't going to require another advanced degree.

Python is different. The programming language has been around since the 1980s. It was invented by a Dutch programmer, who wanted to create a language that was powerful but easy enough for anyone to learn and use. Data scientists use Python because of how well it sorts large datasets using short snippets of code. But the language can be used for a variety of tasks, including establishing ML techniques.

Clariant took advantage of the integration by creating new dashboard features in the data analytics solution. Engineers then used different visualization types by creating ML tags in Python that weren't originally available.

Next, they began to supercharge the company's digitalization program with ML capabilities that allow process experts to establish an even stronger golden fingerprint. From the stronger fingerprint, Clariant's chemical engineers can set up better monitors and alarms for key stakeholders, who can intervene in time to correct anomalies.

Realizing greater efficiency

As Clariant's chemical engineers increased their skills by adding ML capabilities, they also gained efficiency across its operations. Clariant engineers see Python notebooks and ML techniques as powerful and useful additions to its data analytics program.

The company has combined the advantages of a classic engineering model and a data-driven, analytics model. Each Clariant site has its own needs and pain points. In most cases, however, increasing throughput to improve production and make a profit is the goal.

With self-service analytics and the power of machine learning, Clariant is prepared to accomplish both goals during the next phases of its digital journey. ∞

Level ups its game

Innovations in ultrasonics, radar, pressure, controllers and conductive liquid sensing gain traction

SENSITIVE TO CONDUCTIVE LIQUIDS

ProSense CLC series conductive-liquid level controllers detect and control tap water, seawater, sewage, chemical solutions, coffee, milk, etc in dual-probe, pump-up (fill) and/or pump-down (drain) applications. A wide adjustable sensitivity range is included for a variety of liquid types. ProSense pulses the probes with a DC voltage to prevent potential electroplating issues, while the output relay can control pumps, solenoids or valves to automatically lower, raise or maintain the liquid level in the tank.

AUTOMATIONDIRECT
www.automationdirect.com/level-controller

ULTRASONIC WITH DUAL INPUTS

U-Gage T30 ultrasonic sensors with dual discrete outputs from Banner Engineering feature simple, pushbutton programming to provide flexibility in demanding environments, such as gauging when sensing liquid levels in a tank or sensing most clear materials. Each sensor includes two discrete outputs, which may be programmed independently with different window limits or together with identical limits. Each output can be set with a sensing distance setpoint centered within a 10 mm window.

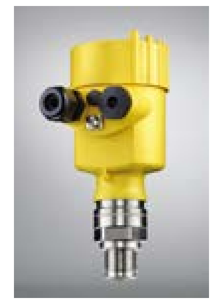
DIGI-KEY ELECTRONICS
www.digikey.com

ULTRASONIC, NON-CONTACT WITH LED

LUS211 ultrasonic, programmable, non-contact level sensor with local LED display measures solid and liquid levels, and isn't susceptible to material build-up or damage. It also features a rotatable, stainless-steel housing and capacitive touchpad menu navigation to simplify programming. IO-Link, switching or analog outputs and easy vessel geometry parameterization provide flexibility. LUS211 can determine tank fill percentage or volumes in gallons or liters, and is ideal for level sensing in non-pressurized vessels.

TURCK
www.turck.com

SENSOR WITH CHIP MEASURES ALL APPLICATIONS



VEGAPULS 6X radar sensor measures in every level application by using a new radarchip, simpler operation, and a self-diagnosis system that immediately detects damage or interference, and ensures higher availability and safety, which enables it to be the first 80-GHz sensor that's SIL certified. VEGAPULS 6X also complies with IEC 62443-4-2 security standard. Because it can handle any application, users don't have to worry about choosing between technologies, frequencies or instrument versions.

VEGA AMERICAS
www.vega.com/radar

AUTO-CALIBRATING RADAR GAUGE

Patented Acurage with guided-wave radar (GWR) is reported to be the first auto-calibrating radar gauge for true level reading and instant-spot, smart calibration. It's an ASME-approved level measuring instrument that displays the level of process fluids in real-time via digital display and a built-in, sight-glass tube. Acurage also features a built-in, safety-ball check system to protect users from accidentally spilling process liquid in the unlikely event of glass breakage.

HAWK MEASUREMENT
www.hawkmeasurement.com

80 GHz, TWO-WIRE, BURST RADAR

Model W-200 Pilotrek two-wire, 80-GHz (W band) pulse-burst radar level transmitters include the WP-210 model for water/wastewater processes and measuring liquids, masses and emulsions. W-200 has a measuring range up to 1,181 in. for liquids and masses, achieves accuracy of ±0.787 in,, and has a 1 in. and 1.5 in. encapsulated horn antenna that allows easily installation. It also features an integrated design with IP68 protection, user-friendly threshold management, and upcoming Ex variant.

NIVELCO USA
630-848-2100; www.nivelco.com

COMPENSATING CAPILLARY TYPE DIAPHRAGM

EJXC80A with compensation capillary type diaphragm seal is the latest in the EJX differential pressure level series. The compensating capillary balances the volume and temperature of fill fluids between high and low pressure side capillaries. EJXC80A reduces the influence of ambient temperature drift caused by day-to-night, season-to-season, or shady-to-sunny swings. Combined with DPharp sensor, this solution provides stability for all DP level measurements.

YOKOGAWA
www.yokogawa.com/us/solutions/products-platforms/field-instruments/pressure-transmitters/diaphragm-seal-system

COMPACT, NO MOVING PARTS, POLYSULFONE

ELS-1100 series single-point, optical level switch from Gems Sensors is a compact, economical, no-moving-parts, polysulfone level sensor with built-in switching electronics. It's available with a variety of mountings, power requirements and electrical terminations. ELS-1100 is suitable for high, low or intermediate level detection. Installation is simple and quick through the tank top, bottom or side. The sensor offers ±1 mm repeatability and broad liquid compatibility.

NEWARK
www.newark.com

SLIM AND THREE SENSITIVITY RANGES

Two new conductive level controllers, CLD2EB1BU24 and CLP2EB1Bxxx, provide precise filling or emptying control of liquid levels between two points, as well as one SPDT relay output rated up to 8 A, 250 VAC. CLD2EB1BU24 is slim and provides three sensitivity ranges, plus a fine-tune adjustment from 250Ω to 500kΩ, enabling control of a variety of liquids, such as saltwater, sewage and chemicals. CLP2EB1Bxxx provides one mid-range sensitivity adjustment from 5kΩ to 150kΩ, and supports common applications.

CARLO GAVAZZI INC.
847-465-6100; www.GavazziOnline.com

ADAPTABLE WITH ULTRASONIC

UC18GS ultrasonic sensors detect fill levels regardless of color and other optical properties. It has a sound beam radius that's easily adjusted with pushbuttons on the instrument or via software. UC18GS also features a measuring range up to 1,000 mm; very small dead bands of 30 mm with response of 70 mm; IO-Link 1.1 infrared interface IrDA; 2x push-pull switching output or 1x push-pull switching output and 1x analog output (current/voltage); ambient temperature range of -25 to 70 °C; and IP67 protection.

PEPPERL+FUCHS
www.pepperl-fuchs.com

ULTRASONIC SENSORS FIND TRUE LEVELS

Signet 2260 ultrasonic level transmitter and 2270 ultrasonic level sensor provide reliable, maintenance-free measurement, and can differentiate between condensation or agitation and the true level of the medium. They use a narrow beam that allows safe installation in limited space tanks and near static objects, display blind and Atex-approved readings, and feature ±0.05% accuracies of the measurement range. Signet 2270 sensors are available in PP, PVDF, and in 4 m and 6 m sizes with 1.5 in. and 2 in. threads.

GF PIPING SYSTEMS
800-854-4090; www.gfps.com

PREPROGRAMMING, DIAGNOSTICS LOGGING

Sitrans LT500 HydroRanger/MultiRanger level controller gives users the control they expect using their preferred sensor technology. Complete with preprogrammed pumping routines, advanced diagnostics, onboard data logging and high-accuracy flow measurement, LT500 controller keeps operations compliant with even the most stringent environmental regulations. It can also help users avoid peak energy times to reduce carbon footprints, and minimize the need for site visits thanks to its reliability and connectivity.

SIEMENS
www.usa.siemens.com/sitransLT500

EQUIPMENT & MATERIALS

VISIBLE FLAG, WIDE VIEW ANGLE

1100 Series magnetic level indicator (MLI) is reported to use one of the widest, most visible indicating flag designs, which can be easily read from 250 feet (76 meters). Along with its patented, 200° vista viewing angle indicator and a five-year warranty on the chamber, 1100 Series MLI includes nitrogen-purged and sealed indicators. With designs for flashing/boiling applications and cryogenics, SOR can customize a magnetic level indicator for rigorous conditions.

SOR INC.
913-888-2630; www.sorinc.com/products/magnetic-level-indicators/1100-series-magnetic-level-indicators

PRESSURE THAT'S ECONOMICAL FOR LEVEL

Differential pressure transmitters deliver accuracy of ±0.065% of calibrated span (standard) to ±0.04% of calibrated span (optional). Available with direct- or capillary-mounted diaphragm seals, pressure transmitters for static pressure can serve at up to 1,035 bar (15,000 psi). Their 97% safety failure ratio achieves what's reported to be the best avaiable safe failure fraction (SFF). They work with all liquids and in closed or open tanks.

FUJI ELECTRIC
732-560-9410; americas.fujielectric.com/products/instrumentation/pressure

DETECTOR FOR PLUGGED CHUTES, CONVEYING

DJ durable level detectors provide high-point level detection of bulk solids in dusty environments and on vessels with vibrators. They require no adjustments and are virtually wear-free. DJs have no moving parts, gaskets or seals, and rely on mechanical oscillations to determine if the probe is covered or uncovered. Signals from DJ operate a single-pole, double-throw relay in the control unit, while the relay contacts actuate alarms, indicator lights or control devices.

DYNATROL DIVISION OF AUTOMATION PRODUCTS INC.
800-231-2062, 713-869-0361; www.dynatrolusa.com

AD INDEX

Smart and smarter P&IDs

Piping & instrumentation diagrams with embedded data and models can help streamline process design and ongoing document maintenance

GREG MCMILLAN

Gregory K. McMillan captures the wisdom of talented leaders in process control, and adds his perspective based on more than 50 years of experience, cartoons by Ted Williams, and (web-only) Top 10 lists. Find more of Greg's conceptual and principle-based knowledge in his Control Talk blog. Greg welcomes comments and column suggestions at ControlTalk@putman.net

GREG: I remember the days of using engineering flow diagrams (EFD), and while the latest edition of the ISA book *Control System Documentation* has a chapter on EFDs, the process industry has moved on to piping and instrument diagrams (P&ID) with increasing efforts to make them smarter. To look at the evolution of the P&ID and its potential future capability, I'm joined today by Michael Stenning, a recently retired former colleague, and Gil Soucy, an instrument and electrical specialist.

MICHAEL: Our older documents include EFDs, but we've transitioned exclusively to P&IDs. The EFDs include instruments and loops and show manual valves in the piping, but the information for piping sizes, insulation and instrument ranges were all kept in separate documents, usually a pipe schedule list and instrument lists. In our major product line, we started using smart P&IDs, of which I'm a huge fan. The reason is that one document can provide nearly all motor information, all instrument information—including vendor, model numbers and instrument ranges—as well as pipe sizes and insulation information.

The smart P&ID can publish reports for all motors, all manual or air-operated valves, including the types of valves (check, ball, gate, globe, relief, etc) and the instrument ranges, insulation reports, pipe diameters and materials of construction. I wish all companies were committed to smart P&IDs because these reports make checkout and construction much easier. Also, the off-page connectors are smart, so one can click on them and go directly to the referenced P&ID. The smart P&ID can include "flow bubbles" on each pipeline that can be used in the process flow diagrams (PFD). In some cases, we've included PFD information on the P&ID by importing a table (from Excel, for example) into the drawing, so all information is in one place.

The PFDs include design information for flow rates for each stream, which then defines the pipe sizes reflected in the P&ID. It also includes ranges for temperatures, flows, pressures, pressure drop, batch sizes as applicable for reactors, weigh bins, silos, feeders, etc, and cycle times. We haven't done a good job of syncing the PFDs with the P&IDs to allow information to update from one document to another automatically. The last set of PFDs I built were all done in Excel, so the information is editable and can be updated based on actual data, but I did have to ensure the P&ID and the PFD information was consistent by manually comparing the two.

Usually, PFDs would show the ranges for flow, temperature, pressure or level, for example, that are the expected max and min values. They're not the instrument ranges, which are usually broader. Ideally, the PFD should include the instrument calibration range as well as the expected operating information. One software package that could transfer information between PFD and P&ID would be desirable.

There's an additional complication in that different sites use different software. There aren't a lot of drafting resources familiar with using the smart software programs, so we had a dedicated E/I engineer (Gil Soucy, who's with us today), who took ownership of the smart P&IDs. We also trained a draftsman, but he retired. As plants upgrade or change equipment, our experience is that PFDs and P&IDs aren't always marked up properly and updated. Our process control group discussed transitioning to a Bentley smart P&ID software application company-wide, but since then, there's been more downsizing and I believe this was put on the shelf.

As with all items in the business world, we must do a better job assigning the value that smart PFD/P&ID software can bring. In the old days, corporate engineering would build the PFDs and P&IDs. It wouldn't be a bad thing to have this as a corporate skill to be used for all plants, then a dedicated group of engineers and drafting resources could manage new smart PFDs/P&IDs, and individual sites would just need the process expertise to maintain and develop these documents.

GIL: To answer your original question, we now use P&IDs exclusively. In the past we generated EFDs as well as instrument flow diagrams (IFD), where the EFD concentrated on equipment, piping, insulation etc, and the IFD concentrated on instrumentation and electrical. It was very difficult to ensure that both of these documents were updated when changes were made. Most times, both documents were incorrect.

Michael has done a very good job summarizing how we use smart P&IDs. The real power, as Michael stated, is to build reports that are helpful to the construction, process and startup teams. Any data included in the P&ID can be organized into customized reports. We can publish e-stop, gauge, temperature element, thermowell and instrument lists, just to name a few. Michael has included many more. In the past, every discipline seemed to have their own spreadsheet(s) for their particular area of responsibility, but now we include everything in one document, and generate separate reports from there. We also include every motor with its rating, and this becomes the basis for motor lists and identifying the power needs for the project.

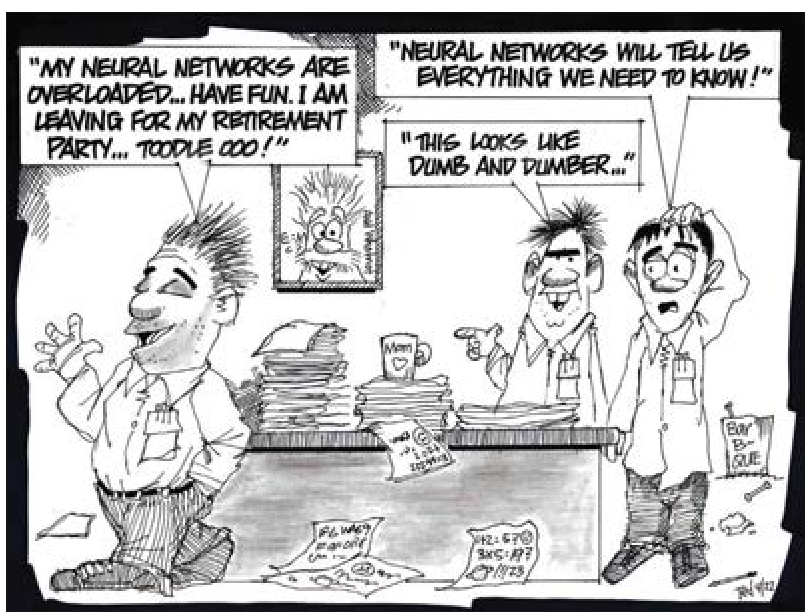
In many cases, we include the drawing number and schematic drawing number for that particular motor and include it on the P&ID. We've also done the same with instruments, so the instrument drawing is easily identified. We've tried to make it so the P&ID is a good index to the process and some of the supporting documentation. In creating P&IDs, we include every I/O point. In the past, many of the I/O points were assumed. For example, in the past, when a motor was shown on the P&ID, it was assumed there was a start, stop, jog and maybe a disconnect switch with an interlock.

With our new philosophy, every I/O point is shown. The P&ID now becomes a document that can be used to generate accurate I/O lists. We even distinguish PLC I/O from DCS I/O, so separate I/O lists can be created. With these I/O lists, we can assign the cabinets where the I/O will be located, and include the file, card and address information that's critical for our checkout documents. This enables us to give our equipment suppliers P&IDs that specify everything we require, including I/O assignments.

Software for smart P&IDs, out of the box, may potentially support Performance Improvement Plan (PIP) drafting standards, as well as those of the International Standards Organization (ISO), International Society of Automation (ISA), German Institute for Standardization (DIN) and Japanese Standards Organization (JIS)-ISO. We're using the PIP standard, but we had to highly customize it, since our specialty plant contains a large percentage of equipment that isn't supported by PIP. Customization is fairly straightforward and the custom symbol sets can be used from project to project. Once a new symbol is created, you can assign properties to that symbol that are specific to that piece of equipment. For example, PIP doesn't have a symbol for a “roll,” so we've created a roll with custom properties. Now we can state whether the roll is smooth, laser engraved, grit blasted, etc. We can also show whether it's an idler, tendency or driven. We also include roll diameter, length, etc. With this custom symbol, we can create roll lists, including all the properties. We also include vendor name, so we can provide vendor-specific lists.

We started using smart P&ID software around 2009. Since then, the product has evolved. We're not using the 3D portion due to staffing issues. In the past, I'd create P&IDs with the help of the process engineers and a draftsman, and the mechanical engineer would create the 3D model of the process piping, equipment, etc. These were separate documents. The newer software can create 3D models of the process from the P&IDs and vice-versa. I am sure it would be an extremely powerful tool, but we haven't had the resources to implement it.

GREG: Smart and smarter P&IDs can make innovation easy and easier, yielding smart and smarter process control improvements. Let’s all hope that when the guy who really knows what's going on retires, we aren't left in the dark. ∞



To read an extended version of this conversation, seek out the online version of this article at ControlGlobal.com, where you'll also find the Top 10 list of "Things you don't want to hear about engineering drawings."

Easier said

IO-Link is a stopover on the road to IT-OT convergence

JIM MONTAGUE
Executive Editor
jmontague@putman.net

"It's ironic how much physical, point-to-point hardwiring can help the Internet and other forms of digitalization that are supposed to replace it."

WHILE researching several Ethernet/Internet-related topics recently, I found that my sources kept bringing up IO-Link (io-link.com) field device protocol as a useful way to extend their networks and enable their processes. This wasn't a surprise because the IEC 61131-9 standard for short distance, point-to-point, wired or wireless networking is becoming increasingly popular for connecting digital sensors, actuators and other devices to higher-level fieldbuses or Ethernet networks.

However, IO-Link still bugs me because its emergence and how it operates run counter to how I was told industrial networking was supposed to evolve. In the past couple of decades, hardwired, point-to-point networks often gave way to low-power fieldbuses and later Ethernet and wireless versions, which snaked among and linked up multiple devices, and allowed them to communicate on one telephone-style loop back to a central device. It makes sense that running one wire or wireless signal among a bunch of components is less costly and time-consuming than sending a dedicated cable out to reach each component and needed signal, right?

Sounds reasonable, but just as flies get into ointments, reality and other unforeseen snags intrude. Most require reassessments of issues we thought were settled, as well as a more closely reexamined and deeper understanding of what we thought we already knew.

A couple of end users and experts reminded me that fieldbuses and Ethernet may have initial advantages over point-to-point hardwiring. However, once their loop is landed, they usually require added configuration and programming, which most plant-floor technicians aren't trained to handle and most 9-to-5 information technology (IT) staffs aren't available to deal with. This can cut into the benefits of fieldbuses and Ethernet, and makes all their bells and whistles less of the terrific deal they promised at first.

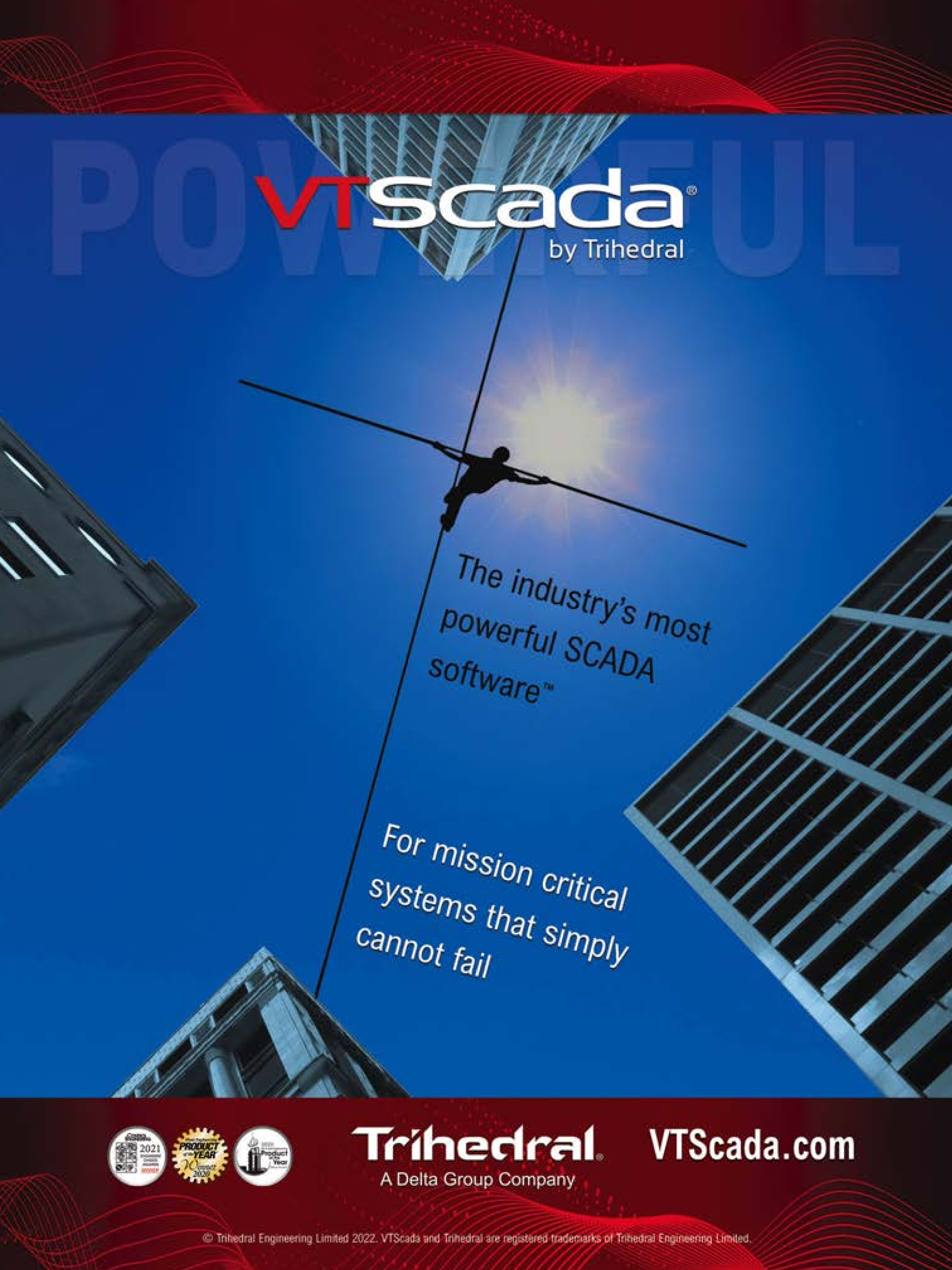
For example, in his presentation at the ODVA conference in March, Paul Maurath, technical director for power, control and information systems at Procter & Gamble (www.pg.com), reported that his team is testing multiple IO-Link devices on P&G's Smart Process Cell (SPC) demonstration project in conjunction with evaluating Ethernet-Advanced Physical Layer (APL) for likely future deployments. (For more, see this issue's "Great expectations" cover story on page 20).

Consequently, despite its physical requirements, IO-Link can provide a simple, close to plug-and-play bridge between numerous field devices and many networking protocols, and apparently do it without much of the programming required by its more digitalized counterparts. And, because many fieldbuses and Ethernet networks are increasingly widespread on plant floors and field operations, I/O-Link often doesn't have to go too far to reach higher-level networks, and give them the last-mile access they need to reach device-level equipment and processes.

It's ironic how much point-to-point hardwiring can help the Internet and other forms of digitalization that are supposed to replace it. Of course, this is similar to the logical assumption that wireless was going to replace wires, which actually resulted in more hardware and wiring on its transmitting and receiving ends. This is where some of that deeper understanding about what's actually happening with industrial networking—or anything else—can occur and come in handy.

At the same time, IO-Link isn't a cure-all. Much of its appeal depends on its master-slave structure, which is familiar to many users. They may appreciate its simplicity and lack of required programming, but is this preference because training in configuring Ethernet and digitalized networking isn't available or because they refuse it?

Either way, many users and their processes will continue to be stuck in the no man's land between IT and operations technology (OT) as they continue their epic struggle to come together. As usual, the only solution is breaking down this huge, overall goal into smaller tasks, and making incremental gains. IO-Link can be one of the steps forward, if it isn't used as a crutch. ∞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