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Automation Transformation through Mentorship

By Renee Bassett, *InTech* Chief Editor

Automation and control professionals are technologists with unique responsibilities. As author and industry veteran Dean Ford puts it in "The Importance of Fundamentals" article, "We must never lose sight of a critical distinction between our work and the work of other programmers and technology professionals: Our work controls things in the field. Our work makes things move...."

That means automation professionals are responsible for both processes and people, both operations and safety, in ways that other technology pros may not be. Ford uses that that fact to make the case for understanding the basics so you can correctly implement the new and improved. I want to use it to encourage ISA members to join the ISA Mentor Program.

This member benefit, started last year, is a professional development opportunity that helps build connections by matching professionals early in their careers with seasoned industry leaders. Patrick Corbett, an automation engineer with PepsiCo International out of Ireland, is an ISA member who's active in the ISA Young Professionals (YP) and Standards committees. He told me his experience with ISA's mentoring program surpassed his expectations in every way.

"I gained invaluable insights into a different area of automation and a whole new approach to looking at problems. This was because my background has always been on the OT [operational technology] side, while my mentor had several years' experience in instrumentation and control. He shared with me documentation on how he approached projects within the instrumentation domain, which gave me a whole new mindset to approaching projects with application or server upgrades," Corbett said.

Corbett added, "The mentoring program has been a transformative experience as it has increased my confidence in my career decisions because I was able to receive guidance and reassurance from an experienced mentor. I wholeheartedly endorse it for anyone seeking a profound impact on their personal and professional journey."

More than 100 automation professionals around the world have offered to be mentors by adding their information to the ISA Mentor Directory in ISA Connect. They choose to become mentors to share their hard-won knowledge and to coach and inspire the next generation of professionals. Mentors also say they get a lot out of interacting with the up-and-coming leaders of tomorrow. That's a win all around.

The authors in this February issue of *InTech* volunteer to teach, coach, and inspire in a different way: through books, articles, and other publications. Automation may make things move, but automation professionals can be moved, transformed, and uplifted by the people of ISA. If that's been your experience, talk to me about it. I'd love to hear your story.

Remote Monitoring: Transforming Process Measurement and Control

By Jess Flight

In the world of industrial processes, efficiency and accuracy are paramount to success. Advances in technology have revolutionized the way businesses operate, and one such innovation that has transformed the landscape of process control is remote monitoring.

Remote monitoring in process control refers to the ability to oversee and manage industrial processes and equipment from a remote location. This is made possible through the use of advanced sensors, Internet connectivity, data acquisition systems, and cloud-based platforms. The collected data is transmitted in real time, allowing operators and engineers to access critical information on process variables, machinery performance, and environmental conditions without being physically present at the site.

Advantages of remote monitoring include enhanced efficiency and productivity, opportunities for proactive maintenance, improved safety, decision making in real time, and cost-effectiveness.

Enhanced efficiency and productivity. Remote monitoring streamlines the workflow by providing instant access to process data. This enables quick identification of inefficiencies, bottlenecks, or potential issues, allowing for prompt adjustments and optimizations. As a result, productivity is significantly improved, leading to cost savings and increased output.

Proactive maintenance. With remote monitoring, businesses can implement predictive maintenance strategies. Real-time data analysis helps identify signs of equipment deterioration or failure before it happens, enabling proactive maintenance to avoid costly downtime and repairs.

Improved safety. Hazardous industrial environments pose risks to workers. By using remote monitoring, workers can limit their exposure to dangerous situations as they can monitor processes from a safe location, reducing the likelihood of accidents and injuries.

Real-time decision-making. Access to live data and insights empowers managers and decision makers to respond swiftly to changing conditions or unexpected events. This agility in decision making ensures better process control and optimal resource allocation.

Cost-effectiveness. Remote monitoring eliminates the need for constant onsite personnel, which reduces labor costs. Additionally, proactive maintenance and optimized processes lead to energy savings and decreased production losses.

Implementing remote monitoring systems

Users can implement a remote monitoring system by choosing smart sensors, transmitting data securely, using cloud-based platforms, and integrating with existing systems effectively.

Choosing the right sensors. The foundation of a successful remote monitoring system lies in selecting the appropriate sensors to gather relevant data. Factors such as the process type, environmental conditions, and specific variables to be monitored should be considered.

Secure data transmission. As remote monitoring relies on data transmission over the Internet, ensuring data security is crucial. Employing encryption and secure communication protocols is essential to safeguard sensitive information from unauthorized access.

Cloud-based platforms. Cloud-based platforms are instrumental in storing and processing the vast amounts of data collected from remote locations. These platforms offer scalability, accessibility, and data analytics capabilities that enhance the effectiveness of remote monitoring systems.

Integration with existing systems. To fully unlock the potential of remote monitoring, it is essential to integrate the new system with existing process control infrastructure and software. This ensures seamless data flow and provides a comprehensive view of operations.

Industries embrace remote monitoring

Remote monitoring is finding applications in various industries like manufacturing, energy, oil and gas, and agriculture. Manufacturers are ensuring smooth production lines, identifying faults in machinery, and optimizing supply chain processes. Energy enterprises are monitoring power generation and distribution systems, enhancing efficiency in energy usage, and detecting anomalies in renewable energy installations.

Companies in oil and gas monitor remote oil wells and pipelines, optimize extraction processes, and enhance safety in hazardous environments. In agriculture, remote systems are used to monitor soil conditions, irrigation systems, and crop health for optimized agricultural practices and increased yields.

Remote monitoring in process control represents a paradigm shift in the way industries manage their operations. The power of real-time data access, predictive maintenance, and remote decision making empowers businesses to unlock new levels of efficiency, safety, and productivity. As technology continues to advance, the scope and impact of remote monitoring are only expected to expand, leading to a future where process control becomes more intelligent, reliable, and sustainable than ever before. Embracing this transformative technology is the key to staying ahead in today's competitive industrial landscape.

ABOUT THE AUTHOR

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DIGITALIZATION

Digital Transformation in 2024: A Guide

By Jonas Berge

Transformation of work and new automation approaches improve reliability, sustainability, safety, and productivity.

Imagine an intelligent plant with no surprise equipment failures and no manual data collection—and how it could improve reliability. Imagine no hidden equipment fouling and no undetected flaring—and what it could mean for sustainability. Imagine no surprise loss-of-containment and no undetected leaks or spills—and how it could enhance safety. Finally, imagine no manual valves in the wrong position and no nonuniform temperature profiles—and how it could increase production. This is the vision of efficiency and performance that digital transformation promises for process plants. Since automation technology is essential to any digital transformation strategy, automation software and hardware selection is one of the most important decisions a plant can make.

Why: Plant operational challenges

First, to set the context, consider the operational challenges that drive change in most plants today. Broadly speaking, these challenges fall into four operational domains: safety, sustainability, reliability, and production. Inefficiencies in these areas are often linked to manual tasks like data collection and interpretation.

Manual data collection—by reading mechanical gauges or using portable testing devices—is typically done too infrequently to predict problems and is very labor intensive. In some cases, there may not be sufficient expertise onsite to interpret the collected data. This can cause a host of problems including health, safety, and environmental (HSE) incidents, over-consumption, flaring, emissions, equipment failure, process downtime, loss of containment, and off-spec products.

How: Transformation of work

Plants can overcome these challenges by transforming how work is done across the major operational domains (Table 1) to become more situationally aware, more responsive, more predictive, and more productive. When plant managers set aspirational goals like zero incidents, zero emissions, and zero downtime, digital automation tools, including threat monitoring, performance monitoring, condition monitoring, process monitoring, and remote valve control, make it possible to either meet them all or come very close.

Health, safety, and environment (HSE)	Emergency safety shower and eyewash stations Manual valves Flammable gas Toxic gas	Tank overfill Breather valve and blanketing Pipe corrosion and erosion And getting people out of harm's way.
Sustainability, energy efficiency, and emissions	Steam trap blowing steam or trapping condensate Pressure relief valve safety release and internal passing Air-cooled heat exchanger fouling Cooling tower fouling	Heat exchangers fouling Other over-consumption and losses Methane leaks Lighting power consumption.
Reliability, maintenance, and integrity	Pumps Air-cooled heat exchangers Cooling towers Pipe corrosion and erosion	Inspection rounds Control valves Heat trace system Breather valves.
Production and quality	Field operator rounds Offsite tank farm storage tanks Wellhead and control panel Temperature profile	Local control panels Offsite standby pumps Consumables inventory Manual valves.

Table 1. Common digital automation use cases.

Mechanistic AI is deterministic; it is robust and it is verifiable.

Top-performing plants do this by automating data collection with sensors, automating data interpretation with analytics in artificial intelligence (AI) apps, and automating workflow with Enterprise resource planning (ERP) integration and alarms.

What: A new approach to automation

Many leading companies are deploying a new approach to plant automation that incorporates the latest advances in analytics, sensors, input/output (I/O) schemes, wireless networking, and edge computing to drive top-quartile performance. But the devil is in the details; consider detailed recommendations for realizing this new type of digital transformation strategy that can be done quickly and with low risk.

AI analytics. Attempting to code custom software applications for analytics purposes, or paying a contractor to do it, is more difficult than one might think; it takes time and can be very costly because a business usually must pay for the entire development. Ready-made apps (Figure 1), on the other hand, involve no programming, no testing, no development cost, no delay, and no pilot proof of concept. Ready-made apps are already widely in use, and already offer a proven track record. Most have rich feature sets based on inputs from thousands of other users and so are more capable than custom-coded applications.

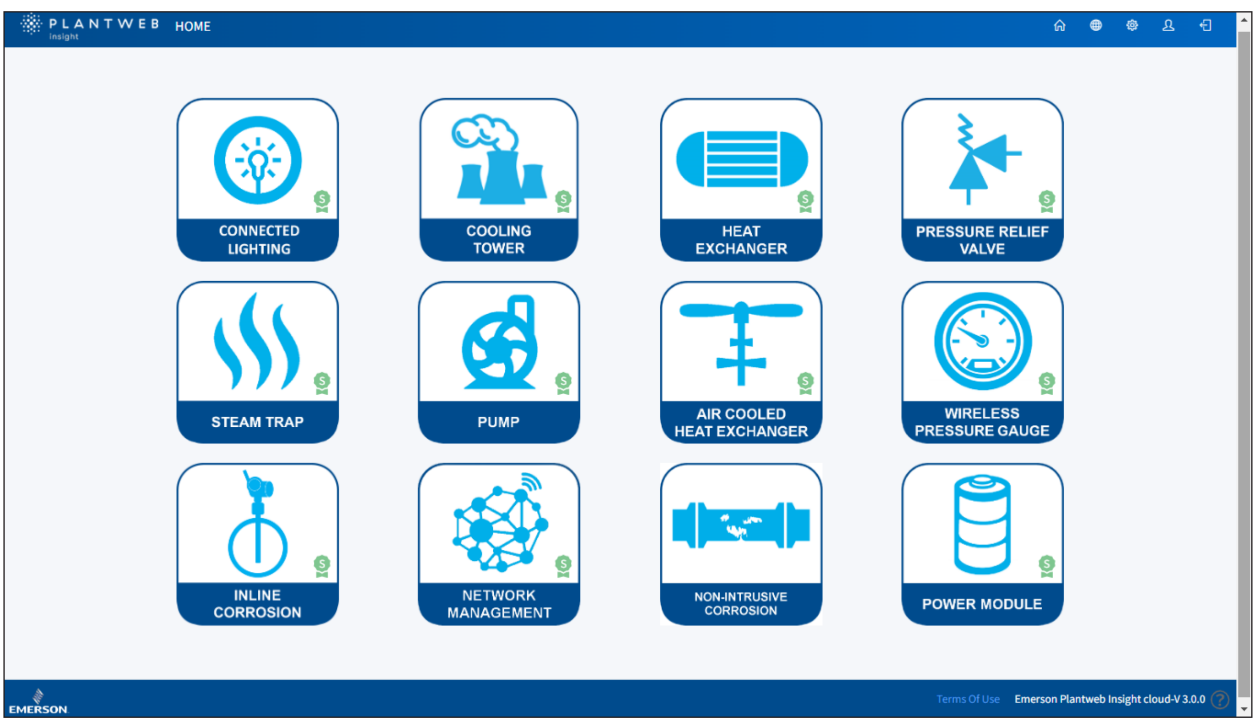


Figure 1. Examples of ready-made apps for common process plant use cases.

Maintenance and reliability engineers typically are not data scientists, so it isn't wise to expose them to data science. It's better to use analytics that require no historical data import, no data cleansing, no algorithm selection, nor any training runs or testing iterations, and do not use unfamiliar terminology. Such industrial analytics tools are much easier to use and require minimal upkeep, which is vital as talent is hard to come by.

An all-purpose data analytics app would furthermore require much customization for industrial use cases. Analytics software specialized for use cases in process plants offer domain-specific features, such as relevant dashboards, detail visualization capabilities, and terminology (Figure 2), are easier to use and are more capable.

Machine learning (ML) is one form of AI that receives a lot of attention lately, but it is not always the best form of analytics for all use cases (Figure 3). Many top-performing plants instead employ engineered analytics with mechanistic AI for equipment and processes with well-known causes and effects, and first principles. Mechanistic AI is deterministic; it is robust and it is verifiable. Deep learning (DL), on the other hand, is used in non-process use-cases like image and speech recognition.

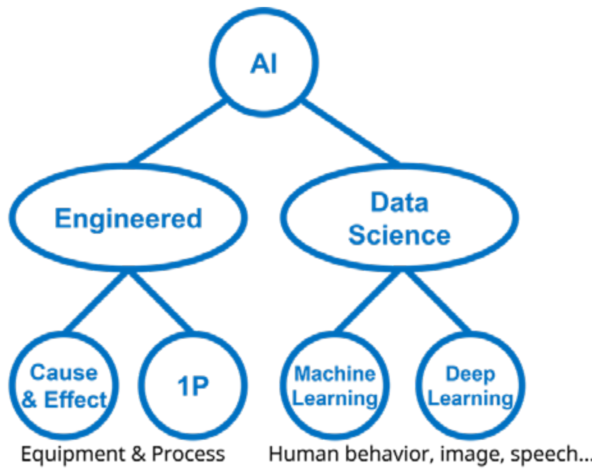


Figure 3. There are many forms of AI, only some of which are ideal for manufacturing.

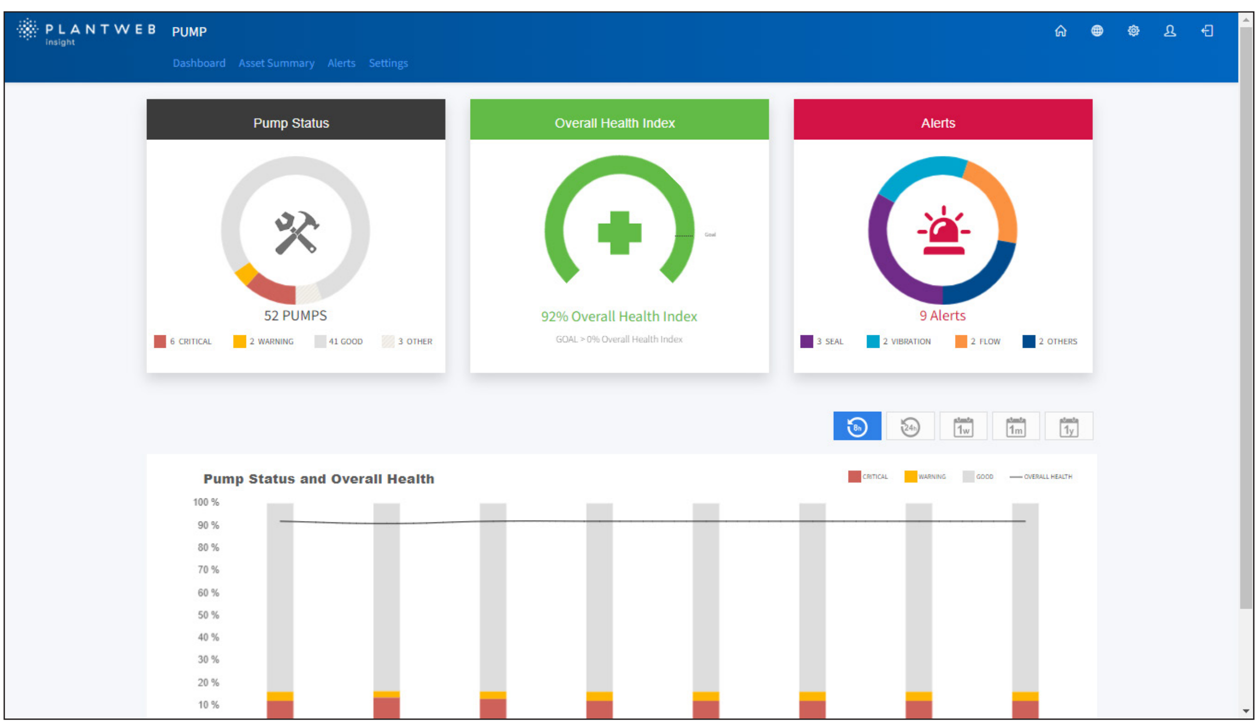


Figure 2. Specialized apps for each domain and task.

While they are ideal for simulation, design, and training, it's often not necessary to build models or digital twins to predict problems. Condition-based analytics tools use "agents" designed to recognize patterns or detect instability and are easier and less costly to deploy and maintain (Figure 4).

ERP systems handle business processes such as accounts and inventory, but will not identify where there are utility leaks, which manual valves are in the wrong position, which heat exchanger is fouling, which process unit is about to have an upset, which pump is about to cavitate, etc. Instead, top performing plants use specialized operations management automation systems consisting of software and sensors for energy management, condition monitoring, and performance monitoring. These technologies use real-time data to provide notifications that pinpoint where in the plant the problem is (Figure 5).

System architecture. In these cases, cloud computing is optional. But if a plant does use the cloud, note that putting business

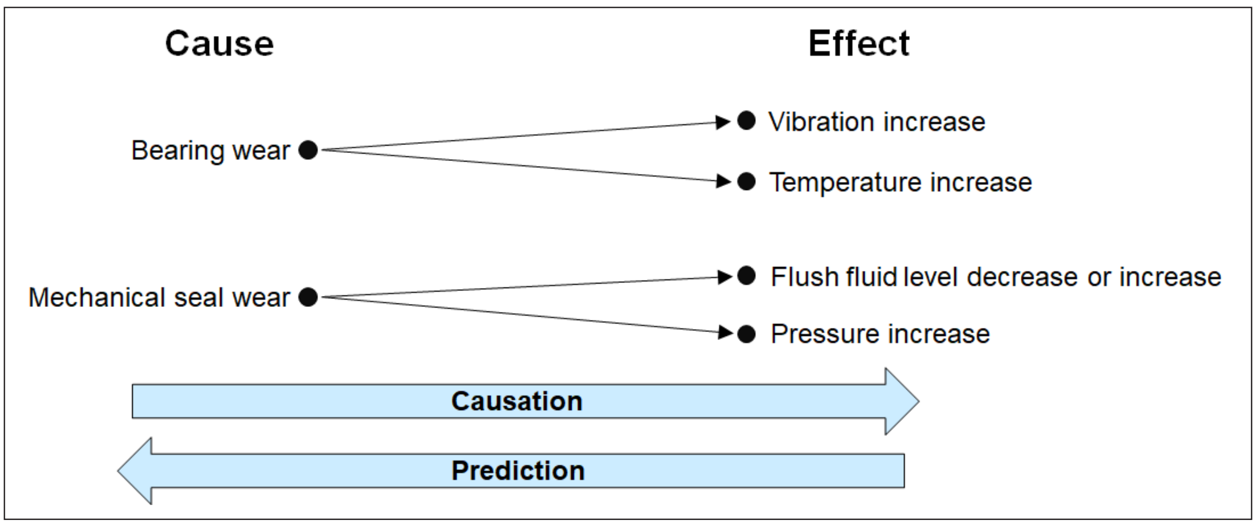


Figure 4. Cause and effect relationships are built into software agents.

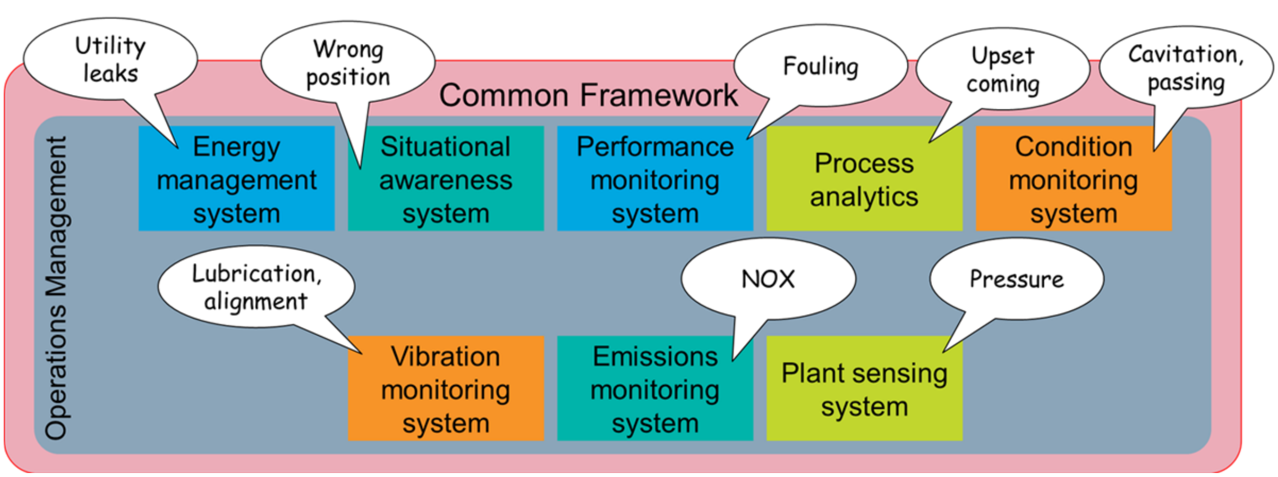


Figure 5. Operations management software for multiple use cases.

administration and plant automation data in the same cloud instance would make security harder to manage. Many plant managers today use an independent cloud instance for plant data and apps as a cybersecurity zone along the lines of the IEC 62443 standard. Some data is passed between the office administration systems and plant automation systems as part of the automatic workflow. For example, pump analytics notifies the ERP/CMMS [computerized maintenance management system] when a pump problem is predicted. Dashboards can show both business and plant data.

IIoT/M+O sensors. The familiar refrain, "You already have all the data," is often not correct. Plants have lots of data, but it is mostly process data. Many plants don't have enough real-time equipment data because that is collected manually using portable testers and by reading gauges. The goal, therefore, is to automate that data collection by installing permanent sensors.

It would be impractical to wire hundreds or thousands of additional sensors in an operating plant, and it would be impractical to cut, drill, or weld hundreds or thousands of additional process connections while the process is running. Instead, top-performing plants use advanced sensors that are wireless and nonintrusive and that bolt onto the outside of the equipment, clamp on to the outside of the pipe, slip between existing flanges, or reuse existing process connections. These may be referred to as Industrial Internet of Things (IIoT) or monitoring and optimization (M+O) sensors. Replacing mechanical pressure gauges with wireless pressure gauges, for example, is relatively easy (Figure 6).

Figure 6. Various types of wireless sensors can take the place of manual data collection.

Native protocols. Existing systems and devices in most plants like programmable logic controllers (PLCs), distributed control systems (DCS), and vibration monitoring systems use Modbus and HART protocols. The easiest way to integrate these systems into new software and systems is to use their native protocols. Therefore, it's best to use systems and software that support HART-IP and Modbus/TCP (Figure 7). This way, no drivers need to be written or tested, and more data is transferred making the system more capable.

OPC-UA. Hiring a developer to code software interfaces to custom application programming interfaces (APIs) often results in costly lock-ins. This can be avoided by using systems and software with standard IEC62541 (OPC-UA) software interfaces. OPC-UA is widely supported in many edge devices, in all modern automation systems, in a large number of apps for all kinds of process automation functions, and in all modern data management platforms. No APIs need to be written or tested. OPC-UA also supports metadata for richer display, automatic server discovery, and a structured information model (IM) for easy data browsing. An operator can both read and write data, and the protocol is supported in all major cloud platforms. In addition, OPC-UA provides transparent integration with older systems using OPC Classic.

Wireless technology. Wireless sensor networking technologies originally designed for smart cities or agriculture do not integrate well with plant automation systems. Instead, most plants use standard IEC62591 (*Wireless*HART) wireless sensor networks. *Wireless*HART enables automatic data conversion to OPC-UA, HART-IP, Modbus, and other industrial protocols without custom coding/programming to a nonstandard API or scripting to parse vendor-specific data formats. This way, data is easily integrated, and no sensor data is left behind. *Wireless*HART enables centralized sensor

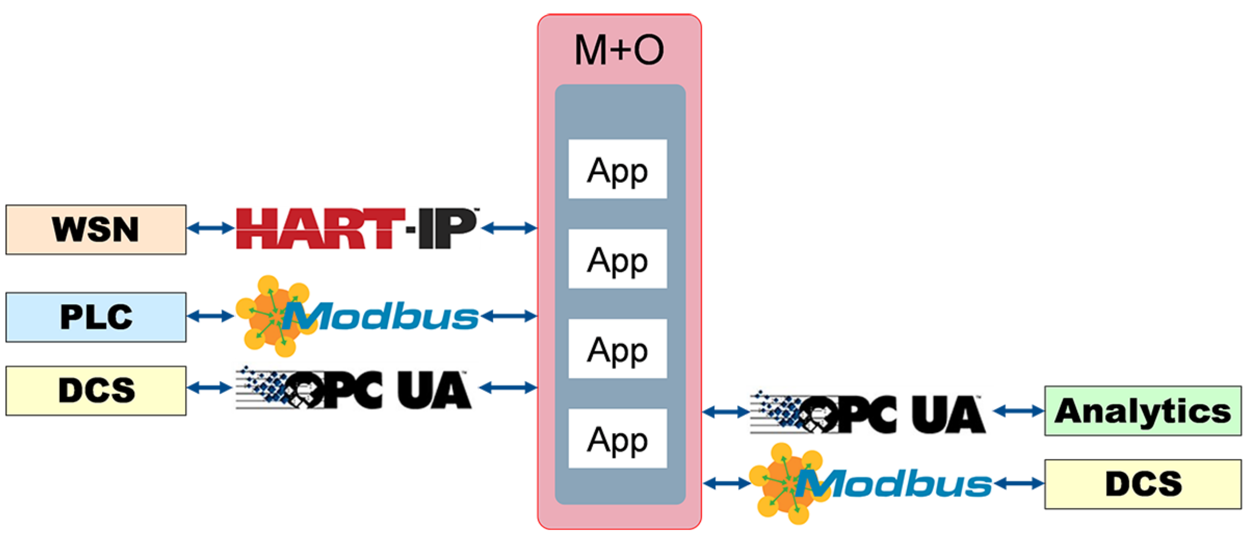


Figure 7. Industrial standard protocols and interfaces.

management such as configuration of remote sensors, and a single common app can be used for diagnostics of all sensors from multiple vendors. Other wireless technologies cannot achieve the same result.

Result

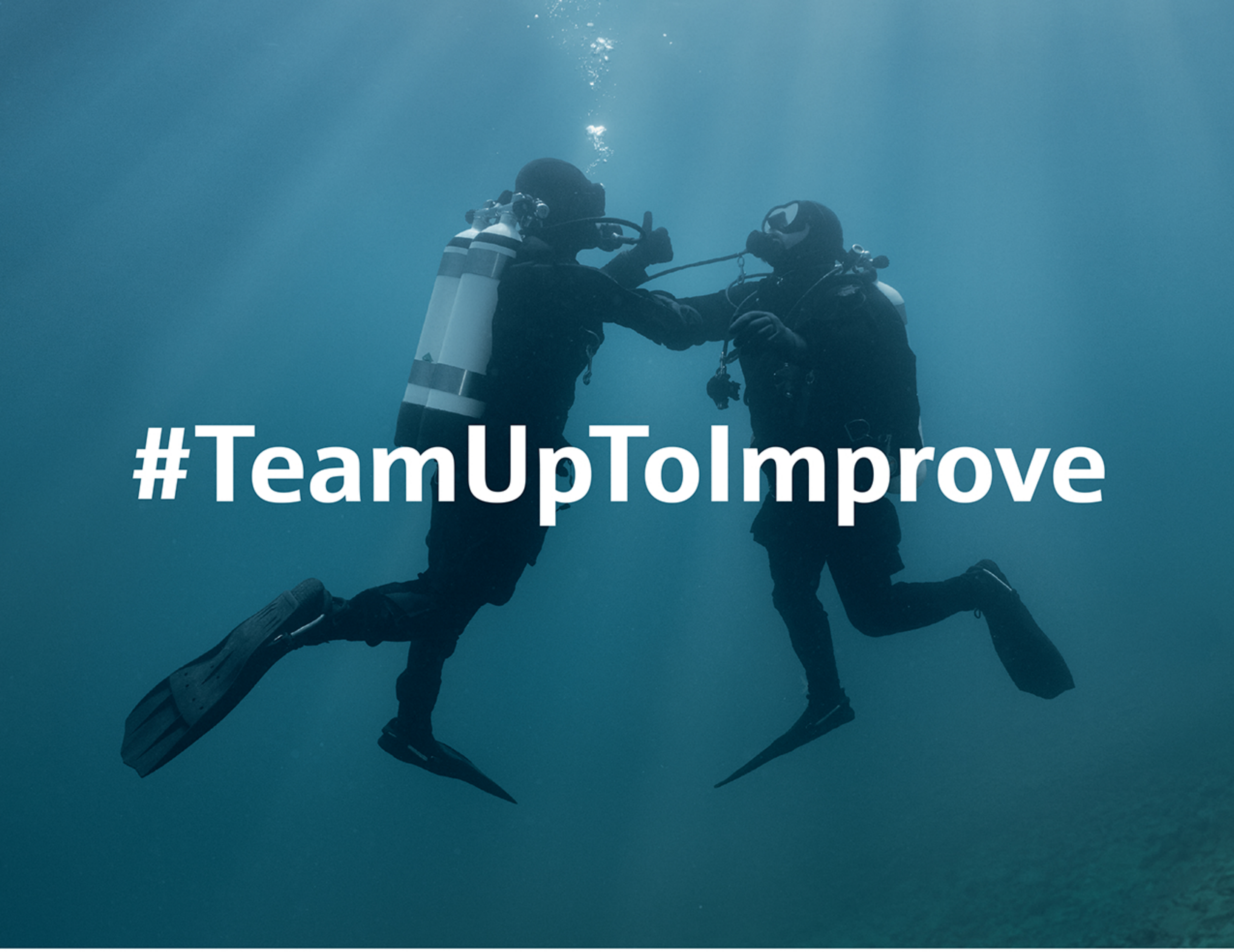
As a result of this new approach to automation and transforming work, plants can operate safer, greener, longer, and faster (Table 2).

Safety, Health, and Environment	Fewer injuries Fewer incidents Reduced clean-up cost Reduced fines
Sustainability, Energy Efficiency, and Emissions	Reduced energy consumption and loss Reduced energy cost Reduced emissions
Reliability, Maintenance, and Integrity	Reduced downtime Reduced loss of containment Lower maintenance cost
Production and Quality	Reduced off-spec product Greater throughput Improved yield Fewer site visits

Table 2. Operational excellence thanks to the new automation.

ABOUT THE AUTHOR

Jonas Berge (jonas.berge@emerson.com) is an ISA Fellow and the senior director of Applied Technology at Emerson in Singapore. He is a trusted advisor for plants and EPCs to adopt new technologies moving the industry forward with digital transformation. He has more than 30 years of experience in the field of industrial automation. Berge is a subject matter expert (SME) in digital transformation (DX)/Industrie 4.0 including data management, analytics, wireless sensors, and the Industrial Internet of Things (IIoT) with particular emphasis on sustainability and decarbonization. Berge is the author of two books and has contributed to several others. He is frequently featured in articles and white papers and is a well-known speaker and panelist. He has also authored a standard and holds patents in safety communications.


#TeamUpToImprove

The Versatility of Signal Interface Instruments

By Bob Myles

Signal interface instruments can be used to share, split, boost, protect, step down, linearize, and even digitize process signals.

Whether they are called "signal isolators," "signal converters," or "signal interfaces," these useful process instruments solve important ground loop and signal conversion challenges every day. Just as important, they are called on to do much more. They can be used to share, split, boost, protect, step down, linearize, and even digitize process signals. This article explains many of the important ways these signal interface instruments can be used, and what to look for when specifying them.

Signal isolation

The need for signal isolation began to flourish in the 1960s and continues today. Electronic transmitters were quickly replacing their pneumatic predecessors because of cost, installation, maintenance, and performance advantages. However, it was soon discovered that when 4-20 mA (or other dc) signal wires have paths to ground at both ends of the loop, problems are likely to occur.

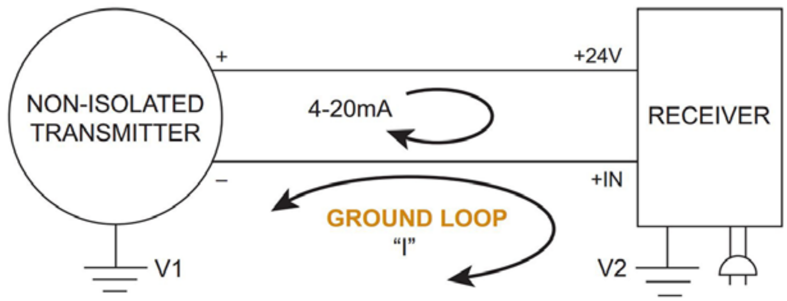


Figure 1. A ground loop forms when the voltages at two ground points in a loop are at different potentials.

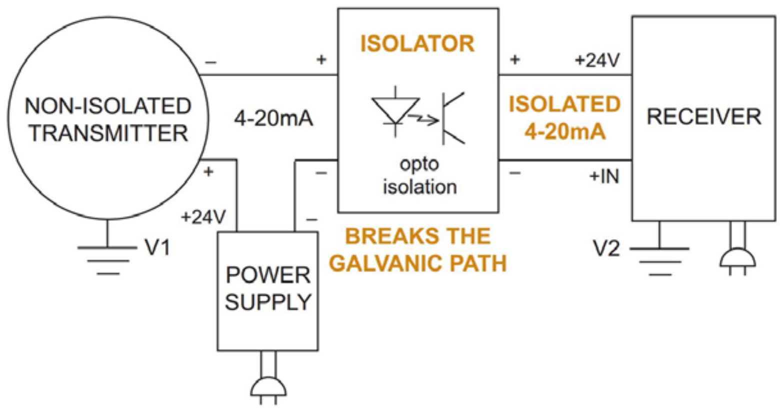


Figure 2. A signal isolator "breaks" the galvanic path between two grounds.

The loop in question may be as simple as a differential pressure (DP) transmitter sending a 4-20 mA measurement to a receiver such as a proportional-integral-derivative (PID) Controller. But when the voltages at the two ground points are different, a circulating, closed current (I) path is formed by the copper wires used for the 4-20 mA signal and ground (Figure 1). When this happens, an additional and unpredictable amount of current is introduced into the loop, which distorts the true measurement. This current path, known as a "ground loop," is a common source of signal inaccuracies.

A ground loop forms when three conditions are present:

1. There are two grounds.
2. The grounds are at different potentials.
3. There is a galvanic path between the grounds.

To remove the ground loop, any one of these three conditions must be eliminated. The challenge is, the first and second conditions are not plausible candidates for elimination because the number of grounds cannot always be controlled, and it is often impossible to just "lift" a ground.

The ground may be required for the safe operation of an electronic device. It's also possible that the ground exists because the instrument is in physical contact with the process, which, in turn, is in physical contact with the ground. From a practical standpoint, one cannot reach into the earth and regulate the voltage at these permanent ground points.

Using a signal isolator to "break" the galvanic path between the two grounds (Figure 2) can correct this situation. When the conductive path between the differential voltages is broken, a current cannot form. Even though there are two grounds and different voltages at each ground, there is no current flow. The ground loop has been eliminated.

Breaking the galvanic path

The duty of an isolator is to break the galvanic path between circuits that are tied or "grounded" to different potentials. A galvanic path is defined as a path in which there is a direct electrical connection between two or more electrical circuits that allow current to flow. Breaking this galvanic path can be accomplished by electromagnetic, optic, capacitive, inductive, and even acoustic methods.

With most industrial measuring equipment, the two prevalent methods chosen for galvanic isolation are optical and transformer.

Optical isolation. Optical isolation uses light to transfer a signal between elements of a circuit. The opto-coupler or opto-isolator is usually self-contained in a small compact module that can be easily mounted on a circuit board.

An optical isolation circuit is comprised of two basic parts: a light source (usually an LED acting as the transmitter) and a photo-sensitive detector (usually a phototransistor) acting as the receiver. The output signal of the opto-coupler is proportional to the light intensity of the source. The insulating air gap between the LED and the phototransistor serves as the galvanic separation between the circuits, thus providing the desired isolation between two circuits at different potentials.

Optical isolation has better common-mode noise rejection, is usually seen in digital circuits, is not frequency sensitive, is smaller, and can sometimes provide higher levels of isolation than transformer isolation.

Transformer isolation. Transformer isolation, often referred to as electromagnetic isolation, uses a transformer to electromagnetically couple the desired signal across an air gap or non-conductive isolation gap. The electromagnetic field intensity is proportional to the input

Two-Way Versus Three-Way Isolation

Two common terms used within the process control industry with respect to isolation are two-way and three-way isolation. Isolation specifications often detail what the isolation levels are from input to output. This is often referred to as two-way (input-to-output) isolation and is the appropriate specification for a two-wire transmitter since it is powered from either its input or output terminals.

However, many manufacturers fail to mention or outline the isolation details when their isolators are four-wire (line/mains-powered) and require 24 Vdc, 110 Vac or 220 Vac to operate its circuits. In these instances, ensure that an isolator has full three-way isolation.

Three-way isolation is defined as input-to-output, power-to-input, and power-to-output isolation. If the isolator is powered by a dc supply, many manufacturers use common signal wires between the output and the power input. In these situations, there could be problems with common mode noise, or a failing switching power supply that could create unwanted output signal errors.

signal applied to the transformer. Transformers are very efficient and fast at transferring ac signals. Since many process control signals are dc, they must be electrically "chopped" into an ac signal so they can pass across the transformer. Once passed, they must be rectified and amplified back into the desired dc signal output.

Signal conversion

Signal converters are used to get legacy signal types, such as 10-50 mA, converted to a standard 4-20 mA or some other signal type that is compatible with a particular receiving device (Figure 3).

Step down dangerous ac signals

Normally, when one thinks of isolators, they think of solving a problem at the instrument control level layer, typically dealing with dc signals. However, very common applications use a signal converter to monitor, trend, or alarm on ac signals. With preventive maintenance budgets shrinking, companies are closely monitoring expensive and critical equipment purchases. Pumps, motors, and fans are quick to fall into this category.

Since much of this equipment is powered with ac voltage and high levels of current, a

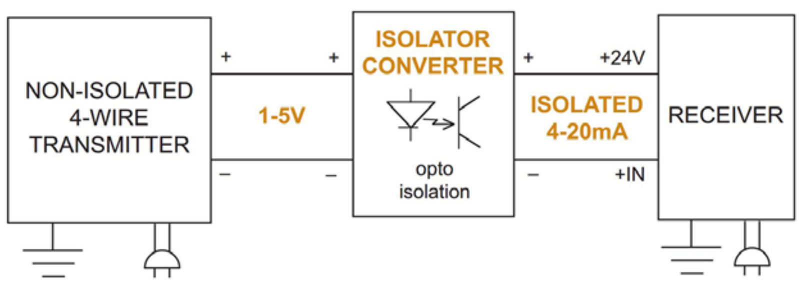


Figure 3. Signal converters convert one signal type to another that is compatible with a particular receiving device.

Fixed Range or Configurable Signal Converters?

There are three approaches to performing signal conversion:

1. One is to use fixed-ranged signal converters designed and built specifically for the conversion need such as 0-10 V in and 4-20 mA out. The advantage is simplicity, as there is nothing to configure. Just mount and wire the device, and you're up and running. The disadvantage is lack of flexibility. If the application changes, the fixed-range signal converter is not easily, or simply can't be, modified to accommodate signal types other than what was originally specified.
2. Another solution is to use a signal converter that has switches or jumpers to select or re-range the input and/or output. There's a little more work to make the instrument suitable to the application, but a configurable signal interface is more flexible in addressing multiple applications or changing signal conversion needs. Fewer instruments need to be kept in stock.
3. The third approach is to use a signal converter that is PC-configurable to provide similar application flexibility, plus some performance enhancements. Usually, the rangeability has more resolution, and there are no potentiometers, jumpers, or switches that can be easily changed without authorization.

current transformer (CT) is installed. The role of a CT is two-fold. First, a CT is used to step down the current to a level that can easily be monitored. Second, safety is always a large concern. No one, especially a plant safety manager, wants technicians used to working with 24 Vdc grabbing hold of 5 amps ac.

A signal converter with an ac current input is used in these situations to convert and isolate a "high level" ac signal to a lower level 4-20 mA dc signal. The secondary of the CT, which is almost always 0-5 amps, can be directly wired into the input of the signal converter. As an added measure of protection, some manufacturers offer an externally mounted CT option that makes use of a "mini-CT" to step the 0-5 amps ac down to 0-5 mA ac. This signal interface with the much lower ac signal is now very safe to wire and handle.

Digital signal conversion

An emerging method of converting signals ignores all the previous rules laid down by analog isolators and converters. This new "digital signal conversion" is becoming especially popular in locations where power is sparse, and wires are few. A common application deals with digitally converting or "mapping" HART digital signals to the popular MODBUS RTU serial communications protocol (Figure 4).

Many programmable logic controllers (PLCs) and distributed control systems (DCSs)—new and old—accept MODBUS RTU, so this becomes a quick and efficient way to get HART data into a control system that doesn't natively accept HART. HART devices and HART signals contain multiple pieces of data per instrument. Therefore, a HART-to-MODBUS converter can be an effective tool when additional process variable and diagnostic data from field instruments are desired.

On the data acquisition side, a remote terminal unit (RTU) or supervisory control and data acquisition (SCADA) system that supports MODBUS RTU can be found. A HART-to-MODBUS converter (Figure 4) represents a new trend in digital signal conversion. Not

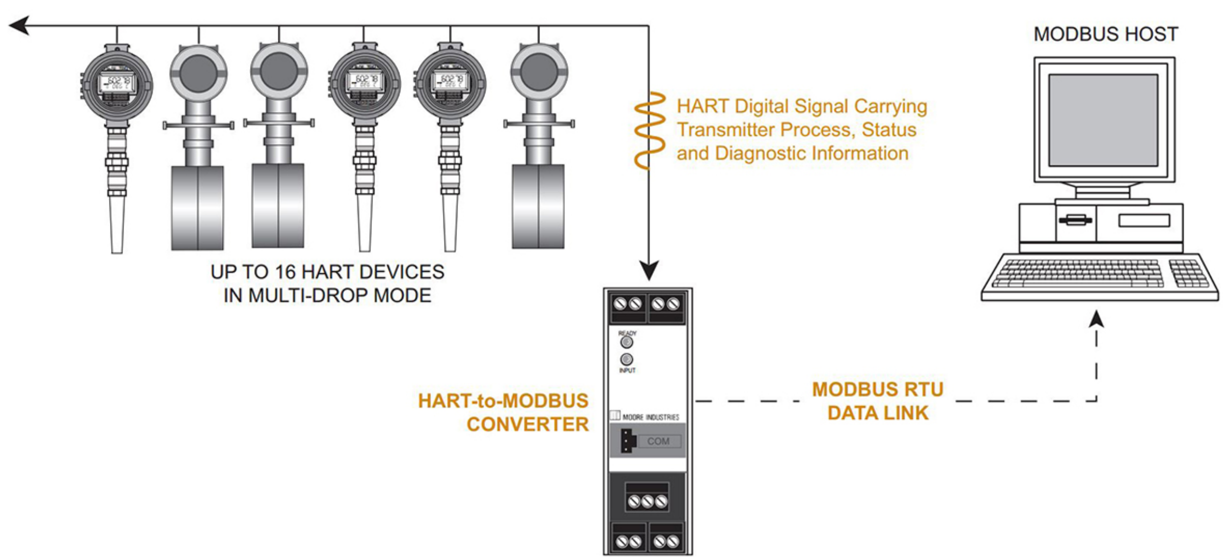


Figure 4. Digital signal conversion is becoming a popular strategy where power is sparse and wires are few.

only does the converter gather all of the HART data from the HART transmitters and convert it to MODBUS, but it also powers the HART bus using its 9-24 Vdc power input. This allows any MODBUS RTU-enabled RTU or SCADA system to monitor any HART variable from any of the up to 16 HART field devices on a multidrop HART network.

Powering an isolator/converter

A signal isolator/converter can be four-wire (line/mains powered) or two-wire (loop-powered). Selecting the correct type of isolator and power configuration depends on the application.

Four-wire signal isolators. A four-wire isolator/converter is used when the instrument output must be voltage (i.e., 0-10 V), zero-based (i.e., 0-20 mA), or bipolar (i.e., -10 V to +10 V). A four-wire isolator usually sources its current output, and typically has a drive capacity of around 1,000 to 1,200 ohms. Some isolators will drive up to 1,800 ohms.

Two-wire signal isolators. A two-wire isolator/converter typically costs less to install than a four-wire unit because power wires don't have to be run to the unit. Loop-powered instruments can be powered from the loop either on their output side or their input side.

Isolators/converters that are output loop-powered are powered just like any other two-wire DP, pressure, or temperature transmitter. The output always has to be some form of 4-20 mA, but signal conversion (such as 1-5 V to 4-20 mA) and split ranging, like a 4-12 mA range, can still be performed. When powered with 24 V, these isolators typically drive into 600 ohms.

A two-wire, input loop-powered isolator is a great solution when applied correctly. The beauty of this isolator is its overall simplicity, with integration into the loop nearly seamless. For example, refer to Figure 5 and imagine that the isolator was not originally implemented. Soon after startup, it is discovered that isolation is required for the process. The good news is that to install this type of isolator, just break the loop where convenient and insert the isolator. A simple solution, wiring changes, and installation costs are minimal.

However, it's also simple to misapply an input loop-powered isolator. Certain "rules" must be followed. An input loop-powered isolator is powered from the four-wire transmitter in the field. The transmitter's 4-20 mA output and its compliance voltage must power the isolator electronics and the isolator's output. Because loop power is limited, the isolator's output load is held to 250

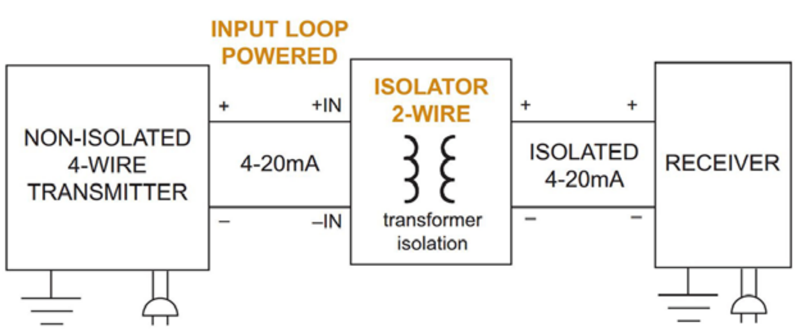


Figure 5. Two-wire, input loop-powered signal isolator/converter.

ohms. The receiver's input impedance can be anywhere from 0 to 250 ohms, and it should be a fixed load. In addition, there can be no voltage on the output of the isolator.

To run the isolator electronics, the isolator consumes 5.5 V from the loop or, to put it another way, the isolator itself looks like a 275 ohm load on the transmitter. To calculate the total burden on the transmitter, add the isolator load to the 275 ohm load. The total load could then be as high as 525 ohms plus wire resistance. That is not usually a challenge for a four-wire transmitter, but it can be for a loop-powered transmitter limited to 600 ohms.

All images courtesy of Moore Industries-International Inc.

ABOUT THE AUTHOR

Bob Myles is director of engineering for Moore Industries-International Inc. He is an exida-certified functional safety practitioner (FSP) with nearly 40 years of experience in development of safety-critical systems for commercial aerospace (DO-178C/ DO-254/ARP4761/ARP4754), military (DO-160), and process monitoring industries (IEC-61508). This article is based on the whitepaper titled "Signal Isolators, Converters and Interfaces: The 'Ins' and 'Outs'."

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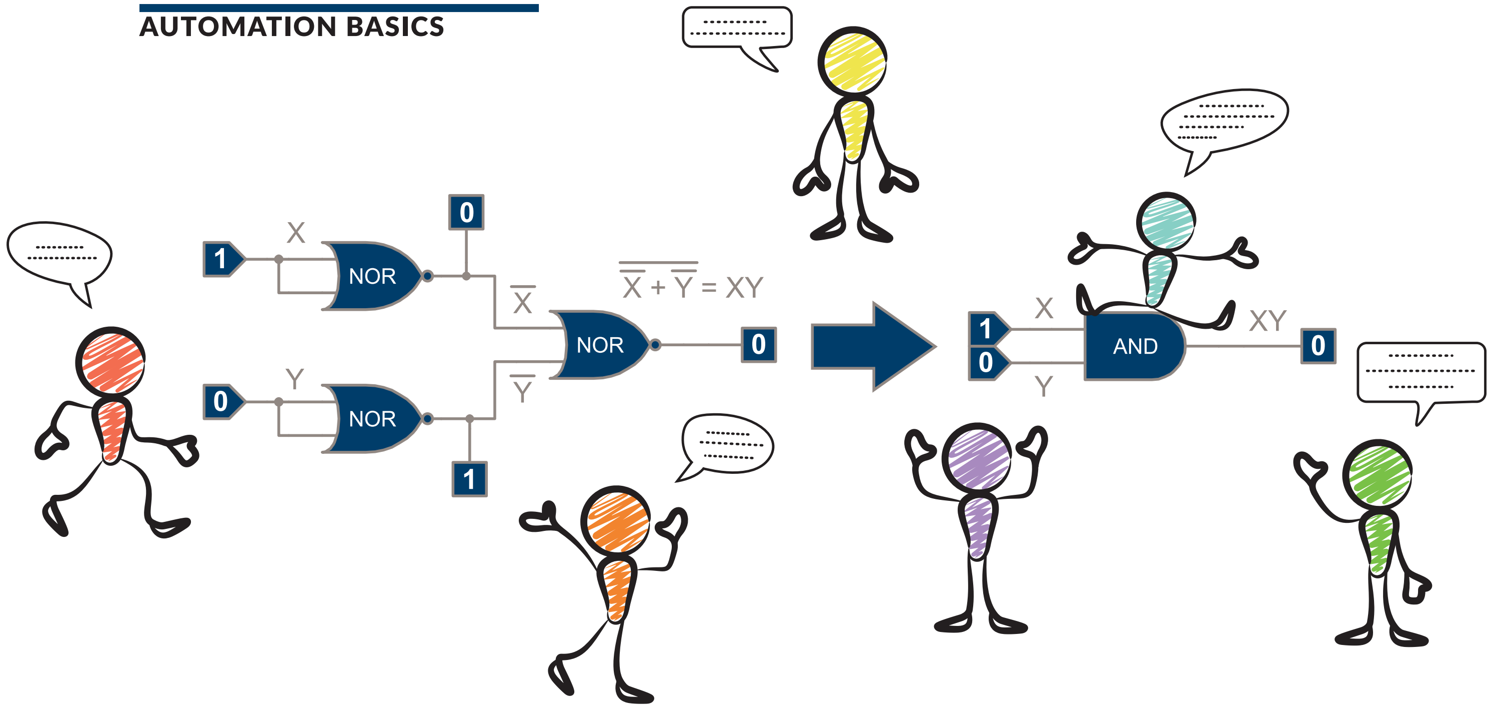


The Importance of Fundamentals

By Dean Ford, CAP, PE

After 30-plus years of continuous learning, an ISA author makes the case for learning the core principles that make automation systems work.

It is hard to believe that I recently surpassed 30 years in the automation business. In the early 1990s, when I started my journey as a co-op student, I was handed a pile of drawings, a couple of documents, and a book on how to program an Allen-Bradley PLC5. It has been an awesome ride since then.

As our world grows more connected, vendors want us to connect their devices directly to our control systems, and others want us to move control out to the edge of our networks. I am not sold on this being a good thing, because automation systems do not handle chaos. The automation programmer usually does not have enough time or background to properly account for every abnormal condition the automation system may face.

These new technologies are exponentially increasing the complexity of our systems without addressing the people who must maintain them. End users are looking for ways to keep things simple and broaden the resource pool that can work for them. A core issue is that we seem to have lost our connection with the automation fundamentals. We can barely maintain what we have and, in many cases, have already lost the battle as workers age out. Even if they are replaced, there is no mentoring or job training program for the new resource. Let us get back to the core principles that make automation systems work.

Start at the beginning

Fundamentally, an automation system is just a bunch of computers talking to each other with ones and zeros. Programmable logic controllers (PLCs) and control programs running on computers are deterministic. "IF" this "AND" that, "THEN" do this "ELSE" do that. A human must work through scenarios and then program all of them into the control system so it can react. Process definition is required for the programmer. Remember the old term "garbage in, garbage out." It does not matter how well you program the system if the mechanical design is junk. Because one can never plan for every scenario, limiting the number of abnormal situations may be better than trying to account for all of them.

I remember troubleshooting a large data highway protocol (DH/DH+) with more than 20 PLC5s, five PLC3s, and a couple of 1774s communicating with each other. The network was slow and unreliable, not performing close to its design parameters. I was a co-op student tasked with figuring it out. The Rockwell Automation technician showed up with an oscilloscope and far less knowledge about the data highway protocol than I had. He brought a book containing a wealth of information about what we should expect to see on the oscilloscope for the different speeds it could run. I learned so much that afternoon. I figured out the oscilloscope and, in a matter of minutes, made several astonishing findings that we quickly corrected to restore the network to its design performance. This started me on my path of learning about the difference between the theoretical and the practical, the office and the field.

One night I was called into a plant after the production train had been down for several hours because they could not establish flow. The maintenance team had tried everything: forcing inputs, changing code, and restarting the train several times. The human-machine interface (HMI) screen showed that all the valves were in the correct position, but still no flow. After listening to what had transpired, I asked if anyone had walked the line yet to see what was happening. Because the train runs every 40 minutes, no one expected anything physical to have changed.

Knowing and understanding foundational concepts will make you a far better control engineer and system programmer, not to mention a much safer person in the field and an expert troubleshooter.

As we opened the door to the production area, we immediately saw that one of the actuators had fallen off the valve, but the air and electrical connections were still connected. The actuator was doing what it was supposed to, but it was no longer attached to the valve body. The team was so focused on the problem being a programming issue that they lost the ability to look beyond it. We must strive not to make assumptions like this. If it worked fine before you made changes and it does not work now, it is highly likely that your changes are affecting it. You missed something and made an incorrect assumption. It is, again, time to get back to basics.

The problem with assumptions

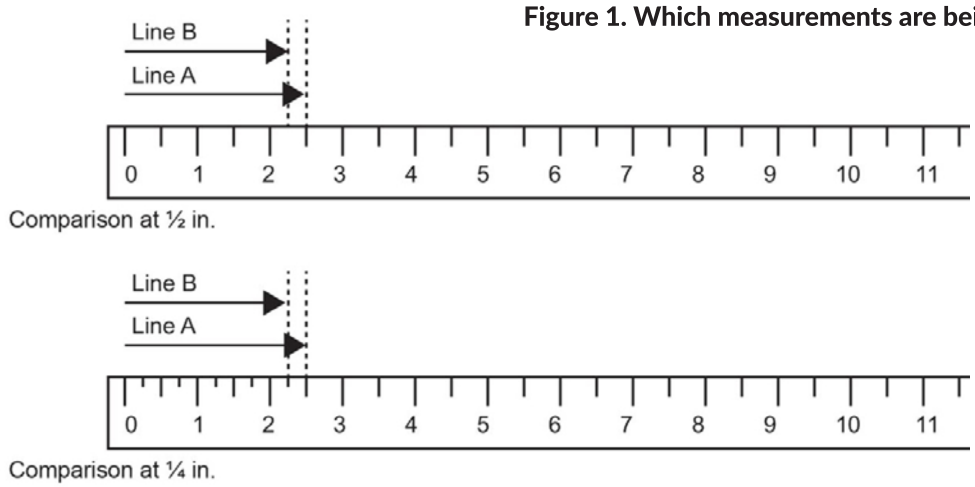
Every decision you make and keystroke you perform in developing a control system comes with many assumptions. How have you validated those assumptions? Are you qualified to make those assumptions? Do you have enough information to make those assumptions? A common issue I often run into is being asked to control something very tightly, but the measurement device cannot provide a value at the same resolution. You may have heard this as "controlling with a micrometer but measuring with a yardstick."

Do you have enough information or knowledge to know the resolution of your measuring device and the abilities of the controlling device? How about the process? Can it be controlled at the resolution the user is asking for? If the desired control is one-quarter-inch but the device can only measure to a half-inch, what should my expectations be about how well I can control the process (Figure 1)?

As more systems are implemented, we are quickly moving away from ac circuits to dc circuits. One thing about ac circuits is you do not have to worry about polarity. In dc circuits, polarity is critical. Even how you measure the circuit with your multimeter is important.

While drafting this article, I had the opportunity to troubleshoot a 600 Vdc short circuit on a label machine. I had to relearn a few of the basics that I had not used in a long time. For example, when measuring a dc circuit, you must maintain polarity on your meter connections to the circuit. I had forgotten that, and the readings I was getting did not make sense. In one case, this led us down the wrong path and wasted valuable time. To understand why this is, you must understand how the components of electronics work (transistors, capacitors, diodes, etc.). Without understanding how these devices work, a lot of energy, money, and downtime is spent arriving at incorrect conclusions and replacing many good components to stumble across the one that failed.

Figure 1. Which measurements are being used?



Four foundational concepts

Automation professionals should have many core foundational concepts committed to memory. The basics like Ohms law, numbering systems, signal conversions, and others are critical to us being successful in our profession. Knowing and understanding foundational concepts will make you a far better control engineer and system programmer, not to mention a much safer person in the field and an expert troubleshooter.

I recommend every automation professional understand these four concepts related to instrumentation and measurements:

1. How a field instrument converts the physical thing it measured to an electronic signal for the controller to use.
2. The opposite of No. 1: How a controller converts the electronic signal to a physical action.
3. The equations used in instrumentation scaling and the potential errors that can enter our systems (such as those for zero and span error, as represented in Figure 2)
4. The different numbering systems available to you (such as octal, decimal and hexadecimal, as shown in Figure 3)

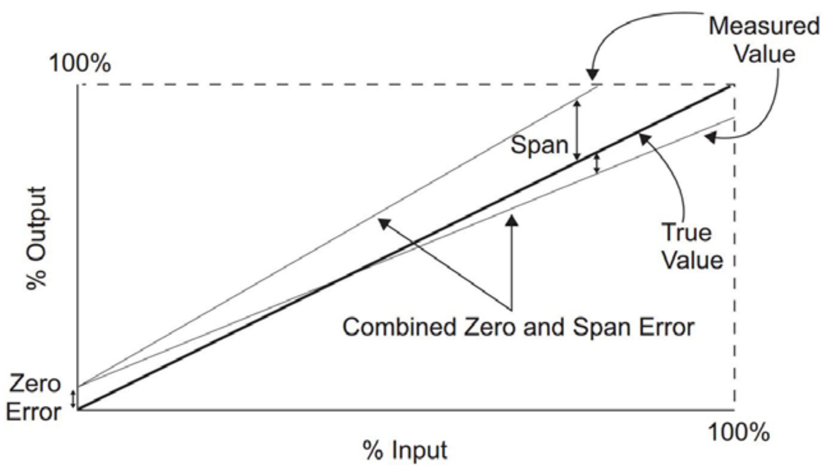


Figure 2. Examples of zero and span error.

Figure 3. Binary numbers 0 through 15.

	Binary	Octal	Decimal	Hexadecimal
	0000	0	0	0
	0001	1	1	1
	0010	2	2	2
	0011	3	3	3
	0100	4	4	4
	0101	5	5	5
	0110	6	6	6
	0111	7	7	7
	1000		8	8
	1001		9	9
	1010			A
	1011			B
	1100			C
	1101			D
	1110			E
	1111			F
Column Decimal Value	8421			

As automation professionals, we must never lose sight of a critical distinction between our work and the work of other technology professionals: Our work controls things in the field.

I had the honor of finishing the most recent edition of a best-selling book on core principles published by ISA, *Basic Electricity and Electronics for Control*, after the death of its original author, Larry Thompson (See sidebar, "Core Principles from Author and Educator Larry Thompson"). The principles in this book are foundational to the automation profession. No matter how smart your phone gets or how artificial the intelligence is, the basic laws of physics and electricity do not change.

As you start work on a new project, ask yourself if you know how the devices you are interfacing with convert their physical work into the logical world. How does that proximity switch or photo eye work? Will it react as you expect it to in various situations? Is the level transmitter the proper selection for the application? Is it configured as the documentation says it should be?

One of the hidden gems in *Basic Electricity and Electronics for Control* is the concept of a test bench or lab. A colleague recently said, "You can't really learn it unless you break it." There is a lot of truth in that statement. Building things in a lab, taking them apart, and putting them back together is a powerful learning mechanism.

Learning to recover from your mistakes is also a great skill. I recommend that everyone has a lab or sandbox at work where they can try new things, fix problems, and learn. I am fortunate to have been engaged in control systems early in my career, and I have worked for some great people who allowed me to learn, make mistakes, and learn some more.

During that next system upgrade, keep the old stuff and set it up in a lab. Keep the devices, instruments, and other parts. Learn how to rebuild them. I am shocked at how often maintenance and automation professionals do not troubleshoot anything. They have become auto mechanics who replace equipment until the problem disappears. Most of the time, it is done in the name of keeping the production system running. However, it causes a long-term loss in production and wastes piles of money by replacing properly functioning parts.

What to know

As automation professionals, we must never lose sight of a critical distinction between our work and the work of other programmers and technology professionals: Our work controls things in the field. Our work makes things move, potentially putting people, equipment, and products in dangerous situations that we did not intend. So, knowing the basics is essential to both operation and safety.

Understand fundamental properties that convert code into physical movement: volts, amps, ohms, and direct current (dc) and the concept of alternating current (ac). Know that ac requires a different approach when using troubleshooting techniques, and one must understand the readings you get on your test equipment. Understanding ac behaviors is essential as most of our modern world uses these behaviors to run industry, to provide information, for medical therapies, and more. To understand ac is to understand the why of modern technology.

Our programs have become bloated and inefficient because memory is cheap and processor speeds are incredibly fast. Knowing the appropriate use of different data types is a foundation of well-written and efficient programs.

To be a great automation professional, you also must know the tools of the trade. Know how to use basic tools, such as multimeters and oscilloscopes, what to anticipate in the measurements, and how to correct the errors.

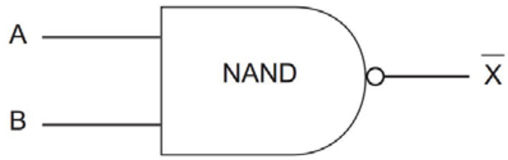
Modern electronic industrial devices are increasingly digital; features provided through software can make a more efficient and scalable networked device that is useful in different environments. While most systems communicate in digital format, the measurements made in industry operate in a continuous or analog world. For the digital device to communicate and control, analog-to-digital (A/D) and digital-to-analog (D/A) conversions are necessary. There are different methods for performing either type of conversion. Know and understand those methods so you will be prepared for the time you work on the systems.

Make the numbers count

Understanding the various numbering systems and data types used in a controller's memory is another important part of our work and one of my favorite topics. It is unfortunate that today's technology creates an environment in which programmers do not have to be efficient.

Processing technology has improved so much that we do not need to worry about efficient programming and how much scan time one instruction uses over another. Different data types, such as double integers versus a float, and how much memory each tag uses are important. Our programs have become bloated and inefficient because memory is cheap and processor speeds are incredibly fast. Knowing the appropriate use of binary, decimal, integer, and double integer data types is a foundation of well-written, elegantly simple, and efficient programs that are easy to troubleshoot.

It is also critical to understand logic. The core of any automation program is to know



$$\overline{A \cdot B} \Rightarrow X = \overline{X}$$

A	B	X	$\overline{X}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

Figure 4. Understanding a NAND gate (left) or logic map is key to writing both PLC programs and documentation.

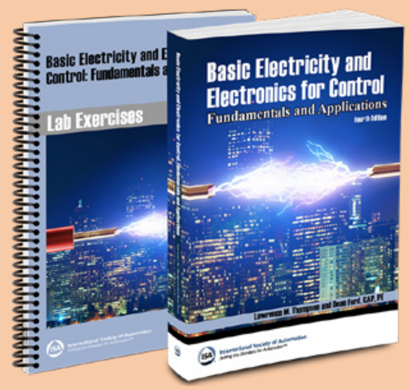
the rules of logic. Understanding AND, OR, NOR, and truth tables is key to not only writing PLC programs but also to writing the functional documentation used to define the process that the program controls (such as the NAND gate and logic map shown in Figure 4).

Final thoughts

After more than 30 years of continuous learning about new technologies and devices and how they fit—or do not fit—into process automation, the one lesson that I want to pass on to every automation professional is to learn and understand the

Core Principles from Author and Educator Larry Thompson

In January 2020, ISA and the world of automation and control lost a passionate and dedicated innovator, educator, and author, as well as a funny, kind, and caring man of great faith. Larry Thompson was dedicated to helping others succeed and expanding the profession. He was also the author of *Basic Electricity and Electronics for Control*.



This student-centered, two-book set focuses on practical applications and provides exercises that simulate real-world applications. The book begins by reviewing the basics, including how to use digital and analog meters, bridges, power supplies, solid-state circuitry, oscilloscopes, and analog-to-digital converters. It expands to more advanced topics, such as understanding how transistors work and their practical application in operational amplifiers. The workbook contains a series of real-world labs so readers can immediately apply the lessons learned.

The principles in this book are core to the automation profession. Even though the original version of the book was written when programmable controllers were just starting, the principles of how devices work have not changed.

Throughout his distinguished career, Thompson was a technician, technical trainer, and course developer in electronics, measurement/

continued on next page

basics. It will make your job easier. It will make the systems you design or create programs for more efficient and easier to troubleshoot, which will increase throughput and profit and reduce waste and downtime.

The value you return to your clients and employers will be exponentially greater when you address problems using the fundamentals.

continued from previous page

control, and computer networking. He was a Certified Automation Professional (CAP) who served as an adjunct instructor for ISA for more than 35 years. He wrote several books, including ISA's *Industrial Data Communication*.

Thompson was a longtime automation professional and owner/general manager of ESdat Co. (Electronic Systems: Development and Training Company), a consulting firm specializing in industrial data communications. A 20-year veteran of the U.S. Air Force, Thompson specialized in maintaining electronic encryption equipment during his service. His post-military industrial experience included test engineering supervisor for numerous companies and department chair for E-Commerce Technology at Texas State Technical College.

Thompson's legacy will continue as those he taught share their knowledge with the next generation of automation professionals, and the books he authored continue to be essential resources. I hope you enjoy the book and workbook as much as I enjoyed supporting the revision.

ABOUT THE AUTHOR

Dean Ford currently serves as the managing principal engineer at Muddy Paws Automation LLC, a firm he co-founded in 2024. His entire career has involved automation systems engineering and consulting. He is a licensed control systems engineer in 24 states and a Certified Automation Professional (CAP). Ford is a senior member of the International Society of Automation (ISA), participates in many industry standards committees, is an active member of the AWWA, WEF, and SWAN industry groups, and is a past AWWA Water Utility Technology and Automation Committee Chair. He is passionate about educating the public and policymakers about the critical role automation plays in the future.

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2024

Cybersecurity Resiliency Takes Center Stage at ISA OT Cybersecurity Summit in London

ISA will host its second annual OT Cybersecurity Summit in London on June 18-19, 2024. This two-track, two-day event focused on operational technology (OT) systems will be organized around two major topics: intelligence evolution and IoT cybersecurity, with additional panel discussions on standards and conformity assessment. In addition to the robust technical program, additional workshops, special events and training opportunities are available.

OT cybersecurity operations resiliency—an industrial organization's ability to identify, respond to, and recover swiftly from a cybersecurity incident—will take center stage with two keynote addresses from two distinguished experts.

Keynote Speaker Sarah Fluchs

Sarah Fluchs is chief technology officer of admeritia, which specializes in security consulting for the process industry, manufacturing, and critical infrastructures. A process and automation engineer herself, she is convinced that creating solid engineering methods that speak the language of automation engineers is key for security in automation. Her main research interest is to help automation security engineering grow up as a discipline.

More specifically, this includes security and systems engineering, understanding security (and safety) as part of a broader resilience engineering, the use of human-readable models to make security engineering more intuitive and the use of machine-readable models to make it more efficient. Fluchs is an active contributor to ISA and IEC standards regarding automation security and the title of her keynote talk is "Security by Design – A Communication Problem?"

Keynote Speaker Simon Hodgkinson

Keynote speaker Simon Hodgkinson is the former chief information security officer for BP and he will be speaking on the intersection of sustainability and cybersecurity. He has said jobs in cybersecurity should enable the business to be successful to deliver on its strategic outcomes.

"That means that we need to think through the lens of is the business operationally resilient, rather than is it just secure from a cyber perspective?" said Hodgkinson. "[At BP] we weren't there to do cybersecurity. At BP we were there to get hydrocarbons out of the ground, there to produce renewable energy or to deliver fuel into retail stations. We were there to enable the business to be successful with appropriate mitigations and controls in place."

Joining event keynotes are more than 30 speakers representing the U.S. Department of Homeland Security (DHS) Cybersecurity and Infrastructure Security Agency (CISA), Rolls-Royce, Siemens, Royal Caribbean, Schneider Electric, Cybeats, exida, Cyber ICS, Exiger, Debian, Surrey Institute for People-Centered AI, National Automation, and more.

Sponsors of the 2024 OT Cybersecurity Summit include OT cybersecurity experts Armis, Cyolo, and Dragos, among others; registration is open. Beyond the technical program are additional special events including:

- A Cyber Escape Room Experience: Imagine you're on the International Space Station, your oxygen system has been hacked and you have 15 minutes to solve the code before you run out of air. Working in a virtual, realistic OT environment, solve puzzles and get answers to achieve your goal before the clock runs out.
- Training: Using the ISA/IEC 62443 Standards to Secure Your Control Systems (IC32)
- Training: Assessing the Cybersecurity of New Existing IACS Systems (IC33)
- Workshop: Incident Command Systems for Industrial Control Systems (ICS4ICS)

ISA standards include ISA/IEC 62443, the world's only consensus-based automation and control systems cybersecurity standards. In addition to developing and maintaining these standards, ISA offers training and credentialing on cybersecurity; certifies products, processes, and systems through its ISASecure certification; and raises awareness about the importance of OT cybersecurity through its membership consortium, the ISA Global Cybersecurity Alliance (ISAGCA).

Claire Fallon, ISA executive director, said, "The ISA OT Cybersecurity Summit stands apart from other cybersecurity events as a venue where attendees can gain practical knowledge about the standard and best practices for its implementation." Past attendees have said, "It's really refreshing to get such a rich group of professionals in the room all talking about the same challenges. ISA represents the leading standard, so it's the right community for these conversations."

—Renee Bassett

Celebrate International Automation Professionals Day April 18

How do you hope to change the world through automation? That's the question that will be asked and answered by automation professionals worldwide in honor of International Automation Professional's Day.

This annual event—started by ISA in 2021 and correlating with the Society's official founding April 28, 1945—celebrates how automation is changing the world for the better. Throughout the day, thoughts and photos come into ISA's social media channels (FaceBook, LinkedIn, YouTube, Instagram, TikTok, X, and Pinterest) using #IAPD or #AutomationProDay hashtag.

Take a peak at some of the responses from last year and then submit your own on the 28th.

—Renee Bassett

ISA Elevates Four Members to 'Fellow' Status

ISA has elevated four individuals to the distinguished grade of ISA Fellow in 2024. The esteemed Fellow member grade is one of ISA's highest honors, recognizing only those Senior Members who have made exceptional contributions to the automation profession, in practice or in academia.

Dr. Soloman Moses Almadi, Ph.D., currently a principal scientist with Saudi Aramco, was recognized for successfully inventing, developing, field-proving and commercializing new technology, Intelligent Integrated Node (IIN), which reduces equipment automation infrastructure from five different vendor devices down to one fault-tolerant device. "I would like to express my sincere appreciation to the leadership at #aramco for their unwavering empowerment and limitless support," said Almadi. "Additionally, I extend special thanks to my family, friends, and all those who have believed in me throughout this remarkable journey. Your encouragement has been instrumental in my achievements."

Jonas Berge, currently senior director of applied technology at Emerson Automation Solutions, is recognized for the development and promotion of models for digital transformation of industrial automation controls. His patents, created with a team, include a revolutionary fieldbus safety system. In this February 2024 issue of *InTech*, see his article, "Digital Transformation in 2024: A Guide," and learn more about him in "A Conversation with Jonas Berge."

Said Berge, "It's a great honor to be recognized and elevated to Fellow by a distinguished organization like ISA, in a technology field as critical as industrial automation. I have always been a technology enthusiast and I encourage other technology enthusiasts to join the automation profession to help solve the dual challenge of increasing the standard of living for a growing population, while reducing environmental impacts."

Dr. Deji Chen, an instructor at Wuxi University in China, was recognized for his ongoing international contributions to industrial Internet of Things (IIoT) technology. He has contributed greatly to WirelessHART, OPC, IEC30141 and IEC30165, and Chinese standards GB/T 38624.1-2020, GB/T 38619-2020, and GB/T 38637.1-2020.

Kevin L. Klein, P.E., currently an instrumented protective systems engineer with Chevron Corp., was recognized for outstanding and significant contributions to the process industries in the areas of Safety Instrumented Systems design, operations and maintenance, Functional Safety and Process Safety.

"ISA is pleased to honor these distinguished achievers who have made exceptional contributions that have positively impacted the automation industry", said Prabhu Soundarrajan, ISA president. A list of past recipients of this honor can be found online. —*Renee Bassett*

ISA Welcomes 2024 Society Leadership

ISA announced its Society leadership team for the term beginning 1 January 2024. These Members of the Executive Board have demonstrated their strong commitment to ISA and to envisioning the role that ISA plays in the future of the automation community.

"I am honored to welcome this new slate of exceptional professionals to ISA leadership," said 2024 ISA President Prabhu Soundarrajan. "International is the first word in our Society's name, and I am delighted to see such a diverse group represented here, representing six countries and with a wide array of experience across ISA and the industry sectors our Society serves."

Members of the 2024 Executive Board include:

- President: Prabhu Soundarrajan, Service by Medallion Inc.
- President-elect Secretary: Scott Reynolds, Johns Manville
- Past President: Marty Bince, EECOL Electric
- Treasurer: Ardis Bartle, Apex Measurement and Controls LLC
- Executive Director: Claire Fallon, International Society of Automation
- Soliman Almadi, Saudi Aramco
- Dean Bickerton, The Reynolds Company
- Francisco Diaz-Andreu, Repsol-ISA
- Nick Erickson, AWC, Inc.
- Colleen Goldsborough, United Electric Supply
- Vivek Gupta, DCM Shriram Ltd
- Eddie Habibi, Zenzero Investments
- Shank Iyer, Amazon Web Services
- Maxym Lachance, BBA
- Carlos Mandolesi, Trinity College Dublin
- Edward Naranjo, Honeywell International
- Megan Samford, Schneider Electric
- Jagdish Shukla, Servilink Systems Ltd.
- Sujata Tilak, Ascent Intellimation
- Jeff Winter, Hitachi Solutions

Nominations Open for ISA Celebrating Excellence Awards

The Celebrating Excellence Awards annually recognize members, volunteers, leaders, sections, and divisions for advancing the mission of the International Society of Automation and contributing to the field of automation.

Visit the ISA recognition page at https://www.isa.org/membership/recognition to view award categories and nominate a colleague through March 31st. The 2024 honorees will be announced in July and recognized at the ISA Automation Summit and Expo, being held September 30 – October 3 in Charleston, SC, USA.

A Conversation with Jonas Berge, 2024 ISA Fellow

Jonas Berge, a newly recognized ISA Fellow, speaks from the Emerson Solutions Center in Singapore where he works to help plant operators and others understand automation solutions for digital transformation, IIoT and the energy transition.

Jonas Berge, senior director of Applied Technology at Emerson in Singapore, is one of four individuals recognized in 2024 by the International Society of Automation as an ISA Fellow. The esteemed Fellow member grade is one of ISA's highest honors, recognizing only Senior Members who have made exceptional contributions to the automation profession, in practice or in academia.

Berge collaborated on two patents describing a revolutionary system for accomplishing safety instrumented systems through digital fieldbus technology. He has authored nearly 100 published articles on topics ranging from fieldbus technology to digitalization of manufacturing to situational awareness in plant operations. ISA Fellow (2001), Richard (Dick) Caro calls Berge "one of the foresightful engineers who enabled the digital transformation of our automation industry worldwide. His development, with a team, of the first fieldbus-enabled safety instrumented system for process control made it possible to design and construct a plant in which all communications were digital over fieldbus, eliminating most analog signals, including the safety systems."

ISA Fellow (2004) David Glanzer said, "Jonas has contributed to the advancement of process automation technology in two critical areas in my experience with him. The first area is in the advancement of using standardized "function blocks" to enable interoperable system solutions to the process industry. The second area is the advancement of oilfield-based safety instrumented systems. He is named as an inventor on US patent 6,999,824 Safety Instrumented Systems in a Fieldbus Architecture."

In an exclusive interview with *InTech* magazine, Jonas Berge answered questions about his distinguished career.

InTech: Can you tell us a bit about where and when you started in industrial automation, and where you are now?

Berge: I started in automation by accident. Back in 1989 or so, I went for a job interview at an "instrument" company thinking I'd fix [Fender] Stratocasters and [Yamaha] DX7s. Alas, it was "signal" conditioners. But I loved the job because every day I worked with customers from different industries, seeing all kinds of plants, and solving all sorts of problems. The job brought me to Singapore where I stayed.

Now, I am working with Emerson [for] many years, still helping plants from different industries with automation for digital transformation and sustainability.

InTech: How and when did you first get involved with ISA? What work with the organization has been most meaningful to you over the years?

Berge: I think I first encountered ISA at the ISA Show, Exhibition, and Conference probably in 1992, maybe earlier. I was impressed by the ISA conference proceedings and books. I wanted to be part of it. A few years later, I met Walt Boyes on the bus at one of the ISA shows. He suggested I write a book on fieldbus, which I did, and ISA published it. This became a huge break in my career. The book [Fieldbuses for Process Control: Engineering, Operation, and Maintenance] and the one that followed [Software for Automation: Architecture, Integration, and Security] helped so many. All the thanks I got from automation folks around the world from this has been very rewarding.

> **In the early days of digital transformation (DX), there was a big focus on digital gadgets and custom software, but it has since become clear that DX is very much mainstream automation.**

InTech: Tell us more about your work on fieldbus safety systems. We notice that your first book came out in 2002. Are you continuing work on this topic? Any more books planned?

Berge: Safety protocols using request-response communication already existed but not for modern time-synchronized publisher-subscriber (PubSub) communication. The network technology we take for granted today was new then. We developed solutions together with TÜV to prove they are safe. Today, many safety protocols use PubSub and time synchronization.

After my second ISA book on automation software, I instead started helping people through early social media like AList and later LinkedIn. I still contributed to a few books but wrote none of my own.

InTech: Tell us more about digital transformation of automation systems and your book "Software for Automation," published in 2005. You've written the *InTech* article for us in this February issue, so is it correct to assume this continues to be a focus of yours?

Berge: The software book was about using more software in automation to operate the plant better, and how to build the software ecosystem securely, tapping into data from the DCS [distributed control system] and other systems using OPC to not be tied to a single vendor software platform. This open automation is still often portrayed as a future vision, but some started doing it back then.

Yes. Digital transformation (DX) of work for operational excellence is what I mostly help plants with. In the early days of DX, there was a big focus on digital gadgets and custom software, but it has since become clear that DX is very much mainstream automation like wireless sensors and readymade software, but much more pervasive. You just need to pick the right ones for each use case.

InTech: What advice or insight do you have for young professionals just starting their automation careers?

Berge: Pick a career you love because love is a better matter than duty. To stand out, you must spend so much time mastering your craft you cannot draw a line between work and play. You must love what you do—not every duty or task, but the overall job must be fun and meaningful. Automation is a meaningful career because it is key to producing safe, clean, reliable, and abundant food and water; energy; light and power;

A representation of Jonas Berge's bookshelf, provided by the ISA Fellow, shows his range of interests and expertise.

daily necessities; paper; clothes; medication; building material; and semiconductors for a growing and more affluent population without damaging our environment.

Emerson's Jim Cahill had this to say about Jonas Berge: "I have tremendous respect for Jonas and his ability to simplify complex topics and make them understandable. He demonstrates these skills in his prolific writings in LinkedIn and industry magazines and in presentations to automation and industry professionals. And, in person, he's very approachable and welcoming to people with whom he comes in contact."

ISA Fellow (2003) Ian Verhappen said, "Jonas continues to promote the digitalization of the automation sector engaging with industry through consultation, presentations, and publications on topics from wireless sensing, integrated asset management using intelligent device diagnostics, and the impact of IIoT on control systems."

ISA Fellow (2011) and member of the ISA São Paulo Section Augusto Pereira said, Berge is "always willing and available to help his colleagues in understanding this technology, even with his multiple activities. Another point I would like to highlight is his humility. [He is] a brilliant person, a winner, but at different times that we were together in project activities and at ISA congresses, he was there with his humility and always with words of support for other colleagues." *—Jack Smith*

Putting Generative AI into Perspective

By Jack Smith

On October 30, 2023, President Joseph R. Biden issued an executive order that called for a "society-wide effort that includes government, the private sector, academia, and civil society" to address artificial intelligence (AI). The order stated that AI holds extraordinary potential for both promise and peril; "Responsible AI use has the potential to help solve urgent challenges while making our world more prosperous, productive, innovative, and secure," he said.

Automation.com is taking on the challenge by increasing its reporting on the industrial uses of artificial intelligence of all types, including generative AI. But industrial organizations can only leverage generative AI successfully by solving the industrial data problem first. Companies must take steps to ensure the promise of AI and avoid the peril.

What is generative AI?

According to Gartner, generative AI can learn from existing artifacts to generate new, realistic artifacts (at scale) that reflect the characteristics of the training data but don't repeat it. "It can produce a variety of novel content, such as images, video, music, speech, text, software code, and product designs."

Generative AI uses several continually evolving techniques. AI foundation models are trained on a broad set of unlabeled data that can be used for different tasks, with additional fine-tuning. "Complex math and enormous computing power are required to create these trained models, but they are, in essence, prediction algorithms. Generative AI most commonly creates content in response to natural language requests—it doesn't require knowledge of or entering code—but the enterprise use cases are numerous and include innovations in drug and chip design and material science development."

"The Definitive Guide to Generative AI for Industry" is a recently released book from Cognite, maker of industrial operational technology software and an Industrial DataOps platform, that discusses the transformative potential of industrial AI. In it, the authors note: "Machines are now equipped with AI-powered capabilities that enable them to adapt, learn, and optimize their performance. AI algorithms can now analyze vast amounts of data collected from various sources to optimize operations holistically, identifying patterns, predicting failures, and making intelligent decisions."

"Generative AI is fundamentally reshaping operational processes and it will be the digital mavericks who will be early adopters of this technology," said Cognite CEO Girish Rishi.

"Safe, secure, hallucination-free generative AI is critical to paving the road to sustainable and profitable global energy supply and manufacturing excellence."

Generative AI in action

Reece Hayden, senior analyst, artificial intelligence lead at ABI Research explained, "In our opinion, there are three main use case buckets. The first is employee augmentation, and we can all understand what that means as simply enabling your employees to [use] generative AI chatbot or summarization tools within their daily workflow. The next is new products and services. This could be implementing predictive capabilities or generative capabilities within software that you provide to your customers. And the third and the highest risk, the highest value use case is automation and optimization."

Sharing a realistic opinion of the state of the market, Hayden said that most users are moving from simply understanding generative AI and using it daily "toward incorporating AI into products and services—like implementing predictive or generative capabilities within the software they provide to their customers."

The reason is technological maturity. The models, applications, and ecosystem aren't ready to support new AI products and services in customer-facing applications, said Hayden. "Enterprises aren't ready to expose themselves to the risk required to produce and deploy these products and services, be that reputational risk or simply that data privacy aspect," he explained.

Hayden said that one of the key trends that will impact the manufacturing sector and the wider generative AI market is open source. "We've seen, in lots of software, that open source is inevitably the winner. The reasons behind this are numerous, [but] the main reason [is] that once you've downloaded and deployed the open source model, you own the output, you own the input, and you can control the data flow. From a researcher's perspective, this is where the growth is: open-source generative AI. We're predicting huge growth in terms of software revenue as we move forward to 2030."

Final thoughts

Biden's Executive Order offers more food for thought—and action: "Irresponsible use [of generative AI] could exacerbate societal harms such as fraud, discrimination, bias, and disinformation; displace and disempower workers; stifle competition; and pose risks to national security. Harnessing AI for good and realizing its myriad benefits requires mitigating its substantial risks."

ABOUT THE AUTHOR

Jack Smith is senior contributing editor for Automation.com and *InTech* digital magazine, publications of ISA, the International Society of Automation. Jack is a senior member of ISA, as well as a member of IEEE. He has an AAS in Electrical/Electronic Engineering and experience in instrumentation, closed loop control, PLCs, complex automated test systems, and test system design. Jack also has more than 20 years of experience as a journalist covering process, discrete, and hybrid technologies.