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InTech DIGITAL MAGAZINE

AUGUST 2023

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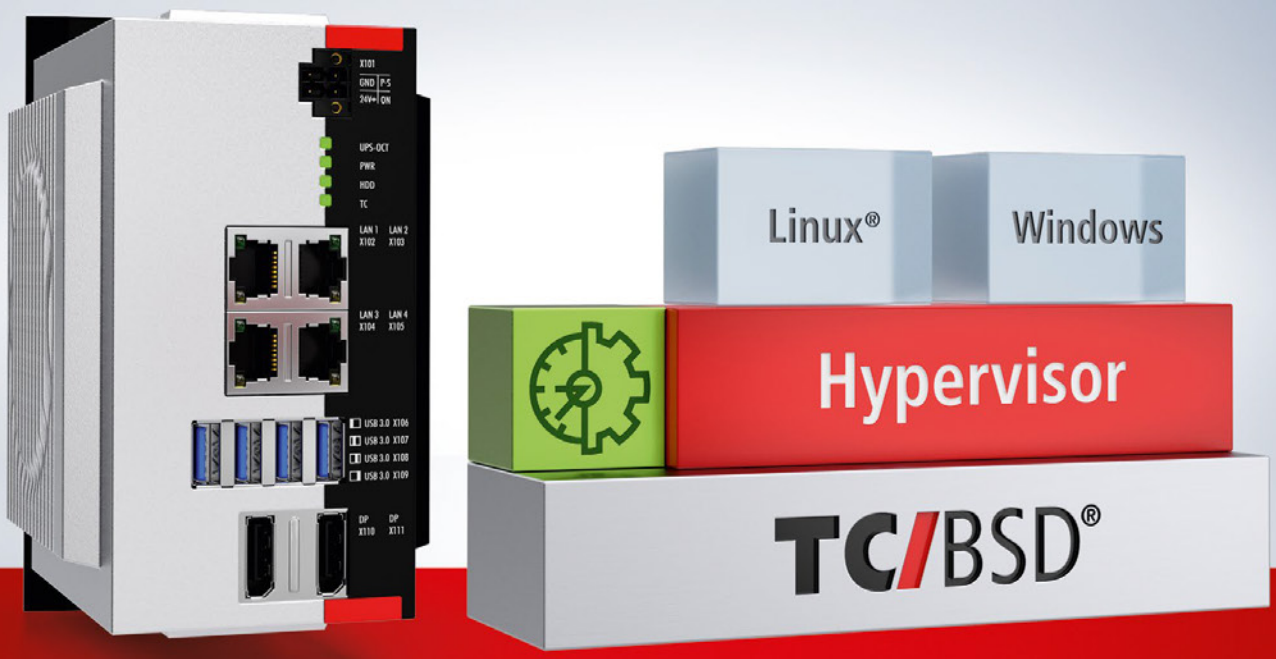

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2023 Media Planner

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Editorial and advertising offices are at 3252 S. Miami Boulevard, Suite 102, Durham, NC 27703; phone 919-549-8411; email info@isa.org.

InTech digital magazine publishes six times per year. **ISA Members** receive *InTech* digital magazine as part of their annual membership and get access to archived issues. Non-members can **subscribe** to *InTech* and InTech Plus newsletters through ISA's automation news and information subsidiary, Automation.com. InTech and the ISA logo are registered trademarks of ISA.

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Worth His Weight in Gold

By Renee Bassett, *InTech* Chief Editor

"Automation professionals are worth their weight in gold to employers when they apply knowledge and creativity to improving production."

Bill Lydon has said some variation of this truism many times over the years, and it is as true today as it ever was. Now I get to use the phrase to wish Bill well as he retires from his "second career": writer/editor for *InTech* and Automation.com.

Bill joined ISA in 1975, not long after Johnson Controls Inc. liked his background in real-time controls enough to hire him into an important part of his "first career"—the group developing JCI's first building automation system. A JCI vice president (and ISA member) recommended Bill attend an ISA short course on the application of microprocessors for controls and automation. Fast forward to Bill's second career with ISA and he is writing and speaking with his unique knowledge of information technology (IT), operational technology (OT) and business systems. (For more on Bill's history, see p. 54.)

Long before IT and OT converged in the industrial space, Bill saw the potential for open, secure, and interoperable industrial system design: One of his best-read articles was "Achieving multivendor interoperability with open systems" in which Bill wrote about a project involving ExxonMobil, Schneider Electric, CPLANE.ai and others in The Open Group.

Bradon Williams of CPLANE.ai said this about Bill soon after the article came out: "In my experience, Bill has more insight into IT/OT convergence than almost anyone in the industry. Why is that? Bill has lived (not just written about) both sides of the equation for several decades. With apologies to Wayne Gretzky (the Great One), Bill is skating to where the puck will be. And that is what makes him worth listening to."

Bill skated to where the puck will be for us recently in the 8th annual AUTOMATION 2023 Industrial Automation & Control Trends ebook, where he discusses open automation and other technologies enabling digital transformations and corporate resilience. On Automation.com and LinkedIn, he posts about ChatGBT, digitizing manufacturing and more.

Like many of us, Bill says he has missed the hallway conversations and spontaneous discussions of live events recently. The good news for him and us is that he will make an in-person appearance at ISA's Automation & Leadership Conference (ALC) in Colorado Springs this fall (p. 23). I will be there, The Open Group and its partners will be in the exhibit area, and Bill will be cruising the hallways—ready for conversation and happy to share his points of view.

You've been worth your weight in gold to me and all of ISA, Bill. I look forward to seeing you soon. Godspeed.

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Safeguard Systems to Maintain Manufacturing Uptime

By John Parrott

Industrial automation is supporting greater opportunities than ever for improving operational efficiency, even as it is facing some of its greatest challenges in the form of cybersecurity threats. With skilled-workforce retirements leading to more outgoing personnel, technological innovation, especially related to data analysis and cloud transformation, can provide new capabilities, making jobs easier at all levels. Although this enhanced connectivity is essential to support corporate imperatives for remaining competitive, it comes with a shadow side: cybersecurity dangers that companies must work diligently to mitigate.

A multifaceted threat landscape

For production managers, unplanned downtime is public enemy number one, capable of derailing any day of productivity and profitability. However, the highly connected systems now essential for operating in the modern world also introduce openings for cyber breaches if not locked down effectively. Cybercriminals are now aware of the daily conditions businesses operate in, often with an acute understanding of the cost of downtime specific to a company. This knowledge enables more effective ransomware attacks, including financial demands for unencrypting seized data assets.

Data is critical to modern manufacturing because it is used to make decisions, and losing access to data limits operational efficiency. This loss is at the core of a cyber breach, and intrusion in OT environments carries the additional weight of potential equipment-imposed damage or safety risks.

Cybersecurity must be established as a sustainable service. Within each company, it is a policy change that must be managed organization-wide, applicable not only to devices and assets, but also to personnel and procedures.

Borrowing a term from the IT stack, cybersecurity must be established as a sustainable service. Within each company, it is a policy change that must be managed organization-wide.

Assess, protect, and detect

As the business landscape and networks become increasingly complex, it is critical to both strategically plan capital improvements and diligently maintain daily housekeeping. Companies can benefit by engaging consultants who understand OT threats and can provide informed and targeted guidance.

Cyber-preparedness begins with taking stock of all connected components within the walls of a facility. This includes gathering information on what is running where, at which address, and for what purpose. It is only possible to protect what is tracked and understood.

Next, companies should work with their selected consultant to develop and implement standard security protocols for individual devices, overall networks, and personnel procedures, all part of a defense-in-depth strategy. As organizations expand, it is critical to align with the standards while adapting as necessary.

Many modern OT network security strategies rely on IT departments to airgap the automation system, with a single point or two for external access. But if the safeguard is breached from the outside or compromised by a user on the inside, the automation system must depend on its own set of protections, including:

- Network separation and segmentation
- Protection against unauthorized access, or log-in
- Protection against unauthorized modification and manipulation
- Authentication support
- Audit and security event reporting
- Intrusion detection and alerting.

Intrusion detection is of particular interest because hacking does not occur in one fell swoop. Instead, it typically involves days, weeks, or months of bad actors snooping around the network to plan their attack. The best automated threat detection systems alert at first breach, providing administrators with advance notice to address vulnerabilities.

These systems can even be set up to automatically begin mitigative measures. With the right backbone, AI algorithms can work in concert with industrial controllers to cut power in strategic locations, turn off device communications, initiate secure firewalls, identify and quarantine affected devices, and deny network access. Before unauthorized access can grow into highly consequential attacks, these quick intrusion detection and in-depth defense strategies can be used to drastically reduce the risk of disruptive incidents.

Rethinking cybersecurity

While cyber-preparedness comes with a price tag, today's top industrial leaders understand that the cost and risk of taking no action is greater. There are so many hypothetical scenarios to consider and, unfortunately, frequent headlines often preclude the need to use our imaginations. The cost of lost production at best, or safety compromise at worst, far outweighs the cost of putting protective safeguards in place.

Integrating an automated threat detection systems is one proactive step companies can take to significantly soften the blows. Today's data-driven and highly interconnected processes leave no room for downtime when cybercriminals strike, and the world is depending on manufacturers staying online.

ABOUT THE AUTHOR

John Parrott is the vice president of Digital Industries at Siemens and leads the Food and Beverage/CPG vertical market in the US. He has been with Siemens for more than 20 years. In Parrott's current position. He currently supports key clients in achieving their sustainability goals and accelerating their digital transformation journey.

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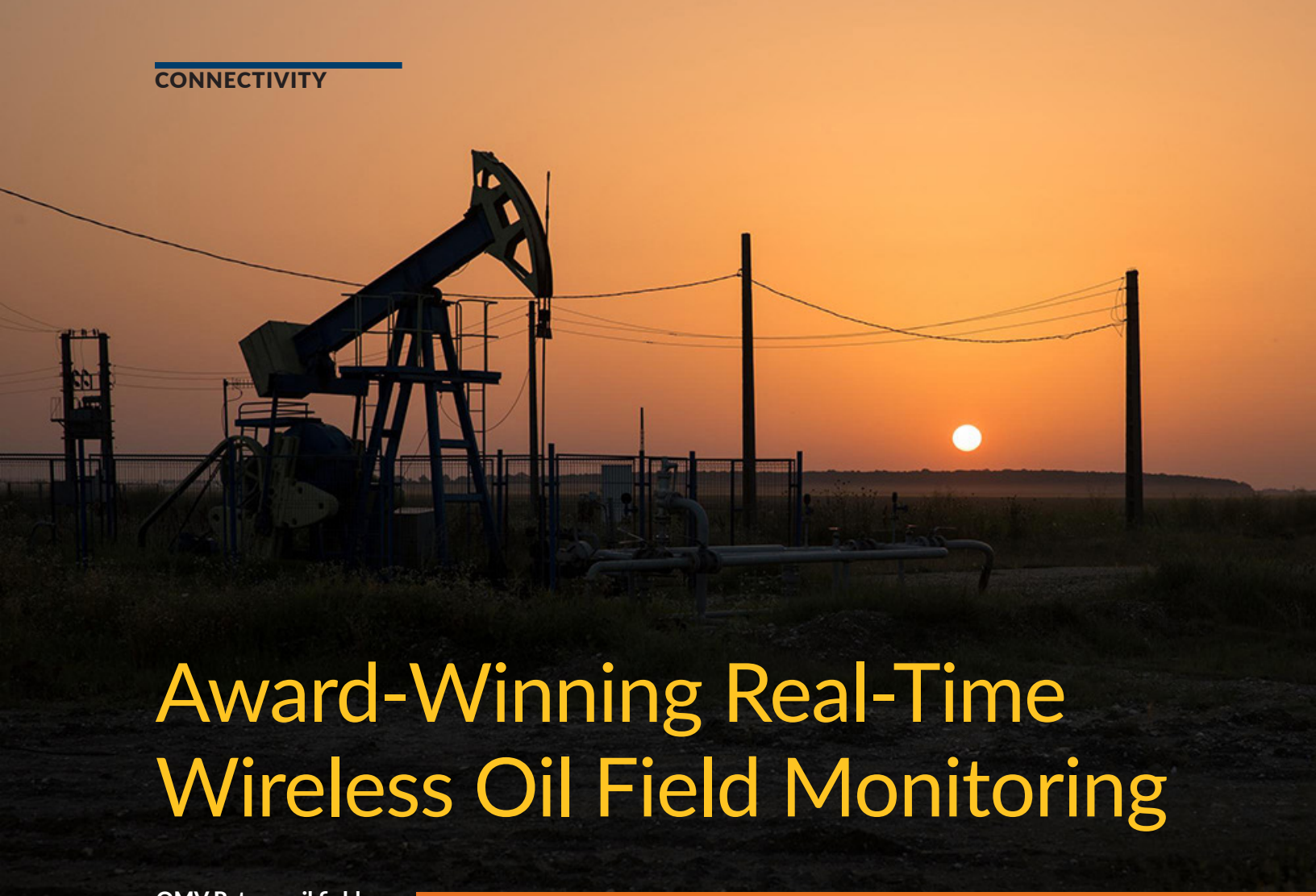


Award-Winning Real-Time Wireless Oil Field Monitoring

OMV Petrom oil field in Parc Scurtu Mare, Romania

OMV Petrom furthers its digitalization and production goals with an ISA100 Wireless network and instrumentation.

By Jack Smith

What began as a pilot project for narrowband Internet of Things (NB-IoT) technology became a test case for real-time monitoring of oil wells located in isolated areas. The resulting application not only advanced one oil company's strategic and production goals with minimal capital expenditure, but the completion of the pilot project by the company's operation technology (OT) engineering team also earned a prestigious award: the 2022 ISA100 Wireless Excellence in Automation Award. Romania-based OMV Petrom, the largest oil and gas producer in Southeast Europe, is the first global end user to use ISA100 Wireless technology for real-time oil-field monitoring, and its project proves interoperability among ISA100 Wireless certified devices from multiple technology providers.

"The oil and gas business is one of the most challenging industries. There are many uncertainties," said Sorin Dobrescu, automation engineer in the OT department at OMV Petrom. "The need for efficient, optimal, and safe operation requires advanced, yet cost-effective digital solutions, especially in onshore oil fields."

"We had to build a highly available real-time network with additional sensors and with supervisory control capabilities for the whole production system at a minimum capital expenditure," Dobrescu continued. "We also had to add temperature and pressure [sensors] to have correct parameters, in addition to the existing control system parameters, to achieve our business goals of improving the health of production and extraction processes."

OMV Petrom owns and operates 152 onshore and offshore commercial oil and gas fields. The company's 2030 strategic goals are to transform to a lower carbon future, where innovation and digitalization are among the key enablers. Its oil fields typically consist of tens of oil wells, which the company calls "production cells," outfitted with pumpjacks.

Although oil fields are typically not monitored in real time because of their remote locations and large geographic areas, OMV Petrom recognized the need. Pumpjack monitoring and surveillance ensures that the extraction process is occurring and operating efficiently. In addition, it proactively detects potential issues that could result in an oil well collapse, as recovering a collapsed oil well is an extremely costly and complex endeavor.

An industrial IoT (IIoT) wireless connectivity solution seemed appropriate to eliminate the costly cabling needed for both the backbone infrastructure and the field equipment.

Pilot project details

The oil field in Urlati, Romania, located adjacent to the Village of Orzoaia de Sus, was chosen as the first field trial location for the pilot project (Figure 1). The oil field is comprised of eight operating oil wells

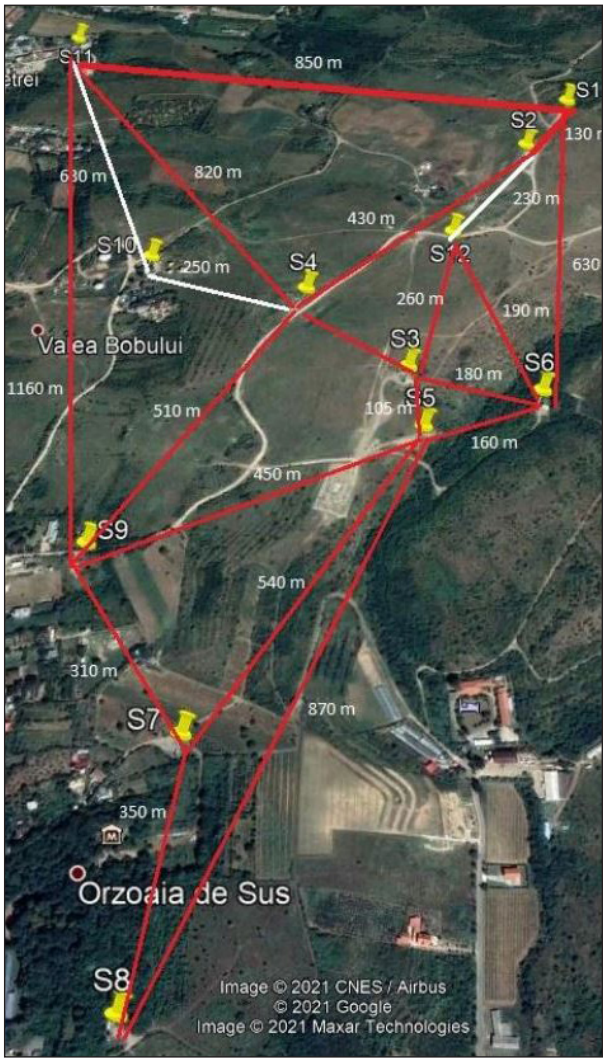


Figure 1. The OMV Petrom oil field in Urlati, Romania, located adjacent to the Village of Orzoaia de Sus, was chosen as the first field trial location for the pilot project.

spread over an area of 1.5 x 1.0 kilometers (0.932 x 0.621 miles) with hills and wooded areas. Each production cell has its own local programmable logic controller (PLC), which is also engaged in supervisory control.

OMV Petrom evaluated various Industrial IoT (IIoT) wireless connectivity solutions. They had help from Atlanta-based Centero, a provider of wireless technologies, products, and services for Internet of Things connectivity. High data reliability and latency guarantees were of vital importance for the proposed monitoring and operation of the production cells. The solution also had to be compliant to an open, worldwide standard to support the installed equipment from various providers. Interoperability among the instruments was of vital importance, as was cybersecurity, given that these high-value assets are part of critical infrastructure.

The wireless solution had to meet other site-specific criteria. Field instruments were to be installed at the eight production cells with a wireless backbone infrastructure to form the plant-wide wireless network. Parameters of interest needed to be available in real time throughout the plant-wide network via wireless field instruments, PLCs, and RTUs. Installed field instruments engaged in monitoring would also report data locally to PLCs for supervisory control through wired actuators. The instruments needed to monitor and control various parameters, such as pressure and temperature, and be installed in hazardous location (HAZLOC) areas. Backbone infrastructure devices, such as gateways and routers, would be installed in non-HAZLOC areas.

Technical and interoperability requirements

OMV Petrom chose ISA100 Wireless over other IIoT technologies and solutions because it not only met but exceeded the requirements for oil field real-time monitoring. ISA100 Wireless is the only IIoT standards-based solution that can cover a large geographic area using a single wireless mesh, IPv6-addressable network. (See sidebar, "ISA100: Open and Secure Wireless Technology.")

A project of this magnitude demands interoperability, backend connectivity, and strong cybersecurity.

The deployed wireless network is based on a distributed topology centered on an ISA100 Wireless field gateway and multiple ISA100 Wireless field backbone routers. The field gateway and backbone routers are connected through a Wi-Fi Mesh+ backbone canopy. Centero's ISA100 Wireless UNISON infrastructure product line provided connectivity for both ISA100 Wireless instruments and Wi-Fi field adapters engaged in real-time monitoring.

The ISA100 Wireless Compliance Institute (see sidebar) certifies the wireless backbone infrastructure products that form the plant-wide wireless network, as well as the field instruments installed at the eight production cells. In addition to the Honeywell pressure and temperature transmitters, data is also

collected from the Kenech WLP Wireless Load accelerometers installed on the pumpjack donkey arm (Figure 2). This data is vital for monitoring oil well efficiency and proactively detecting potential issues that could result in either partial or full oil well collapse. Field instruments monitor and report data locally to supervisory control PLCs.

On the back end, data is reported to a Honeywell Experion distributed control system (DCS) via Modbus TCP. Data is also extracted and reported at ISA Level 4 via an OPC-UA interface to an OSI PI historian. The OPC-UA interface uses the ISA100 data model standardized by the WCI in cooperation with the OPC Foundation.

Distances between the production cells required the installation of directional antennas, which Centero aligned and fine-tuned for optimal long-range wireless performance. The antennas were installed via extension cables on top of electric poles at various heights, but terrain and vegetation still presented challenges for some of the wireless links.

The ISA100 Wireless Mesh+ network

Centero provided a dual infrastructure for the OMV Petrom oil field: the field area network (FAN) and the wireless communication backbone, also referred to as the wide area network (WAN). Data from the FAN is

Figure 2. Data is collected from load accelerometers installed on the pumpjack donkey arm to monitor oil well efficiency and detect issues that could result in oil well collapse. Inset: The pumpjack donkey arm lift.

transmitted over the Wi-Fi Mesh+ backbone infrastructure (Figure 3). This highly reliable plant-wide wireless backbone canopy connects ISA100-compliant field instruments, Modbus RTU/TCP, and Ethernet/serial field instruments using Wi-Fi adapters.

The Centero UNISON gateways and access points (Figure 4) of the backbone, which support high-throughput, low-latency communications and mobility for simultaneous field data, audio, and video surveillance transmission, can be deployed in hazardous and nonhazardous areas. The wireless backbone infrastructure bridges the OT and IT domains for comprehensive digitalization.

"Up to 50 instruments can be added to each backbone router," explained Robert Assimiti, Centero cofounder and CEO, and an active member of the WCI Technical Steering and Strategy committees. "Each network supports up to 200 instruments, which could be distributed in up to 20 wireless mesh subnets. The network is improved as more [wireless] instruments are added by leveraging the mesh capabilities inherent in the ISA100 protocol."

Assimiti said that the FAN is comprised of instruments installed in the field at the

Figure 4. Centero UNISON gateways and access points are used for the wireless backbone infrastructure.

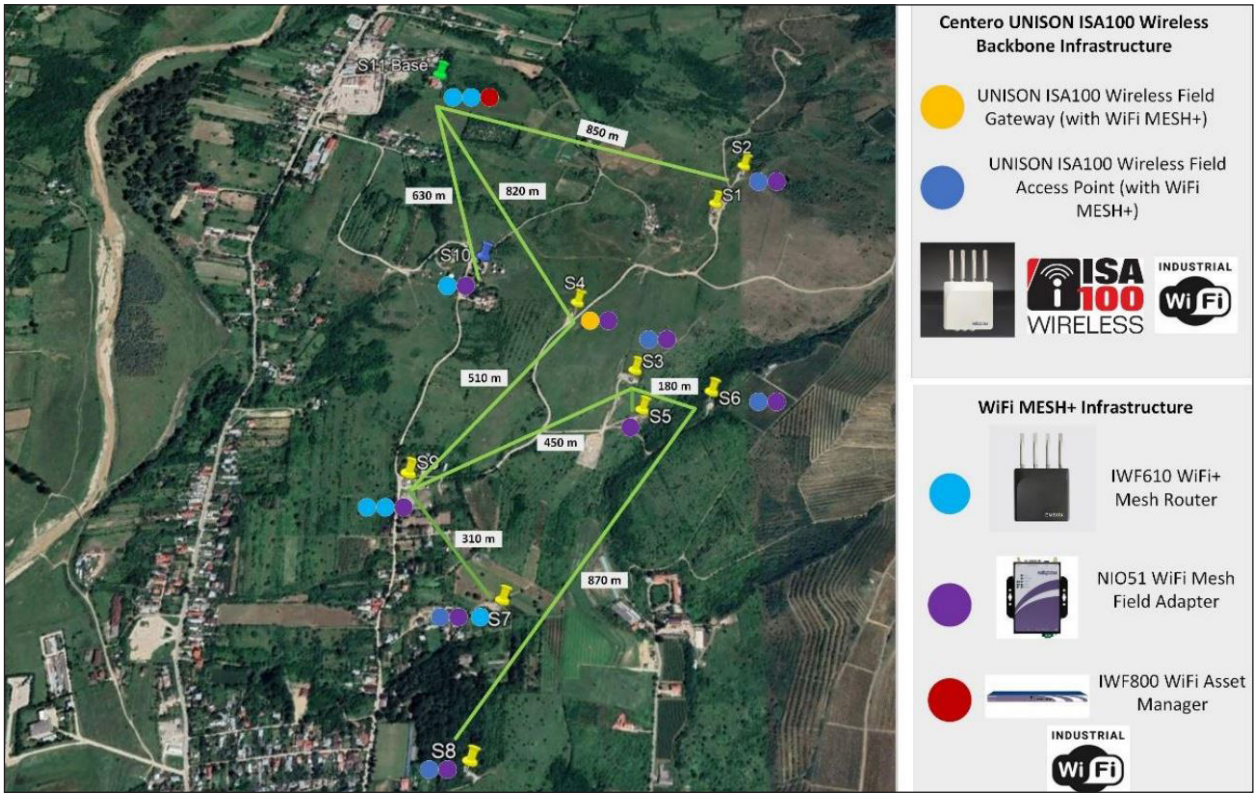


Figure 3. The Centero UNISON plant-wide wireless backbone canopy connects ISA100-compliant field instruments, Modbus RTU/TCP, and Ethernet/serial field instruments using Wi-Fi adapters.

ISA100: Open and Secure Wireless Technology

ISA100 Wireless, also known as international standard ANSI/ISA-100.11a-2011 (IEC 62743), is a plant-wide wireless infrastructure technology for industrial environments. Its development, led by ISA, sprang from a 2002 DOE study that estimated billions of dollars could be saved and billions of tons of energy waste could be avoided by deploying open, standards-based wireless applications at industrial sites.

ISA100 Wireless helps make the industrial Internet of Things (IIoT) a reality by being the only industrial wireless protocol to incorporate IPv6 directly as part of its network layer and transport layer. IPV6, which stands for Internet Protocol Version 6, allows communication by helping to identify and locate devices on the network. It replaces IPV4, which was running out of addresses, and provides other technical benefits:

- **Better security.** Internet Protocol Security (IPsec), a major design improvement of IPv6, authenticates and encrypts each IP packet of a communication session. IPsec operates in the internet layer; thus, it protects any and all application traffic across an IP network.
- **Support for new services.** By eliminating Network Address Translation (NAT), true end-to-end connectivity at the IP layer is restored, enabling new and valuable services. Peer-to-peer networks are easier to create and maintain and a more robust Quality of Service (QoS) is enabled.
- **More efficient routing.** It reduces routing table sizes and enables more hierarchical routing.
- **More efficient packet processing.** It simplifies packet headers and eliminates the IP-level checksum that exists in IPv4.
- Directed data flows. IPv6 supports a superior multicast method, saving network bandwidth.
- **Simplified network configuration.** Auto-configure functionality (address assignment) is built into IPv6.

As of 18 August 2023, the next generation of ISA100 Wireless field devices will support Bluetooth Low Energy (BLE) as a second radio while the established ISA-100 (IEC 62734) protocol will continue to be used for field reporting. BLE will enable provisioning and commissioning of ISA100 Wireless field devices by Bluetooth-enabled handhelds, particularly by mobile phones.

In addition, ISA100 Wireless gateways are also adopting a new OPC-UA data model, based on the PA-DIM specification. End users will be able to build a single set of applications that work end-to-end with all ISA100 Wireless systems using the OPC-UA model. These ISA100 Wireless enhancements will improve interoperability and the overall user experience.

Lists of certified ISA100 Wireless devices and suppliers can be found on the ISA100 Wireless Compliance Institute (WCI) website.

production cells and the ISA100 Wireless Mesh+ that connects them. The FAN provides real-time monitoring of the entire oil field and includes the instruments, PLCs, and RTUs.

The functionality of the FAN includes pumpjack monitoring/surveillance and oil well production cell monitoring. A wireless load accelerometer monitors the pumpjack donkey arm via a HAZLOC-capable WellLynx RTU. This RTU interfaces with the oil field's legacy network protocols: RS485, Ethernet, Wi-Fi, Modbus RTU, Modbus TCP, DNP3, OPC-UA, and MQTT.

ISA100 Wireless certified instruments, including temperature and pressure transmitters, are installed in HAZLOC areas and communicate with the ISA100 Wireless field gateways and field access points to perform production cell monitoring. Typical data reporting rates range from 1 to 30 seconds. Local PLCs connected to Wi-Fi Mesh+ field adapters communicate with Wi-Fi Mesh+ routers.

Results exceeded expectations

According to all involved, the results of the pilot project exceeded all expectations.

About the ISA100 Wireless Compliance Institute

On 26 June 2023, the International Society of Automation (ISA) and its subsidiary, the ISA100 Wireless Compliance Institute (WCI), announced that OMV Petrom won the 2022 ISA100 Wireless Excellence in Automation award for its novel application of wireless instrumentation. WCI is a non-profit organization dedicated to decreasing the time, costs, and risks of developing and deploying standards-based, industrial wireless devices and systems. It brings together users, suppliers, and other stakeholders to support adoption of the ISA100 wireless standard. It does this by:

- Conducting independent testing and certification of ISA100 wireless devices and systems
- Providing education, tools, and technical support to users and suppliers in the design, certification, deployment, and management of ISA100 wireless devices and systems
- Certifying that ISA100 wireless devices and systems meet a common set of specifications
- Assuring interoperability of ISA100 wireless devices and systems using standards, tests, and conformance processes

WCI's ISA100 Wireless Excellence in Automation Award, presented each year since 2013, goes to an end user company that has demonstrated outstanding leadership and innovation in the use of ISA100 Wireless technology, or for completion and publication of related research or field studies about ISA100 Wireless. Previous award recipients include Fuji Oil Company (2020), ILBOC (2019), BAPCO (2018), ALCOA (2017), Phillips 66 (2016), Petronas (2015), Nippon Steel & Sumikin Engineering Co., LTD (2014), and RasGas (2013).

Wireless technologies helped reduce capex because they eliminated the need for costly cables. “Connectivity is also better,” Dobrescu said. “Real-time monitoring and control is also one of the major basic functionalities of the wireless systems envisioned for this project, in addition to high availability and low latency.”

A project of this magnitude demands interoperability, backend connectivity, and strong cybersecurity. “Interoperability is achieved through standardized technologies of ISA100 and Wi-Fi mesh wireless,” Dobrescu explained. “Accepting multivendor solutions is very important when you have to deal with a small budget. Backend connectivity is essential for reporting data to software entities like the Honeywell Experion DCS, OSIsoft PI historian, and Seeq [analytics software].”

ISA100 standards ensure cybersecurity, said Dobrescu. “Production cell parameters are collected using ISA100 sensors and combined with existing parameters collected by legacy PLCs. We’re also adding some edge RTUs capable of running supervisory control features per the IEC 61499 standard [Standard for Distributed Automation],” he added.

Data is used to proactively detect potential issues that could result in well collapse. Oil well operations are now fully monitored in real time, which allows crude to be extracted and transported efficiently and cost-effectively.

Final thoughts

All these benefits were realized with minimal capital expenditure due to the field network architecture, connectivity technologies, and security mechanisms present in ISA100 Wireless. According to Assimiti, data availability for the ISA100 drivers is 99.9 percent, and the Wi-Fi Mesh+ wireless backbone infrastructure communication reliabi'ity is greater than 99.7 percent. This is allowing assets to run autonomously 24/7, backed by an adaptive digital workforce.

Members of the OMV Petrom engineering team presented the case study about this wireless implementation in an ISA webinar in July 2023.The 2022 ISA100 Wireless Excellence in Automation award for this application will be presented in person during the ISA Automation and Leadership Conference in Colorado Springs, Colorado, October 4-6, 2023.

Photos courtesy of OMV Petrom.

ABOUT THE AUTHOR

Jack Smith is senior contributing editor for Automation.com and ISA’s *InTech* magazine. He spent more than 20 years working in industry—from electrical power generation to instrumentation and control, to automation, and from electronic communications to computers—and has been a trade journalist for more than 25 years.

Managing Your Plant Operations Just Got Easier

ISA100 Wireless now supports Bluetooth Low Energy and OPC-UA

The ISA100 Wireless Compliance Institute (WCI) has adopted Bluetooth Low Energy (BLE) and Open Process Communications–Unified Architecture (OPC-UA) technologies to enhance the ISA100 Wireless family of products.

Bluetooth Low Energy

The next generation of ISA100 Wireless field devices will support BLE as a second radio. The established ISA100.11a (IEC 62734) protocol will continue to be used for field reporting. As a complementary technology, BLE will enable the provisioning and commissioning of ISA100 Wireless field devices by Bluetooth-enabled handhelds, particularly by mobile phones. These new capabilities ensure ISA100 Wireless technology delivers an improved user experience when new devices are configured and deployed.

Open Process Communications-Unified Architecture

ISA100 Wireless gateways are also adopting a new OPC-UA data model, based on the industry standard Process Automation Device Information Model (PA-DIM®) specification. This program will enable end users to build a single set of applications that work end-to-end with all ISA100 Wireless systems using the OPC-UA model.

Together, these ISA100 Wireless enhancements will improve interoperability and the overall user experience in the ISA100 Wireless community.

View our free on demand webinar or contact Andre Ristaino at aristaino@isa.org to learn more.

2023 ALC: Where Technical Content and Lively Experiences Meet

By Renee Bassett

Oil up those rusty social skills. ISA's Automation & Leadership Conference is designed to educate, inspire, and have you interacting.

Plan now to oil up those rusty social skills in service of advancing your career because live events are the place to be this fall: Debate the merits of OpenAI over dinner. Discuss process safety standards over drinks. Learn the latest OT cybersecurity strategies from a keynote speaker. Find technical solutions from exhibitors. Get inspired by stories of Olympic athletes. The second annual Automation & Leadership Conference (ALC) drops into Colorado Springs, Colorado, USA, October 5-6, to become the place where technical content and lively experiences converge.

The International Society of Automation has attracted superb speakers and a global mix of automation managers, engineers, technicians, and technology experts to Colorado. These are professionals who want to stay abreast of trending industry topics, including OpenAI, digital transformation, cybersecurity, IIoT, smart manufacturing,

process automation and more. In addition to simultaneous tracks of technical sessions and career-skills sessions, the event also offers exhibitor booths, ample networking opportunities, and in-depth pre-show training courses.

Says 2023 Society President Marty Bince, "ISA is committed to bringing the best content and the most exciting, enriching experiences to all our conferences and events. I've been fortunate to be able to attend several ISA technical conferences and leadership meetings over the years, and the value I've received has been significant. I would recommend attending to advance your career—both your technical journey and in support of any moves you might want to consider into leadership or management."

Keynote speakers include Mark Weatherford, who is the chief security officer and senior vice president of regulated industries at AlertEnterprise. He is also the chief strategy officer at the National Cybersecurity Center (NCC), which works to provide leadership and cybersecurity education to advance forward-thinking security policies and programs in the US, and serves as the operational home to the Space Information Sharing and Analysis Center (ISAC) that helps to secure assets and systems in space. Weatherford will speak on national cybersecurity issues and workforce development.

Attendees can engage with ISA subject matter experts, event speakers, sponsors, exhibitors and ISA staff to ask questions or find solutions.

The second keynote speaker is Dr. Lauren Goodwin, formerly chief information security officer (CISO) for NASA Houston White Sands Test Facility. Dr. Goodwin was a well-received speaker at last year's ALC in Galveston, Texas. This year she will speak on OpenAI and its implications and applications for industry.

Keynote speaker Mark Weatherford, who is chief strategy officer at the National Cybersecurity Center, will speak on national cybersecurity issues and workforce development. *Source: Wisconsin Department of Military Affairs photo by Sgt. Katie Eggers*

Keynote speaker Dr. Lauren Goodwin spoke at last year's ALC. This year she will speak on OpenAI. *Source: ISA*

Educational Tracks

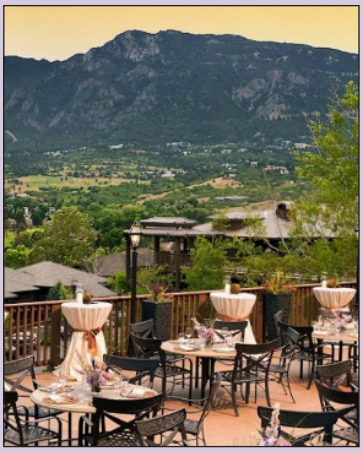
ALC technical sessions are presented in overlapping tracks during the three days of the conference, which is why having access to session recordings can be important. (See "Can't Be Two Places at Once? Sign Up for the Virtual Event.") Technical tracks are divided into Digital Transformation and Cybersecurity topics. ISA standards and consortia will be represented, including ISASecure, the ISA Global Cybersecurity Alliance (ISAGCA), and ISA100 Wireless Compliance Institute (WCI).

WCI will present its 2022 ISA100 Wireless Excellence in Automation award to Romania-based OMV Petrom, which is the first global end user to utilize ISA100 Wireless for real-time oil field monitoring. The award

ALC Hotel and Registration Details

Registration is now open at https://alc.isa.org. The conference venue is the beautiful Cheyenne Mountain Resort, a Dolce by Wyndam hotel in Colorado Springs, Colorado, a 90-minute drive south of Denver. Conference dates are Wednesday through Friday, October 4-6, 8:00 am, 16:00 MDT.

In-person attendee registration includes access to technical and career-skills sessions, the exhibitor showcase, appropriate ISA member meetings, conference recordings (available for 30 days after the event), and all food functions. Separate fees and registrations apply to the ISA Gala awards, the Fellows and Former President Reception, golf tournament, and pre-show training classes.



Registration for the virtual event allows access to technical and career-skills sessions, select society meetings and leadership presentations, the virtual exhibit hall, online networking events and live chat, and a virtual swag bag of valuable information and giveaways.

The conference is open to all. Non-members can join ISA and save on in-person attendance. Special student rates for the in-person and virtual events are also available.

for leadership in digitalization and innovation will be presented during the conference, and members of the OMV Petrom engineering team will host a session describing their award-winning operation.

The Digital Transformation track also has sessions such as "Where Are You In Your Digitization Journey?" and "Innovation in Sports." The latter is presented by Boyd Smith, curator of the nearby US Olympic & Paralympic Museum, which is an immersive experience focused on America's greatest athletes. The 60,000-square-foot attraction embodies the Olympic values of excellence, friendship, and respect, as well as the Paralympic values of determination, equality, inspiration, and courage. Visitors can try one of six interactive sport demonstrations such as alpine skiing and archery, see a full set of Olympic torches dating back to 1936, or experience what it was like to walk alongside Team USA members in the Parade of Nations.

The Cybersecurity track has sessions by noted presenters such as Chris McLaughlin, CISO of Johns Manville, who has 20 years of information security and infrastructure experience leading the vision for a highly complex manufacturing company, and Lt. Col. James I. Maher, the deputy head and assistant professor of computer and cyber sciences for the U.S. Air Force Academy, who will speak on "Artificial Intelligence and Autonomy Instruction."

Brandon Price, senior principal engineer for industrial control system (ICS) cybersecurity at ExxonMobil, will present "ISA/IEC 62443–An Asset Owner's Perspective." This overview of ExxonMobil's journey toward utilization of industry standards as a foundation for its ICS cybersecurity program includes how standards such as ISA/IEC 62443 are used and how ExxonMobil is supporting efforts to further mature and sustain the standard consistent with changes in the technology and threat landscape. Price is also chairman of ISASecure, and he will discuss the importance of this certification program for ensuring that off-the-shelf automation and control systems conform to ISA/IEC 62443 standards.

A special "Cyber Incident Response (ICS4ICS) Workshop" will be presented on-site/in-person only, by Mark Boddy, who is a

Find inspiration for the digitalization journey at the nearby U.S. Olympic & Paralympic Museum. *Source: usopm.org*

security development and support engineer with Monico Monitoring and a member of the ISA Global Cybersecurity Alliance (ISAGCA). Boddy has worked in remote monitoring for more than 15 years, primarily in oil and gas, and has 25 years of IT experience. ICS4ICS is designed to improve global Industrial Control System cybersecurity incident management capabilities by leveraging the Incident Command System used globally by first responders as outlined by FEMA for response structure, roles, and interoperability.

ISA training courses are known as some of the best, and in-depth pre-conference courses are being offered on October 3 and 4. These, which have separate registration and an additional fee, include "Using the ISA/IEC 62443 Standards to Secure Your Control Systems" and "Introduction to Data Visualization (DT103)." In the latter, students will learn the different types of analytics used for visualization, how digital twins and extended reality technologies are used, and different mobility and wearable devices for visualization.

Professional networking events

Attendees can engage with ISA subject matter experts, event speakers, sponsors, exhibitors, and ISA staff to expand their professional network, ask questions, or find solutions. Exhibitor booths will be open throughout the three days. Networking activities by date include:

- **October 4.** The S.W.A.P., or Social with a Purpose Young Professionals and Student Mixer, as well as the ALC Welcome Reception.
- **October 5.** "Rodeos and Recognition" the ISA Honors and Awards Gala will be held at the Flying W Ranch. The Gala is ISA's opportunity to showcase and celebrate the remarkable achievements and contributions of its members, volunteers and partners. This year's dress code is dressy, but make sure you wear appropriate footwear for this working ranch. This event does require a separate fee.
- **October 6.** The ISA Fellow and Past President Reception, which requires a separate ticket.
- **October 7.** The 2023 ISA Championship Golf Tournament will be held at The Country Club of Colorado at the Cheyenne Mountain Resort. Proceeds will benefit the ISA Student Activities fund. This event requires a separate fee.

Can't Be Two Places at Once? Sign Up for the Virtual Event

The ISA Automation & Leadership Conference is being presented as a hybrid event to provide access for automation professionals from anywhere around the globe. The virtual conference experience, presented through ISA's award-winning instance of the vFairs platform, is also useful for on-site attendees to see sessions they missed, like those in overlapping tracks.

The virtual event is a livestream broadcast of the on-site presentations with opportunity for live questions submitted via chat. Registered livestream attendees gain access to technical and career-skills sessions, select society meetings and leadership presentations, the virtual exhibit hall, online networking events, live chat, and a virtual swag bag of valuable information and giveaways. Virtual event attendees can obtain a certificate of completion with PDH credit for each session attended.

Registration for the virtual event is through the same website as the live event: https://alc.isa.org/. Registered virtual attendees do not need to download or install any applications to participate, and no webcams are required. All registered attendees, both live and virtual, have access to conference recordings for a full 30 days after the live event.

The technology information and creative inspiration that the ISA Automation & Leadership Conference provides is worth the investment in time and money. Like other attendees, you'll return to your workplace personally energized and professionally ready to tackle your company's automation projects, digital transformations, and cybersecurity challenges. ISA President Marty Bince suggests that, if you can, ask for company support to attend. "The benefit to the company is significant to improve the value that automation brings to the corporation," he says.

ISA Past President Carlos Mandolesi (left) and ISA President Marty Bince *Source: ISA*

ABOUT THE AUTHOR

Renee Bassett is chief editor for *InTech* magazine and Automation.com. Bassett is an experienced writer/editor specializing in industrial automation and control, smart manufacturing, engineering, infrastructure and related topics. She has a bachelor's degree in journalism and English from Indiana University, Bloomington. Renee has been with ISA since 2019 and is based in Nashville, TN USA.

Implementing Digital Transformation

The digital transformation journey for each company is unique, yet there are common guidelines to help ensure successful implementations.

By Silvia Gonzalez

Digital transformation can mean various things to different businesses, but in most cases a common fundamental aspect is connecting smart technologies so users gain the visibility needed to make production systems and work processes more efficient. While benefits and results vary depending on the industry and application, users expect digital transformation to enable them to:

- Optimize efficiency
- Ensure quality
- Minimize downtime
- Improve sustainability
- Support problem-solving
- Increase safety

These gains become possible when new and legacy systems are outfitted with technologies for establishing a seamless and transparent manufacturing "floor to cloud" architecture. Smart instrumentation, digital controllers, and other Industrial Internet of Things (IIoT) field devices need to integrate smoothly with higher-level systems.

Determining how and where to begin is a challenge, and some large initiatives have failed to deliver value. This article discusses why the most effective projects start small with defined business cases and a clear roadmap, and then build momentum and can be scaled up as they deliver quantifiable results.

Digital transformation is a journey

Digital transformation is not any one technology and is never achieved after just one project. Instead, it is an evolution and an iterative process of identifying and solving problems. Each step forward often reveals less consequential issues, which themselves become targets to address.

An organization's culture, markets, and risk tolerance play a role in how digital transformation is executed. Industrial manufacturing operations are typically looking for simple and reliable ways to access edge-located operational technology (OT) "little data," and transport it to higher level information technology (IT) and even cloud-based resources for "big data" analysis, which can lead to data-driven actions (Figure 1).

As a company embarks on one or more digital transformation projects, whether for an OEM machine or for an automated plant, answering the following questions can bring clarity to the process.

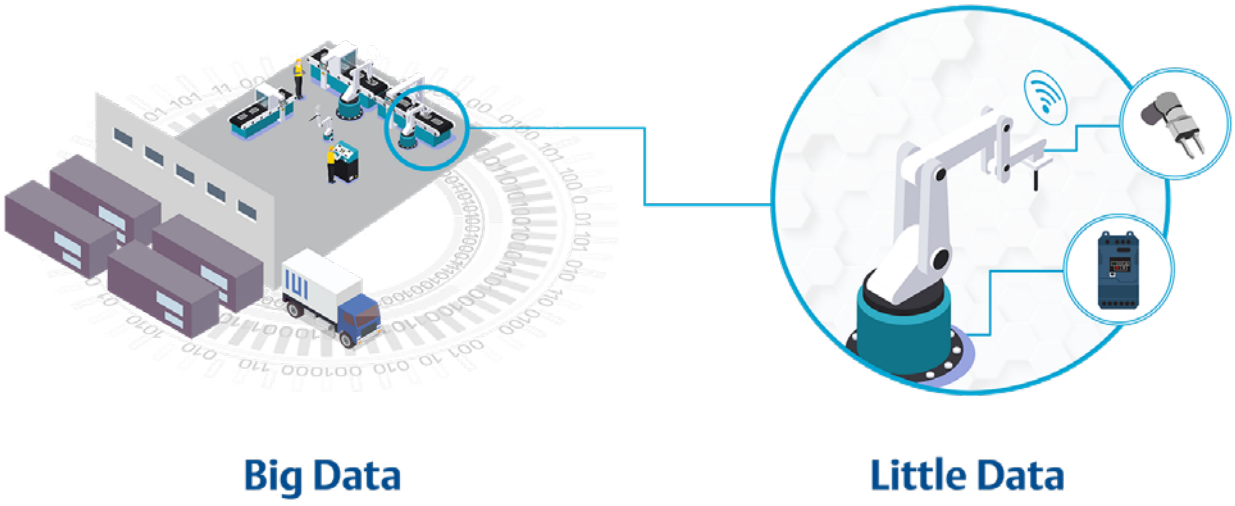


Figure 1. Digital transformation projects use multiple technologies to transport field-sourced "little data" to higher-level computing resources so the resulting "big data" can be analyzed to support actions for improving efficiency, quality, and more.

1. **What problem is being solved?** Identifying the root cause of pain points is a common approach. Where is production constrained by pinch points, and how can energy usage and emissions be reduced? What ways can quality be improved so waste is decreased, and how can equipment be kept running longer without unexpected outages? Can the enterprise supply chain be better coordinated, and what other deficiencies exist? Better data is usually the key to answering questions like these.
2. **Who is affected?** It is important to engage stakeholders so they see the benefit of problem-solving. Both internal (engineering, maintenance, operations, sales) and external (end customers, distributors) stakeholders have needs, sometimes conflicting but often overlapping. The right data will prove the case for essential stakeholders.
3. **Why does the problem need to be solved?** The ability to clearly identify the problem, along with the benefits of resolving it in a definable and timely manner, increases the chance of success. Larger problems should be broken down into bite-sized evolutionary pieces so small successes can be achieved early, then be scaled up into larger wins.
4. **Is the problem worth solving?** By defining the value of success and the cost of doing nothing, the team can make or break the case for any given digital transformation effort. Sometimes there are initial infrastructure costs for networking or computing assets, but these can be appropriately spread across several projects so each particular project carries a fair share.
5. **What information do we need to solve the problem?** Getting the right data is obviously foundational to the preceding questions. Sometimes it is already available and just needs additional analysis, but better data is often needed. The automation maturity level of an organization impacts the amount of effort required to connect with source data.

Smart instrumentation, digital controllers, and other IIoT field devices need to integrate smoothly with higher-level systems.

Automation maturity and accessing stranded data

An organization's automation maturity level can be assessed in three dimensions: people, technology, and data. To understand how a digital transformation project will proceed, the following questions should be considered:

- Are personnel comfortable with technology and resulting data, and can they best be classified as implementors or users?
- Where is the company on the spectrum of technology adoption and implementation?
- Is data currently siloed or are there already systems in place to provide wider accessibility?

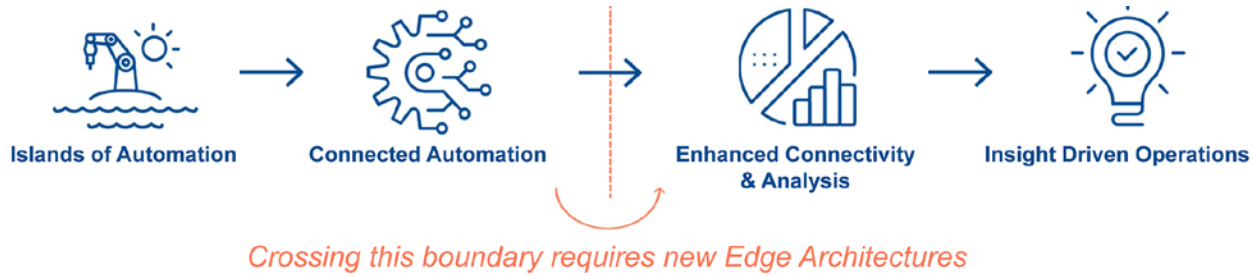


Figure 2. As companies progress from manual operations to more advanced levels of automation maturity, the most advantageous categories can only be reached by adopting new edge architectures.

Automation maturity, and the corresponding accessibility of data needed for digital transformation, therefore spans five major categories (Figure 2):

- Manual operations: Data is collected by hand and trapped on paper or in isolated databases.
- Islands of automation: Control systems collect some time-series process data, but they may not be connected to higher-level systems.
- Connected automation: Control systems data is aggregated by historians or other higher-level computing assets, with some level of interconnectedness.
- Enhanced connectivity and analysis: Data is widely available for analysis, and other non-process information, such as equipment diagnostics, is also collected and stored.
- Insight-driven operations: Data is collected throughout the organization, from the manufacturing floor up to cloud-based enterprise systems, with advanced analytics software in place, leading to actionable insights and forecasts.

Organizations lower on the scale of automation maturity have greater quantities of stranded essential data that is isolated, ignored, under-sampled, outright inaccessible, or non-digitalized. Digital transformation projects must be structured to overcome these shortcomings.

Start small, but plan for scalability

A digital transformation team should use the preceding considerations as they plan their first projects. Before diving too deep into details, a high-level roadmap should be created to define milestones that guide the activity.

To do this, the team will need to obtain and manually analyze any existing data from a wide range of digital and even paper sources. This is necessary to gain understanding of the issues at hand, even though the intent is not to solve them completely. At this proof-of-concept stage, the team is defining a project scope, costs, and benefits.

With a contained scope in hand, the team can internally "sell" the project by soliciting buy-in from stakeholders, identifying implementation personnel, and communicating the plan to business units. This communication is critical because digital transformation projects are about empowering users to perform their jobs more easily and effectively by leveraging technology and data.

Build on a successful platform

So far, we have looked more at project planning concepts and less at underlying technologies because there are plenty of challenges for implementers to first address at the conceptual level before diving into the nuts and bolts of building a project. Even as a digital transformation project proceeds, its team generally prefers to focus on solving business problems, as opposed to expending effort on implementation details.

For this reason, digital transformation teams are best served by choosing an automation and information hardware/software platform built on recognized and proven industry standards. At all levels, the platform should provide open interoperability and complete flexibility, but it must be equally adept for both OT and IT needs to provide seamless integration from plant floor to enterprise cloud. This includes the ability to interface with legacy systems, in addition to contemporary technologies. And to support the goal of starting small while remaining scalable, platform elements should be easy to install in a localized manner, as well as simple to connect to each other and up to higher-level systems.

Digital transformation platform solutions must encompass many elements (Figure 3):

- Field devices: sensors, actuators, motor controllers
- Computing hardware: protocol and network conversion gateways, programmable logic controllers (PLCs)/programmable automation controllers (PACs), edge controllers, operator interfaces, and industrial PCs
- Software: control development environments, human-machine interface (HMI)/supervisory control and data acquisition (SCADA), data servers, analytics for productivity and energy management, edge computing, and connectivity
- Services: implementation expertise supported by a team of engineers and developers.

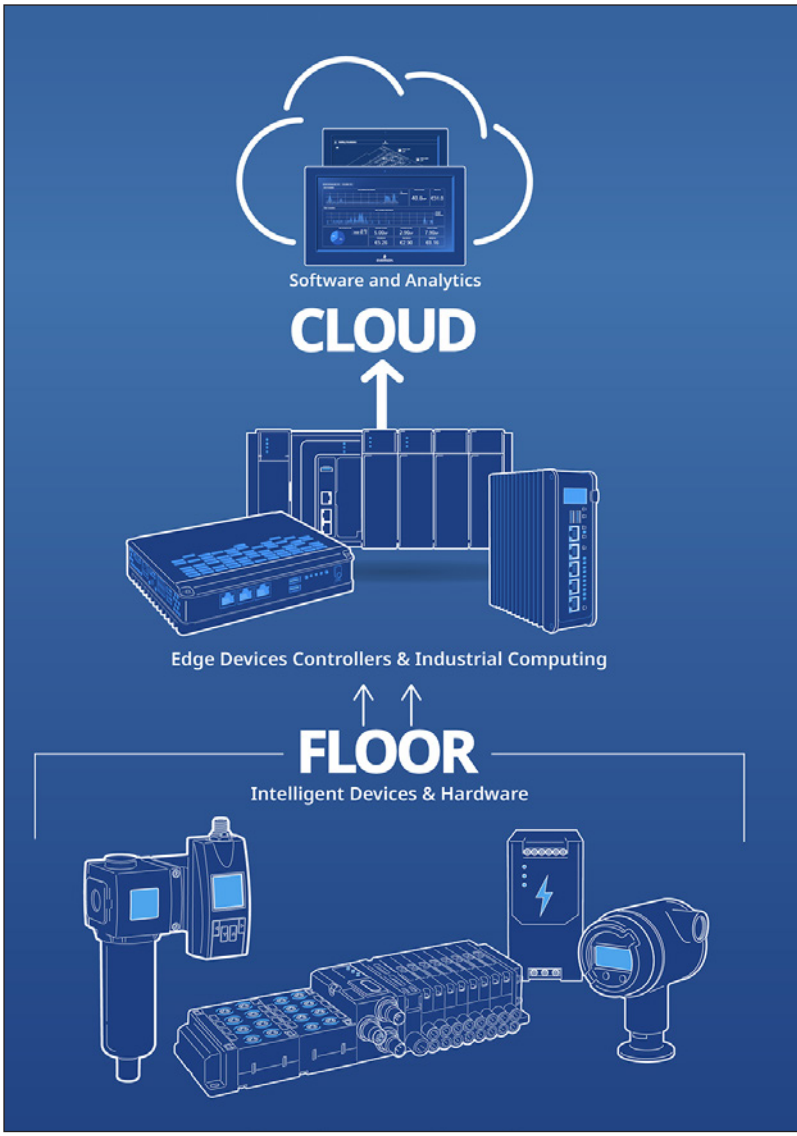


Figure 3. This platform of solutions encompasses field devices, computing hardware, software, and services, helping users perform digital transformation spanning from the manufacturing "floor to cloud."

A comprehensive digital transformation platform includes options for all these needs, designed and tested to work together seamlessly, with appropriate cybersecurity. This last point bears special consideration because digital transformation necessarily implies a higher level of network and internet connectivity, which in turn produces greater concerns and risk surrounding cybersecurity. Proper cybersecurity cannot be simply added on, and instead must be built in using proven secure-by-design and defense-in-depth measures.

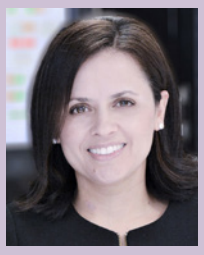
Following a digital transformation roadmap

The digital transformation journey is different for each organization, but there are some common best-practice guidelines that can be followed to improve success. The primary goals are connecting smart technologies to valuable field data, providing visibility, and delivering actionable results through analytics to help users optimize their operations.

By asking the right questions and creating a high-level roadmap supported by answers, digital transformation teams create clarity around goals, costs, and expected value. This helps to engage the appropriate stakeholders and leads to making better moves. Regardless of the organization's automation maturity level, it is important for digital transformation teams to start small, win big with a few high-value projects, and then scale up their successes leveraging the support of end users.

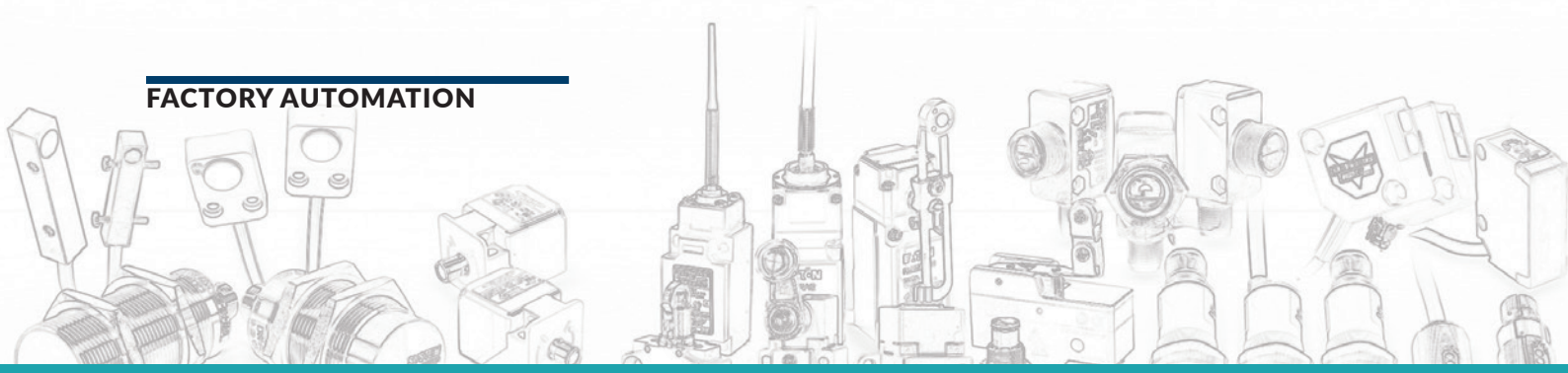
With high-level roadmaps in hand, project teams are prepared to undertake all types of digital transformation projects. While implementation details are important, it is more critical to maintain a primary focus on the larger digital transformation tasks at hand. For these reasons, implementers are best facilitated by selecting and building their solutions using a comprehensive digital transformation platform consisting of field devices, computing hardware, control/visualization/edge software, and services provided by a leader in the industrial automation and computing field. This allows them to focus on people and the business, with time-tested digital tools to support their efforts and improve workflows throughout the organization.

All figures courtesy of Emerson



ABOUT THE AUTHOR

Silvia Gonzalez is the director of product management, SCADA/HMI, for the Emerson Controls & Software business. Gonzalez is responsible for developing IIoT and industrial automation technologies that bring increased value to customer operations. She has a bachelor's degree in electrical/electronic engineering from Universidad La Salle, Mexico, has received a Digital Business Strategy certification from MIT, and is based in Houston.



Discrete Sensor Selection Basics

Application characteristics help specifiers choose the best discrete sensor type.

By Bill Sonnenthal

Industrial automation systems depend on sensors to detect what is going on with machinery and products for effective control and monitoring. In particular, discrete object detection refers to any method of sensing the presence—or the absence—of a target material or product, and then generating an "on" or "off" signal.

There are many types of sensors on the market that use a variety of technologies. Sometimes these are called discrete sensors, but in general, discrete object detection refers to any method of sensing a target. Some specific styles are called proximity (prox) sensors, but there are many other kinds such as photoelectric, electromechanical, and more. With so many choices, it can be tough for specifiers to ensure that they are getting the best sensor for the job, as there are often multiple options that will work well.

Field-proven experience is considered a top guide for sensor selection. However, there are many instances where a completely new application is being evaluated. And even when products have been used for a while because "we have always done it that way," there is a good case for periodically reviewing available products to look for technology, performance, and price improvements.

Fortunately, it is possible to zero in on the best industrial sensor candidates by considering a series of questions about the application. This requires knowledge about the target object, operating environment, detection requirements, and connectivity to the host automation.

Target object

The most obvious first question regards what the target consists of, which usually takes the specifier down one of two paths:

- Products: liquids, powders, pellets, grain, etc.
- Objects: solids made of metal, plastic, cardboard, or other materials

Detecting products will typically require capacitive or ultrasonic technologies. Solid objects can be detected with a wide variety of prox technologies or other methods such as photoeyes. Target material types and densities will have an influence on prox switch sensing effectiveness, and some vendors provide tables or other methods to assist with evaluation. When using optical technologies—such as photoeyes—the target size, distance, color, and other characteristics (lightness, darkness, clarity, or reflectiveness) will play a role.

Detection requirements

For product detection, it is necessary to define whether the sensor can be in contact with the material or if it should sense at a distance. These two considerations are also important for object detection, with a few other modifiers. If the target is magnetic, there are specific prox sensors for that service. Also, if the sensing distance becomes relatively large, photoeye and laser sensors may work best.

Sensing distance is itself an important topic, with these considerations:

Contact. This type of presence sensing is very positive and is usually accomplished with a mechanical limit switch, or sometimes a capacitive or inductive prox. However, contact sensing runs the risk of marring the sensed object. Also, mechanical switches have a finite actuation lifetime, and repeated contact with any kind of target can wear or degrade a sensor.

Non-contact close distance. Many types of capacitive and inductive proximity switches work well in a non-contact manner for distances of about 40mm or less, especially if the sensor and target can be mechanically configured to avoid contact. Also, it is often possible to affix a magnet to the target and use a magnetic prox to sense it.

Non-contact farther distance. For distances greater than 40mm, ultrasonic proxes are an option for large targets. However, many designers find that photoeye and laser sensors are the best options, especially when the geometry allows the sensing elements to be mounted on opposing sides of the target.

Operating environment

It is also important to assess the environmental conditions, both for sensing implications and electrical installation. The IEC ingress protection (IP) rating system is used to identify what degree of resistance the sensor will provide to dust and moisture. Ratings of IP65 are common and indicate that the device is dust-tight and protected against low-pressure water jets. There are other intermediate ratings, and some sensors are rated IP69K, which means they can withstand high-pressure, high-temperature cleaning, such as found in life sciences, food & beverage, industrial vehicle, and other applications.

Note that the IP rating relates to the housing of the sensor itself and the method of wiring

connection. Some sensors are threaded to accept conduit for maintaining their environmental ratings, but it is becoming more common for sensors to use molded-in pigtail cables (flying leads) for wiring at a junction box, or housing bodies or cables with industry standard M8 or M12 quick-disconnect (QD) connectors. QD cables and connectors make it very easy to replace damaged sensors, and the cables and fittings are available in various lengths, with axial or 90-degree angle formats, and field-wireable versions for installation flexibility.

Form factor

The form factor involves the size and shape of a sensor, how much space is available to mount it, and the target size. Typical sensors can be barrel-shaped or rectangular. Barrel-shaped styles are easy to thread through a bracket to adjust the spacing. A non-flush style is a standard offering, but it must protrude through the bracket or fitting. Flush styles, as their name implies, can reside within a metal mounting. Larger sensors will have greater sensitivity, but smaller sensors are often needed for constrained spaces. It is usually best for the target to be at least as large as the sensor's active surface.

Specialty requirements

General-purpose sensors work for many applications, but some specialty versions are more suitable for some applications:

- Weld slag resistant sensors prevent buildup of weld spatter and are more easily cleaned.
- Weld field immune sensors are recommended in welding areas to resist the high level of electrical noise and magnetic fields.
- High-temperature sensors are resistant for temperatures up to 230°C and are needed for some machine and foundry applications.
- High-pressure sensors are suitable for hydraulic applications.
- Metal chip immunity sensors resist false signals due to the metal debris commonly generated in some machining applications.

Evaluate electrical specs

Many years ago, limit switches would often be hardwired to interact with pushbuttons and lights, and even to interlock with larger electrical loads like solenoids, relays/contactors, and motors. It was common for these switches to use electromechanical contacts, operate at 120V AC, and carry high currents—but these types of physical contacts wear out and can fail in a welded-closed state.

Solid-state outputs use various electronic devices to switch current with no moving parts. They are smaller, faster, and quieter than mechanical contacts and offer exceptionally long lifetimes, as long as they are not overloaded. Their high-frequency switching capability is essential for applications like gear-tooth sensing.

However, solid-state devices typically can't switch as much current as their electromechanical counterparts. They also have some small leakage current even in the "off" state, which can be problematic when they are connected to some types of electronic automation devices, such as a programmable logic controller input module.

Electromechanical contacts versus solid-state outputs is only one type of electrical

Figure 1. Many discrete sensors are available with IO-Link, so they can provide advanced data and connectivity, going far beyond basic on/off signals, with simplified field installation.

specification that needs to be evaluated. Others include:

24V DC PNP versus NPN. Although there is still a need for 120V AC 2-wire sensing devices, industry has largely moved to 24V DC 3-wire sensors. The lower voltage is safer, and to a great extent the sensors for modern automation are wired to digital controllers with very low current draws, so this level of power is adequate.

For 3-wire 24V DC sensors, one wire is +24V, another is 0V, and the third is the switched sensing signal. For DC sensors, designers must pay attention to whether they need a PNP/sourcing or NPN/sinking version, although some modern devices support both types of logic. PNP devices switch +24V to the load, while NPN types switch 0V to the load. PNP/sourcing is most intuitive for most users.

Normally open (NO) versus normally closed (NC). The terms NO and NC are a throwback to when there were only electro-mechanical contacts, but the concept still applies to all types of sensor selection.

For NO sensors, the normal output state is off/de-energized if no object is detected and on/energized when an object is detected. For NC sensors, the normal output state is on/energized if no object is detected and off/de-energized when an object is detected.

Some sensors offer combined NO/NC functionality. The logic users are implementing and how they want the system to fail safe upon power failure or cut wiring will dictate the NO or NC format.

IO-Link digital bus. Traditional hardwired sensors are still widely used, but digital buses like IO-Link provide high-speed digital communications of many sensor parameters and device power, all via a single cable. Specifiers can realize many performance and overall cost savings advantages by incorporating IO-Link sensors (Figure 1).

A quick survey of sensor styles

Following are summaries of some of the most common discrete sensing devices and where each offers the best price/performance ratio:

Limit switches use a mechanism such as a lever, plunger, or other arrangement in a variety of form factors to operate physical electromechanical contacts. These are a simple and economical option for many types of equipment and material handling situations.

Magnetic proximity sense magnetic targets at relatively long ranges of 60mm or more but are only suitable if a magnet can be mounted. A typical application is when the target is behind a non-magnetic barrier, such as for sensing location of a ferrous piston target within an aluminum-walled cylinder.

Inductive proximity generate an electromagnetic field used for detecting various metallic objects at relatively close range. Ferrous metals are easiest to detect, but other metals work also, and some technologies like "Factor 1" offer the same sensing range for any metal target. They are especially good for sensing the position of equipment traveling on known paths (Figure 2).

Figure 2. Proximity sensors using capacitive, magnetic, or inductive technologies are a compact way of detecting various targets.

Capacitive proximity generate an electrostatic field used for detecting all types of objects and materials at relatively close range. They can sense target products through insulating materials, such as a plastic window in the side of a bin or vessel.

Ultrasonic sensors transmit sound waves and receive echoes bounced off a target. They are not affected by object color or transparency, so they work well for detecting clear objects and liquid levels.

Photoelectric sensors use light—visible red, infrared, or laser wavelengths—to detect targets over relatively large distances (Figure 3). The emitter/sender and the receiver can

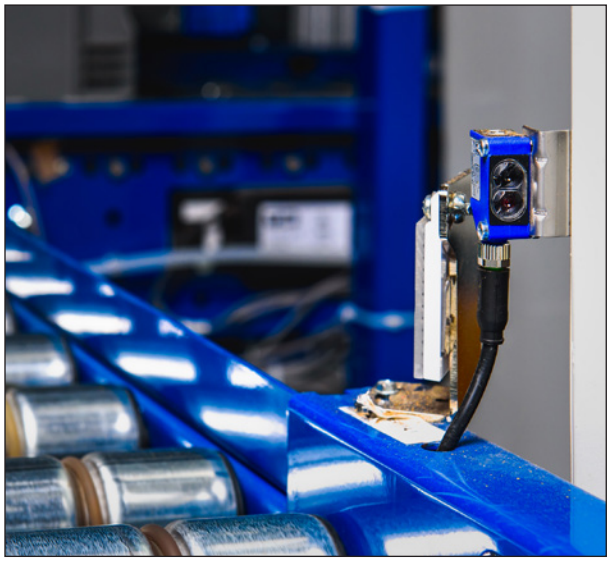


Figure 3. Photoelectric sensors are especially suitable for detecting the presence or absence of larger targets, such as conveyed boxes.

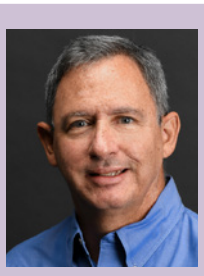
be in one housing (diffuse), or in two housings (through-beam), in either case arranged to detect objects crossing their path. Some diffuse sensors detect objects directly, while retroreflective versions detect the object obscuring a reflector located away from the sensor but across the object's path. These sensors are especially useful for detecting conveyed goods like boxes. Similar to NO/NC, a photoelectric sensor may be configurable to provide an output when light is blocked from entering the sensor (dark-on) or when light does enter the sensor (light-on).

Getting the right discrete sensor

Selecting the right discrete sensor for any given application requires specifiers to consider a number of factors, and perhaps even make some tradeoffs. There is no single best technology, and sometimes there are multiple types of sensors that may serve well in a given application.

However, by evaluating the requirements associated with the target type, form factors, environment, and other details described in this article, designers will be able to obtain the right sensing product for their industrial automation application.

All figures courtesy of AutomationDirect



ABOUT THE AUTHOR

Bill Sonnenthal is a technical marketing engineer at AutomationDirect. He has worked at AutomationDirect since 2009 in technical and marketing roles, and he holds a BSEE degree from the Georgia Institute of Technology. Before joining the company, Sonnenthal spent 15 years designing, programming, and commissioning control systems in the newspaper and printing industry.

Temperature Measurement and Control Fundamentals

Starting with the sensor, measuring and controlling temperature is an essential building block of process industries.

By Jack Smith

Automatic control in continuous processes uses industrial control systems to achieve a production level of consistency, economy, and safety that could not be achieved by human manual control only. It is implemented widely in industries such as oil refining, pulp and paper manufacturing, chemical processing, and power generating plants, to name a few. The "big four" process control parameters are temperature, pressure, flow, and level. Other parameters, such as pH, conductivity, and composition, are indispensably important. However, this article focuses on temperature control only.

Temperature measurement

"You can't manage what you can't measure," Peter Drucker, management consultant, educator, and author, said more than a half-century ago to apply to the business world. Since then, automation, instrumentation, and controls professionals have "borrowed" this to apply to their own needs: "You can't control what you don't measure."

Temperature is arguably the most extensively measured variable in process industries. If a temperature measurement is not accurate, repeatable, and reliable, it can have a detrimental effect on process efficiency,

energy consumption, product quality, and process safety. Each temperature measurement system must be evaluated carefully and designed to satisfy process requirements.

Measurement starts with the sensor

As with any control parameter, temperature measurement starts with the sensor. Typical sensors used for modern temperature controllers include thermocouples and resistance temperature detectors (RTDs). Although there are other sensors associated with temperature, thermocouples and RTDs are the most common.

Thermocouples. Thermocouples are simple sensors, rugged, relatively inexpensive, and easy to use (Figure 1). When certain selected metals (such as Chromel and Alumel in a type K thermocouple) of different composition come into contact, they form a junction that produces a voltage in the millivolt range. If the temperature changes, there will be a corresponding change in the millivoltage produced by the hot junction. To operate, thermocouples must form a closed circuit, or loop. Within this circuit are two primary junctions: the hot, or measuring, junction, and the cold junction.

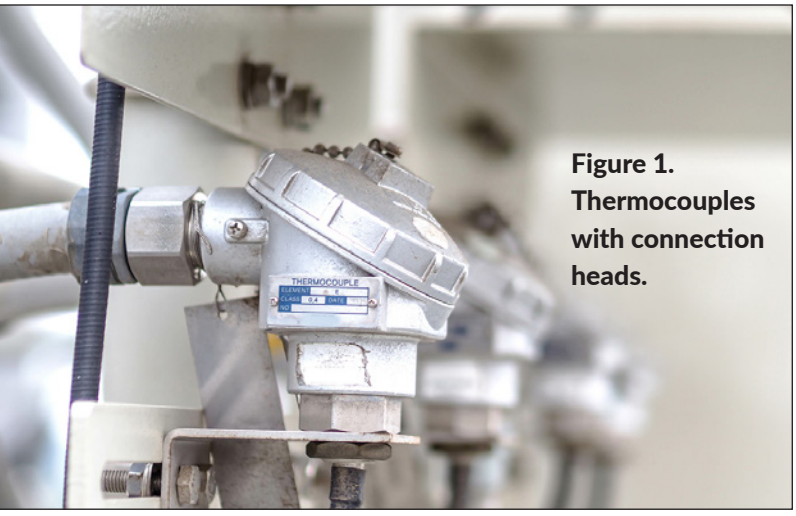


Figure 1. Thermocouples with connection heads.

Temperature is arguably the most extensively measured variable in process industries.

The cold junction must have compensation. Cold-junction compensation "offsets" the junction formed where the thermocouple attaches to the measurement device or controller, which is frequently called the "reference junction." If the cold junction is not compensated, its presence introduces an error into the measurement that corresponds to the ambient temperature at that point. Cold-junction compensation "corrects" the temperature reading by compensating for the error introduced by the junction itself; it continues to compensate for errors introduced by the reference junction even when the ambient temperature changes.

RTDs. The electrical resistance of an RTD changes according to the temperature it senses (Figure 2). The electrical resistance increases in a predictable manner as temperature increases. Most RTD elements consist

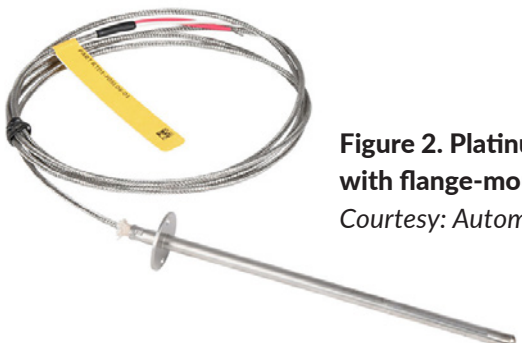


Figure 2. Platinum RTD with flange-mount probe. *Courtesy: AutomationDirect*

of a length of fine platinum, nickel, or copper wire wrapped around a ceramic or glass core. Because platinum is more stable, more linear, and covers wider temperature ranges than the other metals, it has become the industry standard. Platinum RTDs have a high degree of accuracy and repeatability.

According to the book Temperature Reference Guide, by Moore Industries, high-quality RTDs are very stable and rarely drift. If a measurement error is suspected, the problem is typically caused by the extension wire. Error can also be caused by long lead wire runs where multiple junction points are made. It is important to ensure that all junctions are tight, as loose connections can be another source of lead-wire resistance imbalance. To eliminate lead-wire induced error, the use of 4-wire RTDs is recommended.

Transducers/transmitters. A transducer converts a physical phenomenon into an electrical signal. In effect, thermocouples and RTDs are types of transducers. In temperature control, the word "transducer" is used infrequently. The use of the term is more common in flow and pressure control. In temperature control, most process control engineers just say, "thermocouple, RTD, or sensor."

Transmitters convey a measured signal to a control device. The signal coming directly from the sensor is at a low level. The job of a transmitter (Figure 3) is to convert the sensor output into a strong standardized signal and transmit it to a control system. Most temperature transmitters have the ability to work with different types of sensors. They can handle various types of RTDs and thermocouples (Figure 4). Transmitters can perform the required cold-junction compensation when working with thermocouples. Sophisticated transmitters can perform diagnostics on the sensor to determine if there is degradation of the actual element. The transmitter connects to the control system to provide the process variable (PV) measurements.

According to Temperature Reference Guide, when using intelligent transmitters or remote input/output (I/O), additional accuracy is gained over transmitters that must use a 4-20 mA output. In addition, maintaining a digital signal to the control system maximizes accuracy. Digital communications avoids errors of converting the digital signal to analog 4-20 mA on both the transmitter end and the control system end. Digital options include HART, Modbus, Profibus, and FOUNDATION Fieldbus.

Figure 3. Transmitters convey the measured signal to a control device. *Courtesy: Emerson*

Figure 4. Termination head of a temperature transmitter that can accommodate both RTD and thermocouple. *Courtesy: Emerson*

Temperature control

Accuracy and stability are considered fundamental traits of any process measurement. They are absolutely essential in temperature control. Although temperature control can be accomplished in many ways with many technologies, such as programmable logic controllers (PLCs) or distributed control systems (DCSs), for the purpose of this article, assume a stand-alone single loop controller. This theoretical controller includes a signal processing front end that converts the nonlinear millivolt input from the thermocouple (assuming that's the type of sensor used) to a usable linear signal, which is compared with a setpoint. The resulting output depends on the amount of error between the measured temperature, or process variable (PV), and the setpoint.

Single-loop temperature controllers (Figure 5) are used in small facilities, or for some isolated stand-alone processes. Large continuous process facilities, such as refineries and chemical plants, use DCS (Figure 6) to control pressure, temperature, flow, and level, and how they affect the operation of the plant. In some cases, and in some industries, PLCs (Figure 7) instead of—or in addition to—DCSs are used. Sometimes, PLCs control subprocesses via signals obtained from a main DCS.

PLCs have been used to control temperature for decades. It should be noted that if only temperature control is required, a DCS or a PLC is gross overkill. These systems are designed to control entire process plants, or parts of plants. Either of these devices is capable of having hundreds of temperature control loops, as well as flow, pressure, and level.

Closing the loop

Regardless of the type of controller (PLC, DCS, or single-loop controller), the measured signal from the sensor and/or transmitter is compared to a setpoint. The resulting output depends on the amount of error between the measured temperature, or PV, and the setpoint.

Figure 5. This controller can control both heating and cooling simultaneously, and can accept signals from a thermocouple or RTD, or from a pressure/flow/level sensor, and maintain a setpoint using a relay, voltage pulse, current, or linear voltage output signal. *Courtesy: AutomationDirect*

Figure 6. A DCS monitors and controls all production processes with the help of powerful controllers and distributed I/O. *Courtesy: Siemens*

Figure 7. PLCs can range from small modular devices with tens of I/O points, to large rack-mounted modular devices with thousands of I/O. *Courtesy: AutomationDirect*

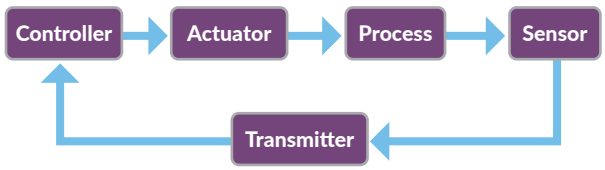


Figure 8. The process being controlled is necessarily part of the closed temperature control loop.

In addition to accurately measuring a process, there must me a way to control the amount of heat or cooling applied to that process. The process itself "ties" the system together (Figure 8). The process materials absorb (or dissipate) the energy applied to the process. The sensor detects the temperature of the process and feeds this information back to the temperature controller, which affects its output by applying more or less heating or cooling to the process.

The output of the controller can be relay, voltage pulse, current, and/or linear voltage. It is applied to the heating actuation device. Assuming the temperature control system controls process heat rather than cooling, the process can be heated by gas burners or electrical heating elements, in most cases. Heating actuation devices for gas burners can include modulated gas valves or solenoid valves. There are a variety of heating actuation devices that enable electrical power to be applied to heating elements. These may be pulse-width modulation (PWM), relay, or silicon-controlled rectifier type units.

Control modes

Control modes can be on/off control or some type of variable output control such as proportional-integral-derivative (PID).

On/off control. On-off control is the simplest form of temperature control. All temperature controllers use a setpoint, which establishes the temperature at which a process is maintained. For example, setting a temperature controller that maintains a food mixture in a vat at 275 degrees F should ensure that the temperature of ingredients in that vat is at that temperature.

A controller that uses on-off control supplies an output to increase heat when the process temperature is lower than the setpoint, and no output when the process temperature is higher than the setpoint. It is 100 percent "on" when heating is called for; it is "off" when the process temperature is at or above the setpoint. This arrangement is reversed for cooling control.

Theoretically, the controller switches "on-off" states exactly at the setpoint. However, in reality, this is not practical. If this condition were allowed to exist, the output device would switch on and off so quickly that it would make the process either unstable or ineffective. Another reason is because rapid state changes would quickly wear out the output actuation device.

Rather than have an on-off temperature controller switch on and off exactly at the setpoint, manufacturers provide for an adjustable range around the setpoint. Introducing a small range above and/or below the setpoint effectively desensitizes the controller to rapid on-off cycling around the setpoint. Some manufacturers call this adjustable range deadband. Others refer to it as hysteresis. Regardless of the name, it can be effective in

stabilizing the operation of an on-off controller if adjusted properly.

In some applications, on-off control produces a cyclical temperature response. The actual temperature of a process could vary from a minimum temperature to a maximum temperature. If the process can tolerate this, an on-off controller may be a simple, inexpensive solution to a temperature control need.

In other applications, the thermal mass of the process may be large enough to resist rapid thermal changes. An example of this is die casting. Typically, die casting machines maintain a reservoir of molten metal at an optimum temperature to allow the machine to operate efficiently. Because of the volume of material and its resistance to thermal change, an on-off controller is adequate for maintaining precise temperature control of this process.

Proportional control. Proportional control takes on-off control a step further. A temperature controller can be proportional with respect to time or it can be analog-proportional.

Time-proportional controllers apply power to the output as a percentage of a cycle time. If cycle time is adjustable, the time-proportional control divides this cycle time into a percentage of that time. If the cycle time is 10 seconds and the controller output is at 60 percent, the outputs are energized for 6 seconds of the cycle time. For the remaining 4 seconds, the outputs are deenergized. Time-proportional controller outputs can be relay, triac, solid-state relay (SSR), or dc pulse, which drives an external SSR.

Analog-proportional controllers can have voltage or current outputs. Popular output ranges are 0-5 Vdc and 4-20 mA. Analog-proportional controllers are used with SCR power controllers or valve positioning motors.

To set proportional control, the user selects a proportional band. A proportional band is a region above and below the setpoint within which the output of the controller is neither full on nor full off but somewhere in between. The direction and deviation between the setpoint and process temperatures determine the exact output level.

PID. PID control combines proportional control with two other actions: integral and derivative. Integral action is also referred to as reset. It is introduced when a stable process does not coincide with the setpoint. Derivative action is also referred to as rate. It is introduced when abrupt or rapid changes in the load affect controller response.

Reset and rate are intended to compensate for temperature offsets and shifts. More often than not, heaters and burners do not match the application. Typically, systems are designed using the “if enough BTUs are good, then more are better” concept. Not true. In a perfect world, heater or burner output would be 50 percent when the process and the controller are at setpoint. In real life, there are usually many more BTUs available than are actually needed. Reset helps to minimize this mismatch.

Rate is used when the process or load changes. Extreme variances in load size and thermal mass necessitate the use of the rate parameter. Because processes behave

differently with different loads, the controller must compensate for this difference as if there had been no load change. When used correctly, rate is effective only when there are rapid changes in process physics.

Final thoughts

All temperature measurements begin with the sensor. Measured temperature is compared to a desired temperature in a controller, which provides an output to an actuating device that provides heating energy to elevate the temperature of a process. The process is a necessary part of the temperature control loop. The controller mode can be on/off or some type of proportional control such as PID.

Although much of the temperature control in process industries is performed via DCS, a single-loop controller is sufficient to illustrate the fundamental operating principles of temperature control.

ABOUT THE AUTHOR

Jack Smith is senior contributing editor for Automation.com and ISA's *InTech* magazine. He spent more than 20 years working in industry—from electrical power generation to instrumentation and control, to automation, and from electronic communications to computers—and has been a trade journalist for more than 25 years.

ISA Announces 2023 Celebrating Excellence Honorees

Congratulations are in order for the 2023 Celebrating Excellence honorees. ISA's annual Celebrating Excellence awards are designed to stimulate, enhance, encourage, acknowledge, and reward outstanding contributions to ISA and the automation profession overall. The Honors & Awards Committee receives award nominations for defined Society awards, reviews the candidate qualifications, and recommends to the Executive Board honorees for approval.

Award categories and awardees are listed below. Individuals will be recognized for their outstanding achievement at the 2023 Automation & Leadership Conference in Colorado Springs, CO, in October.

Enduring Society Service	Alan Bryant	
Excellence in Division Leadership	Alan Bryant	Chemicals and Petroleum Division
	Jayesh Barve	Automatic Controls and Robotics Division
	Jeff Winter	Smart Manufacturing and IIoT Division
	Kelvin Erickson	Education and Research Division
	Manoj Yegnaraman	Water and Wastewater Division
	Rathan Bala	Building and Automation Systems Division
	Ronaldo Neves Ribeiro	Pulp and Paper Division
	Sandra Krauthamer	Aerospace and Test Measurement Division
	Zain Ali	Process and Measurement Control Division
Excellence in Mentoring	Isabel Vidal-Tato	
Excellence in Section Leadership	Francisco José Alférez Canales, Spain Section	
Excellence in Standards	Frank Stieglitz	
Excellence in Student Section Leadership	Haard Shah, India	
Excellence in Technical Achievement	James Haw	
Division Achievement	Don Dickinson	Water and Wastewater Division
	R. Russell Reinhart	Education and Research Division
	Rajshekhar Uchil	Aerospace and Test Measurement Division
	Sherry LaBonne	Process Measurement and Control Division
Section Excellence	Colombia Section, Maharashtra (India) Section, Pune (India) Section	
Student Section Excellence	Mukesh Patel School of Technology Management & Engineering (India)	
Standards Achievement	Frank Stieglitz, Gregory McMillan, and Peter Morgan	
Volunteer Leader of the Year	Gurmeet Anand	
Best-selling Book	*Measurement and Control Basics, Fifth Edition*, by Thomas A. Hughes	

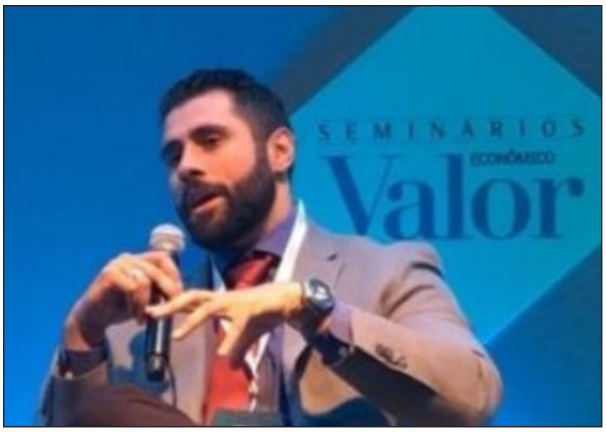
IEC-62443 at NASA: ISA Cybersecurity Director Gives AI Presentation

ISA Cybersecurity Director in Brazil and IEC-62443 official instructor Felipe Sabino Costa presented at a National Aeronautics and Space Administration (NASA) conference on how to leverage artificial intelligence (AI) for the creation of security zones to address cybersecurity challenges.

The presentation noted that AI can be used to fortify industrial control systems (ICS) and minimize their attack surfaces. Using different types of AI techniques, such as unsupervised learning, supervised learning, and neural networks, proposed security zones can be compared, Sabino Costa said.

Unsupervised learning algorithms enable the identification of hidden patterns and structures within data, assisting in the delineation of potential security zones based on inherent characteristics, he added. Supervised learning algorithms, on the other hand, utilize labeled data to train models, facilitating predictions and defining appropriate security zone boundaries. The utilization of neural networks, with their capacity to model complex relationships and adapt to evolving data, presents an additional avenue for accurately defining security zones.

He pointed out that it is important to acknowledge that AI cannot completely automate the process, and the need for human validation and the critical perspectives of companies remains crucial. Collaborative efforts, combining human expertise with the capabilities of AI, are essential to ensure the reliability and effectiveness of security zones.



ISA/IEC-62443 industrial cybersecurity instructor Felipe Sabino Costa on how to leverage AI to fortify industrial control systems.

He said it is important to acknowledge that AI cannot completely automate the process; the need for human validation and the critical perspectives of companies remains crucial.

In addition to being an ISA/IEC-62443 industrial cybersecurity instructor, Felipe Sabino Costa is also a LATAM Industrial Cybersecurity (IACS) Expert, an international speaker, and an author of books and white papers with more 15 years' experience in the industrial sector. He is product marketing manager for networking and cybersecurity for Moxa Americas Inc. and holds cybersecurity certifications from the U.S. Department of Homeland Security, MIT, IBM, and Stanford. *—By Renee Bassett*

Registration Opens for ISA Digital Transformation Conference—Asia Pacific

The dates have been set—November 26-30—and registration is open for ISA Digital Transformation Conference—Asia Pacific. The event will be held live in Perth, the capital and largest city of Western Australia.

This dual-track conference will focus on mining and supply chain issues in the Asia Pacific region. Specifically, it will home in on improved security and efficiency in the energy and mining industries, with an emphasis on predictive analytics, supply chain, and new technology implementation. This first-of-its-kind ISA event brings together subject matter experts from key end users within Australia's major industries to share presentations, end-user case studies, and best practices for adopting, accelerating, and monetizing digital transformation applications.

Join your peers on this deep dive into technology applications that streamline design, certification, and start-up processes—while improving safety, efficiency, and the bottom line. The metals and mining industry supplies minerals critical to powering a green economy, so sessions also will explore ESG topics and advances in AI that will drive a sustainable future.

ISA's Inaugural Podcast, Podomation, Is Live

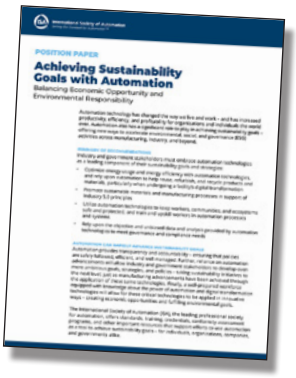
Subject matter experts from throughout the industrial automation community are the focus of Podomation, ISA's original podcast covering all things automation and cybersecurity. The first episode launched in July with a conversation recorded live at ISA's OT Cybersecurity Summit in Aberdeen, Scotland, on the topic of software bills of materials, or SBOMs.

ISA's Director of Communications and Events Morgan Foor facilitated the conversation between Chris Blask, vice president of strategy for Cybeats; Steve Mustard, ISA treasurer and president of National Automation, Inc.; and Cheri Caddy, deputy director at the US Office of the National Cyber Director. Blask, Mustard, and Caddy broke down the importance of SBOMs and how they impact software supply chain risk management.

The ISA/IEC 62443 series of standards "is all about *what* needs to be done and not how, which is deliberate, as the standards are all about what needs to be done without being prescriptive about technology or vendor," says Mustard.

Subscribe wherever you listen to podcasts to hear new episodes as soon as they are available. Future topics include industry 4.0, digital transformation, manufacturing and machine control, connectivity and cybersecurity for operational technology, and continuous batch processing. Experts interested in suggesting topics, being a guest, or advertising on Podomation can contact staff at podomation@isa.org. *—By Ashley Ragan*

ISA Releases Position Paper on Sustainability

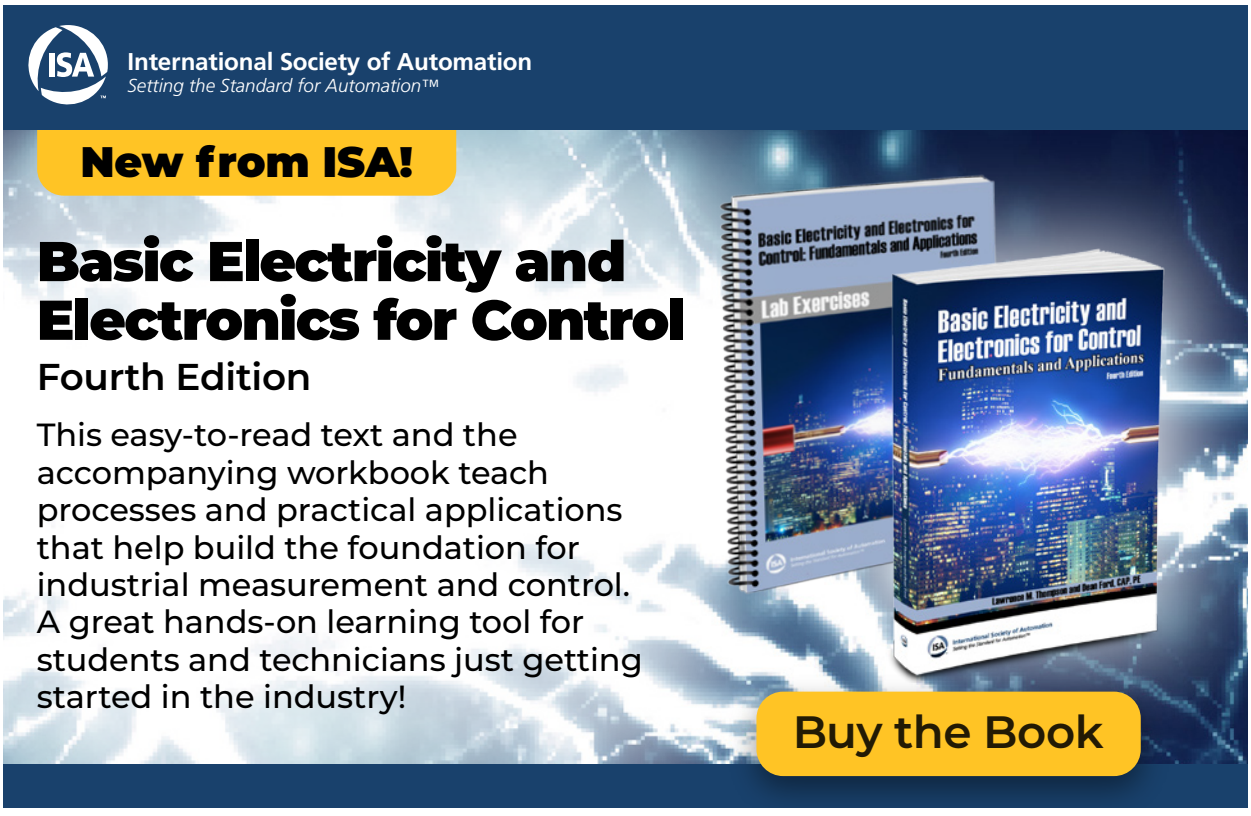


ISA has released its first position paper, "Achieving Sustainability Goals with Automation." The paper recommends that industry and government stakeholders embrace automation technologies as a leading component of their sustainability strategies and environmental, social, and corporate governance (ESG) programs.

The paper notes the emergence of "Industry 5.0," which includes the use of renewable energy sources, the reduction of waste and emissions, and the adoption of circular economy principles, which aim to eliminate waste and pollution, keep products and materials in use, and recycle and reuse to 'regenerate nature.'"

Specific recommendations for companies and governments include:

- Optimize energy use and energy efficiency with automation technologies, and rely upon automation to help reuse, refurbish, and recycle products and materials, particularly when undergoing a facility's digital transformation.
- Promote sustainable materials and manufacturing processes.
- Utilize automation technologies to keep workers, communities, and ecosystems safe and protected, and train and upskill workers in automation processes and systems.
- Rely upon the objective and unbiased data and analysis provided by automation technologies to meet governance and compliance needs.



ISA-106: New ISA Standard on Procedure Automation for Continuous Process Operations

By Charley Robinson

ANSI/ISA-106.00.01, Procedure Automation for Continuous Process Operations, has been published by ISA. The standard sets forth models, styles, strategies, philosophies, and life cycle for the automation of procedures in the continuous process industries. Terminology is included that helps explain the relationships between these elements and terms.

Procedures for continuous process operations, as outlined in ANSI/ISA-106.00.01, include startup, shutdown, and abnormal situations, hold step, and transitions of process feed/output. These procedures might exist in manual form, probably written, prior to automation. The goals are to increase uniformity and consistency of procedure automation, and reduce the risk, cost, and errors associated with automating procedures.

The standard addresses automated procedures that primarily reside on systems within the supervisory control, monitoring, and automated process control section (per ISA-95 functional levels 1 and 2) of a production process (ISA-95 functional level 0). This standard does not address procedure execution at the operations management functional level (ISA-95 level 3). The interaction with manual procedures is within the scope, but manual procedures are outside the scope of the standard. Manual procedures include manual operations by the operator using the control systems.

The new standard follows two prior technical reports completed by ISA106:

- ISA-TR106.00.01, Procedure Automation for Continuous Process Operations—Models and Terminology, provides an overview of the benefits, best practices, and language, including terms and definitions, for applying procedure automation across the continuous process industries.
- ISA-TR106.00.02, Procedure Automation for Continuous Process Operations—Work Processes, provides information regarding the work processes involved in the lifecycle of automated procedures for continuous process operations, with a primary focus on the work processes that are unique to automating procedures.

The new ISA standard sets forth models, styles, strategies, philosophies, and life cycle for the automation of procedures in the continuous process industries.

The ISA106 committee is now turning its focus to a new technical report on simulation for the purpose of testing automated procedures as well as some level of operator

training. Possible content is still being considered, but ideas include benefits; level of fidelity; justification process; impact on work process, including iterative testing; and operator training involving familiarization with the automated procedures. ISA106 welcomes new participants.

New ISA84 Technical Report

In other ISA Standards news, the ISA84 committee has developed a series of technical reports to provide guidance as well as practical implementation examples on various aspects of the ANSI/ISA-61511-1-2018, *Functional Safety—Safety Instrumented Systems for the Process Industry Sector*. That widely used standard gives requirements for specification, design, installation, operation and maintenance, modification, and decommissioning, so that a safety instrumented system (SIS) can be confidently entrusted to place and/or maintain the process in a safe state.

Three of the supporting technical reports provide guidance related to specific phases of the SIS lifecycle, including a newly published updated version of ISA-TR84.00.03, *Automation Asset Integrity of Safety Instrumented Systems*.

Control Centers Standards Committee

ISA60, *Control Centers*, is seeking new members as it reactivates under the leadership of cochairs Donald Dunn and Ian Nimmo. The committee will work on writing and updating a series of recommended practices on topics that could include terminology; human engineering; seismic and other vibrations; modular construction; documentation and division of responsibilities; profiles; fabrication and finish; electrical wiring and sizing; graphic displays; inspection and testing; and more. For more information, contact crobinson@isa.org.

ISA Standards Meetings Calendar

Oct. 7: ISA101, Human Machine Interface, WG4, ISA ALC, Colorado Springs, Colorado

Oct. 9–10: ISA88, Batch Control Systems, Dallas, Texas

Oct. 26–27: ISA18, Instrument Signals and Alarms, Dallas, Texas

Oct. 31–Nov. 2: ISA84, Instrumented Systems to Achieve Functional Safety in the Process Industries, Houston, Texas

Participation on ISA standards development committees is open to automation professionals from any country. Visit www.isa.org/standards.

ABOUT ISA STANDARDS

ISA standards and technical reports may be viewed or purchased by visiting www.isa.org/findstandards. Charley Robinson is director of ISA Standards operations. Contact him with questions or with a TR topic, training class, or standard ISA should consider.

An Automation Industry Icon Retires

By Jack Smith

Imagine a 9-year-old lad making a crystal radio set with his dad, an electrical engineer at Allen-Bradley for more than 30 years. Nearly half a century later, that lad is looking back on a successful technical career and looking forward to retirement. Through it all, Bill Lydon's fascination with all things technical, especially automation and controls, remains as strong as ever.

"I learned basic electronics by reading my father's copy of the *American Radio Relay League Handbook*," he says. This foundational text launched Bill down a path that included being the first building automation product manager at Johnson Controls, the North American director of PLCopen, and the editor of ISA's *InTech* magazine. The *InTech* masthead will list Bill as Editor Emeritus, but the term barely captures the essence of this industry expert, writer, editor, consultant, and commentator, and his distinguished 40-year career.

From his *InTech* "Final Say" columns to his annual Industrial Automation & Control Trends Reports and countless feature articles in between, Bill has been a beacon helping automation and control engineers do their jobs better. In this year's trends report (his eighth), he writes: "The world of manufacturing is an exciting, ever-changing landscape that is continually being driven to new heights of productivity, efficiency, and quality through the application of innovative technology." Bill has reported on changes, highlighted innovations, asked tough questions, told stories, and shared advice—and the automation and control industry is better for it.

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Bill first was involved with ISA starting In 1975. He attended a three-day ISA short course roadshow in Milwaukee on the application of microprocessors for controls, which he said "provided an excellent education and insight on the application of microprocessors for controls and automation." He joined ISA after that and over the years volunteered as a conference paper reviewer and presenter at the annual ISA Expo tradeshows.

Bill's engineering journey

After attending Milwaukee Area Technical College (MATC), Bill's first "real" engineering position was at Sundstrand Machine

Tool. He was part of a team developing new products for the direct computer control of machine tools. "Sundstrand was really pushing the technology, and this was a serious application of real-time computing for controls," he explained. "I learned about the application of computer-driven servo systems and closed-loop controls using encoders and resolvers."

After Sundstrand, in 1973, Bill began working for Johnson Controls after learning that the company was just beginning to apply minicomputers to building controls. "They showed me a room full of high-performance minicomputers in the development group and I was sold. Let me play in this sandbox!" he exclaimed. "Their first building automation system [BAS] was launched based on these technologies and included a 1-kb-per-second token loop over coax communicating with remote data acquisition and control units."

After 13 years at Johnson Controls, Bill was cofounder and president of an industrial control software company, Event Technologies Inc. ETI had a vision of creating automation and links from the plant floor to the front office without the need for complex programming. Everything would be accomplished with simple visual programming.

"We developed an object-oriented software architecture with visual programming for controls and automation before Windows was available, running on UNIX-based platforms. Later the software was migrated to Windows 3.1," Bill explained. "Many major controls users told me the big benefit of the soft control initiatives was to force PLC companies to lower prices and add functions."

Subsequently, Bill had positions at RTP Corporation working with nuclear-certified control and safety systems and at WAGO as a product manager for controls and input/output (I/O) hardware.

In 2003, Bill became an independent consultant in the automation industry working on projects and advising companies on strategy, applications, and technology. He has been doing this ever since.

Bill's "second" career

"In 2008 at the annual ARC Orlando conference, [Automation.com Director] Rick Zabel asked me if I'd be interested in covering and writing about an event for Automation.com. I said I'd give it a try. I liked doing it and [a writing career] just grew organically," Bill said. In 2010, ISA needed an editor for *InTech* magazine, and he joined the team.

Writing about this industry is, for some like Bill, a natural extension of the discussions, group facilitating, and creative problem-solving involved in being an automation professional or technical product manager. "If I can inspire other technical people to become writers and contributors to Automation.com and *InTech*, and the industry at large, I would like that," added Bill, who said he thinks his affinity for writing came from his mother "who grew up on a farm and taught in a one-room schoolhouse before subsequently moving to the city and marrying my dad. I had a teacher before I could talk."

Bill Lydon's family expects to spend a lot more time with him as he retires from his roles with Automation.com and *InTech*.

What's next for Bill

In addition to his engineering and editorial careers, Bill has been involved with PLCopen for more than 19 years. PLCopen is a non-profit industry organization developing and setting control software standards based on the IEC 61131-3 standard. He plans to continue his work there and engage in select consulting projects and advisory boards. He also looks forward to being more involved with his family, including five grandchildren.

Bill will be a special projects contributor to ISA publications and will continue sharing his thoughts on LinkedIn. Automation.com and *InTech* magazine have greatly benefitted from Bill's enthusiasm and experience over the years, and we are happy we still get to work with him. I'll be taking over his column slot in *InTech* but do not pretend to fill his shoes. I and so many others have learned a lot from you, Bill. Whatever you decide to do, we wish you the best!

ABOUT THE AUTHOR

Jack Smith is senior contributing editor for Automation.com and ISA's *InTech* magazine. He spent more than 20 years working in industry—from electrical power generation to instrumentation and control, to automation, and from electronic communications to computers—and has been a trade journalist for more than 25 years.