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InTech provides the most thought-provoking and authoritative coverage of automation technologies, applications, and strategies to enhance automation professionals' on-the-job success. Published by the industry's leading organization, ISA, *InTech* addresses the most critical issues facing the rapidly changing automation industry.

2020 – Looking back and looking forward while seeming to stand still

By Renee Bassett, *InTech* Chief Editor

It's good to look back sometimes . . . to reminisce . . . to indulge in a bit of nostalgia about how times or people might have been sweeter or simpler or more exciting in the past. It's also natural to review accomplishments and note lessons learned from the challenges we've faced. Anniversaries and disasters often spur the reverie, causing people to take stock of where they have been, where they are, and how they got there.

The year 2020 has been full of global disasters—the COVID-19 pandemic, inland and coastal flooding, civil unrest, refugee crises, earthquakes, tornados, hurricanes, and wildfires—but it also brought us the platinum anniversary of the founding of ISA, then the Instrument Society of America, now the International Society of Automation, and this special edition of *InTech*, its official publication. During a summer that seemed to stand still, we at *InTech* were looking back and looking forward toward what comes next.

InTech is a bit younger than ISA, given its start in 1954 as *ISA Journal*, but it has chronicled the passions and challenges of ISA members since the beginning. Members are the heart of ISA, and *InTech* is there for them. So, when 2020 became the year social distancing requirements made IRL (in real life) gatherings impossible and online meeting apps essential, *InTech* happily fulfilled a new role: a place to celebrate the anniversary and learn from those who've been with ISA through the years.

To give you a taste of the knowledge and history embedded in our leader members, we reached out to past presidents, ISA Fellows, and others willing to reminisce and remember (p. 24). Regarding the status of ISA standards work, we gathered stories from volunteers working on some of the most significant and influential, including ISA-88 (batch control), ISA-99 (cybersecurity), and others (p. 40). Automation.com's Bill Lydon offers "Top Tech: 75 Years of Automation Milestones" and "Titans of Automation" (p. 10) to provide technological and human context for Society endeavors.

But we aren't just looking back. ISA and this issue of *InTech* are looking forward. Global megatrends are disrupting the status quo and pushing industrial automation forward (p. 48), and we're committed to helping automation professionals ride the waves of change into 2021 and beyond. For insight related to workforce development, safety and cybersecurity, standards, and manufacturing technology trends including digitalization and Industrial Internet of Things (IIoT), bookmark https://isaautomation.isa.org/isa-megatrends.

Speaking of IIoT, ISA's newest division—Smart Manufacturing and IIoT (SMIIoT)—has grown to encompass more than 800 members and multiple topics, including industrial cloud technologies, machine learning, cyber-physical systems, digital twins, and more (p. 73). These technologies are the future of industrial automation, and ISA members are helping each other understand and apply them.

ISA Fellow Ian Nimmo, a part of our industry for more than 50 years (p.36), admits that "in the early days it was simpler: Everyone was focused on technology within a narrow bandwidth. Today, however, is different, and this creates new challenges for a society that has become so diverse and broad in discipline. The questions we face are: What is the next generation of technology and how does ISA as a society continue to support the needs of such a diverse membership? We need to focus on how ISA has and will continue to evolve with the evolution of its members—especially in an IoT world that answers almost any known question but is limited to what is, not what will be."

May we never stop considering what will be. ■

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The importance of working in the "now"

By Chris Lee

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Chris Lee is a customer success manager at Falkonry. Based in Sunnyvale, Calif., Lee guides customers from use-case concept to successful proof of value to production implementation of the company's machine-learning-driven software that performs time series pattern detection and classification for Industry 4.0 applications.

When you are swapping parts in a compressor for the third time trying to get production restarted, you do not care what was for lunch last Saturday.

With the increased workloads brought on by a competitive market, plant engineers do not have much bandwidth to spare. They are frequently running from crisis to crisis. Their ability to think about historical problems is limited. Unless that history has bearing on an immediate issue, why spend hours, or even minutes, sifting through old data about a problem that was resolved months ago?

Yet this is how industrial analytics projects are frequently carried out today. Assemble a team of highly trained data scientists to look at volumes of historical data, logs, and contextual information (like maintenance records). Then spend months pouring over that data to create and validate models that can predict the behavior of interest—as it happened in the past. It is no great surprise, then, that one of the most difficult parts of these projects is getting timely input from the engineering subject-matter experts (SMEs). Yes. It may help in the future, they say, but how is this helping me now? I'm busy. I want to help, but I just can't, they say. Short of deprioritizing production, what can be done?

Data analytics ought to focus on the problems the SMEs are dealing with today, instead of on problems that happened in the past.

Data analytics ought to focus on the problems the SMEs are dealing with today, instead of on problems that happened in the past. It is like a really smart new engineer who is learning every day by talking with experts about what they are finding. The key to their success is how quickly they learn and put what they learn into action. This is not easy to do with traditional analytics and machine-learning techniques today, but it will soon be. The proliferation of Industrial Internet of Things (IIoT) sensors is putting the power of "now" in the hands of people who need it. What might this look like?

Start with the data you have

A plant's process or production engineer is starting up a new variant of an existing process. The equipment is not new, so there is a history of sensor data from running the old process. However, there is no data about what the new process looks like on this equipment. That is, the individual sensor behaviors, much less the interplay of the various subsystems on the sensors' output, are uncharacterized. Nor is there a history of plant issues peculiar to this process.

Instead of trying to build a physics-based digital twin of the new process, or extrapolating rules from old behaviors, the plant engineer just flags the start of a new use case and begins collecting data. This lets him or her get feedback using insights from current operations.

In a short time, the system establishes what the new, system-level, multivariate "normal" looks like based on a few short, qualitative questions to the engineer each day. As the system finds novel behaviors, it alerts the engineer, explains the insight from the sensor data and past behaviors, and then asks for confirmation about what these events were: Were they different kinds of normal behavior? Were they known, adverse issues? Were they novel conditions? Based on these answers, the system automatically updates its alerts and provides more finely tuned notifications over time.

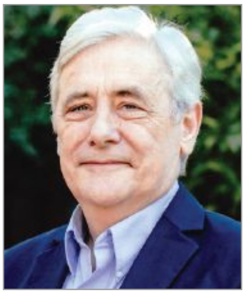
Improve performance while gaining valuable insights

Through this approach, plant engineers see things in real time that they might otherwise have missed. For example, subtle instabilities in the equipment related to certain parameter combinations trigger alerts, allowing a faster response to those instabilities. Or correlations are found between final product quality and alerts of unknown system behaviors, identifying conditions that lead to poor quality. This is done without taking plant engineers out of their day-to-day work. Every minute spent working on analytics saves multiples in lost production.

The traditional way of evaluating analytics is built on historical data. This is fine for those who are not in the trenches keeping a plant operating. But those on the front lines need to stay focused on the *now*. Only by applying analytics to today's operations and validating them on current issues will plant managers gain confidence that the solutions apply to the real problems costing the business today. We need to start from now rather than meandering to it. ■

Technology, innovation, and future of our profession

By Eric C. Cosman



ABOUT THE AUTHOR
Eric C. Cosman (www.linkedin.com/in/eccosman) is ISA 2020 president and cochair of the ISA99 committee on industrial control systems security.

I am very pleased to have been given an opportunity to provide a brief editorial for this special version of *InTech*. Although this year has been challenging for everyone, the volunteer leaders and staff at ISA are working very hard to move forward with our strategy for our Society, positioning it for long-term success as the "Home of Automation."

When I started my career as a chemical engineer, I would have never predicted that automation would be my area of focus for so many years. In fact, of all of my courses in school, process control was the one that I struggled with the most. However, my strong interest in computers and programming led me first to the automation of various process design calculations, then to simulation, and ultimately to the use of computers to visualize and control plant operations. I have never looked back.

Over these many years, a recurring theme that has never failed to excite me is the application of computers and automation to all aspects of engineering and plant operations. Although the laws of physics and chemistry do not change, the processes used to harness them to develop innovative and profitable products are infinite. In virtually all cases, these processes can be improved or optimized using some degree of automation. Some processes, in fact, are so fragile or dangerous that they are impossible to operate without automation.

It is the intersection of data and knowledge with the physical world that I have always found so interesting. This is the essence of engineering, and I am convinced that this is what attracts people to our field.

While the popular caricature of an engineer may be of one who is staid and conservative, I have had the privilege of working with—and learning from—some of the most creative and innovative people I have ever known. A successful engineer must have both an appreciation for and an understanding of proven and effective practices, as well as a curiosity about emerging techniques and technology. This in turn requires sharing experience and expertise.

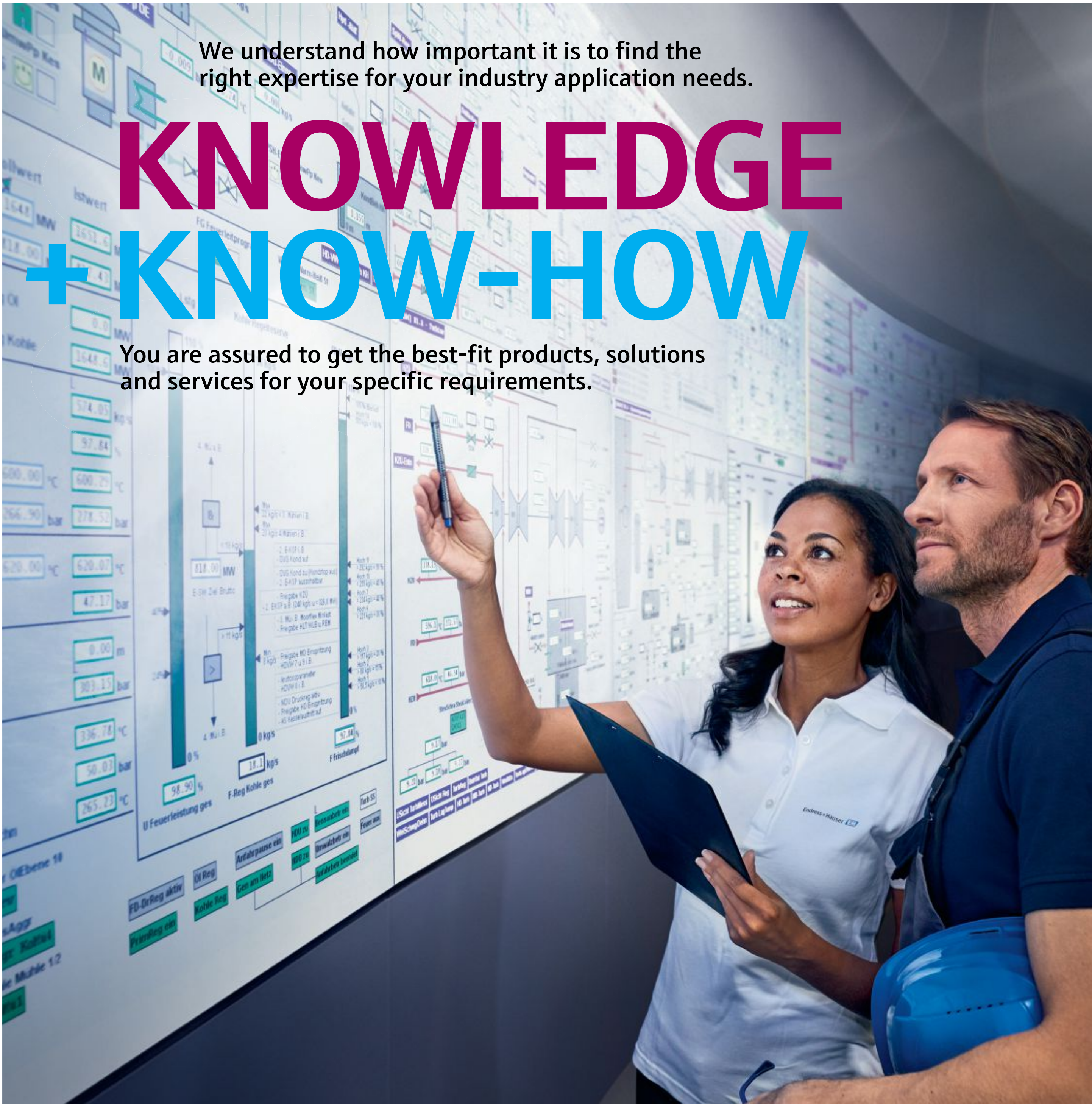
ISA provides a forum for this sharing for automation professionals. This is what a professional association is all about—and ours has been successfully doing that for 75 years.

We come together to share, coach, teach, and learn about all aspects of our profession, from technology and applications to "soft skills," such as leadership and project management. In these and other areas much has changed since our Society was first formed. We have expanded from an instrument society to an automation society, reflecting a much broader focus. We continually strive to expand our reach outside our origins in North America. Meanwhile, industry expectations and enabling technologies continue to change, sometimes at what seems like a breakneck pace.

Over these many years, a recurring theme that has never failed to excite me is the application of computers and automation to all aspects of engineering and plant operations. While the laws of physics and chemistry do not change, the processes used to harness them to develop innovative and profitable products are infinite.

As a Society we must respect and learn from our legacy while responding to these changes and meeting new challenges. I believe that we can do this much more effectively as a community than individually. This is why I am a member of ISA, and why I take every opportunity to attract people both to our Society and to our profession.

Our past is rich and, together, our future promises to be even richer. ■



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Top tech: 75 years of automation milestones

From transistors to the brink of Industry 4.0

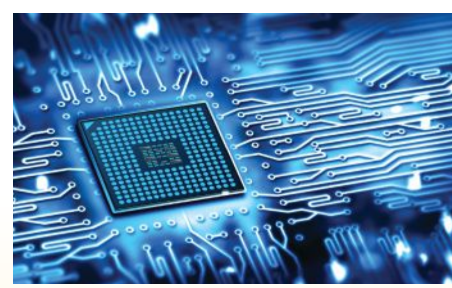
By Bill Lydon

Since ISA's founding in 1945, technology has leapt forward, bounding across the decades to change the world. Industrial automation technology has changed no less than technology for transportation, communication, and commerce, and it has indeed borrowed heavily from innovations in those fields. Now, 75 years later, we are on the brink of the Fourth Industrial Revolution, called Industry 4.0, and a wide range of products, methods, plans, and architectures have allowed automation and controls professionals to step ever onward. Here are the top technology milestones that have marked their path. Below are some of the titans of automation technology—ISA members and others—who furthered the tech, optimized it for industrial operations, and supported others in applying it.

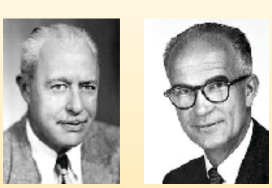
Semiconductors and Moore's law

The significant power spanning from mainframe computers down to embedded processors inside of controllers and sensors is rooted in the transistor, which was invented in 1947 by John Bardeen and Walter Brattain at Bell Labs. Innovations in transistors are the basis of the development of integrated circuits and microprocessors. Even the most powerful processor chips today are measured based on the number of transistors they contain.

The first low-cost junction transistor widely available was the CK722, a PNP germanium small-signal unit from Raytheon, introduced in early 1953 for $7.60 each. Putting cost in perspective, Texas Instruments of Dallas and Texas and Industrial Development Engineering Associates (I.D.E.A.) of Indianapolis, Ind., collaborated on creating the Regency TR-1, the world's first commercially produced transistor radio. When it was released in 1954, the Regency TR-1 cost $49.95 in U.S. dollars (approximately $476 in 2019 U.S. dollars).



Transistors made possible electronic industrial controllers in the 1950s that over time supplanted the application of many



Walter Brattain and William Shockley, transistor inventors

The device that changed everyone's life in industrialized society, including in the process control industry, was the transistor, invented in 1947 by John Bardeen, Walter Brattain, and William Shockley of Bell Laboratories. Arguably the most important invention of this century, the transistor opened the electronics age, driving out many pneumatic or air-based controllers of the 1920s and '30s. The transistor contained three electrodes and could amplify or vary currents or voltages between two of the electrodes in response to the voltages or currents imposed on the third electrode.

Federico Faggin, microprocessor innovator

Microprocessors made industrial controllers of all types practical, and Federico Faggin designed the first commercial microprocessor, the Intel 4004, in 1971. He led the 4004 (MCS-4) project and the design group during the first five years of Intel's microprocessor effort. After the 4004, he led development of the Intel 8008 and 8080. Later he cofounded Zilog, the first company solely dedicated to microprocessors, and led the development of the Zilog Z80 (used extensively in controllers) and Z8 processors. The influence of microprocessors continues; they are embedded in sensors, actuators, and other end devices. Microprocessors are fueling the implementation of Industry 4.0, industrial digitalization, and IIoT. In 2010, Faggin received the 2009 National Medal of Technology and Innovation, the highest honor the U.S. confers for achievements related to technological progress.

Richard Rimbach, ISA founder and first secretary

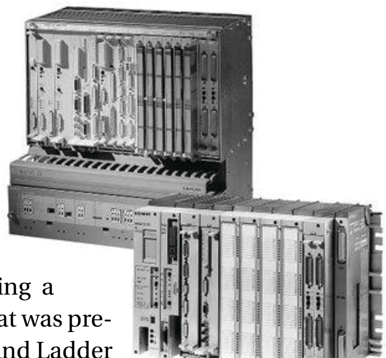
ISA was officially born as the Instrument Society of America on 28 April 1945, in Pittsburgh, Pa., U.S. It was the brainchild of Richard Rimbach of the Instruments Publishing Company and grew out of the desire of 18 local instrument societies to form a national organization. Rimbach graduated from MIT with an engineering degree and was the first executive secretary of the Instrument Society of America. Industrial instruments, which became widely used during World War II, continued to play an ever-greater role in the expansion of technology after the war. See www.isa.org/about-isa/history-of-isa.

pneumatic or air-based controllers of the 1920s and '30s.

The cost of solid-state electronics is a history of delivering more power at lower cost. It was expressed in Moore's law, which has stood the test of time since it was first defined by Gordon Moore, the cofounder of Fairchild Semiconductor and CEO of Intel. In a 1965 paper, he described a doubling every year in the number of components per integrated circuit, and projected this rate of growth would continue for at least another decade. Moore's law continues to drive computing technology as evidenced by the sophistication and miniaturization of commercial and industrial devices.

The Internet of Things (IoT) is possible because of continued high-performance electronics and processors that continue to get smaller in size and lower in price.

Programmable logic controller (PLC)



The first PLC was delivered to General Motors in 1970 to control metal cutting, hole drilling, material handling, assembly, and testing for the Hydramatic Model 400 automatic transmission. The two ingredients for success were using a computer to solve logic that was previously done with relays, and Ladder Logic Programming that empowered electricians to program the computer from their base knowledge. Before the PLC, huge banks of relays were used. They consumed a large amount of space, were dependent on mechanical relay reliability, were hard to troubleshoot, and required significant hours of rewiring to change the logic for any reconfiguration.

Richard Morley, a Bedford engineer, is credited with the original design. He and his team of engineers created a solid-state, sequential logic solver, designed for factory automation and continuous processing applications: the first practical programmable logic controller. It was called the "Modicon 084," because it was the 84th project at Bedford Associates. Upon learning of GM's requirements, the company demonstrated the Modicon 084 to General Motor's Hydramatic Division in November 1969.

Ladder Logic Programming was a huge advantage for working electricians. Much like spreadsheets that later empowered accountants and others, users could program a computer in an easy-to-understand way. Bedford Associates' Ladder Logic incorporated symbols from electrical engineering to depict sequences of operations. In his article, "Ladder Logic Languishing?" published in the April l992 issue of *Manufacturing Systems,* inventor Morley recalled:

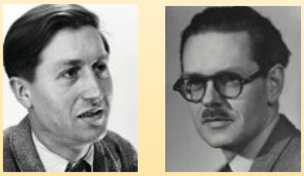
"Ladder Logic, as a control language, was first used in conjunction with silicon devices around 1969 at Bedford Associates. To support the control language, a hardware platform was devised that had three constituent elements: a dual-ported memory, a logic solver, and a general-purpose computer. Early at Modicon, we used a degenerate form of ladder representation. The great advantage was that the language could be understood by any working electrician in the world. Later the language was expanded to multi-node, and additional functions were added . . . Ladder Logic functionality and PLC adaptability

Albert F. Sperry, ISA founder and first president

Albert F. Sperry, chairman of Panelit Corporation, became ISA's first president in 1946. The same year, the Society held its first conference and exhibit in Pittsburgh. The first standard, RP 5.1, *Instrument Flow Plan Symbols,* followed in 1949, and the first journal, which eventually became *InTech*, was published in 1954. Representatives from regional societies first gathered in New York on 2 December 1944. ISA was officially founded on 28 April 1945, with 15 local instrument societies and about 1,000 members. Sperry was the first president; Karl Kayan, a professor at Columbia University, was vice president; Clark E. Fry of Westinghouse was treasurer; and Richard Rimbach of Instruments Publishing Co. was secretary.

Glenn F. Harvey

ISA executive director for 32 years, Glenn F. Harvey oversaw ISA's direction and saw the focus shift from valves and other electrical, mechanical, and pneumatic instruments to microprocessors and PCs to a solutions-based, software-driven discipline. Under his leadership, ISA grew from a few thousand members to a peak of more than 60,000 members during the 1990s.



A. T. James and A. J. P. Martin, gas-liquid chromatograph

In 1952, A. T. James and Archer John Porter Martin developed the process of gas-liquid chromatography, a technique for separating and analyzing a mixture, for which they later received the Nobel Prize. This technique dramatically improved the speed, accuracy, and sensitivity of previous chromatographic procedures. By 1956, a company called Beckman Instruments was marketing the first gas chromatograph.

quickly spawned an entire industry."

The advantage that the PLC brought to the control industry was the ability to program the system, which could not be accomplished with electromagnetic relay panels. The panels had to be rewired when control schemes changed. In contrast, the new PLC could be changed much more easily and faster, and also had the advantage of a much smaller footprint.

Distributed control system (DCS) architecture

The introduction of the Honeywell TDC 2000 in 1975 was the beginning of commercial DCSs. It was the first system to use microprocessors to perform direct digital control of processes as an integrated part of the system. This distributed architecture was revolutionary with digital communication between distributed controllers, workstations, and other computing elements. Computer-based process control systems before the TDC 2000 were mainly data collection and alarm systems with control done by pneumatic loop controllers and standalone electronic proportional, integral, derivative (PID) controllers.

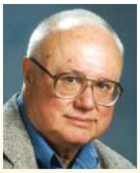
About the same time in the mid-1970s, Yokogawa in Japan introduced a distributed control system called the Centum. The Yokogawa Centum and Honeywell TDC 2000 were based on the concept that several microprocessor-based loop controllers could be controlled by supervisory minicomputers. The operator would have a push-button, cathode ray tube (CRT) based display rather than an annunciator panel. The controllers would be connected together on a data highway that would carry the information from the various nodes or stations. The highway, or bus, would serve as a signal route. The design would move the controllers back to the process, shorten the control loops, and save on wiring costs.

Personal computer (PC)

In 1981, IBM introduced the personal computer using what was to become the standard disk operating system (DOS), created by Microsoft. The PC was a general-purpose computer at a cost point significantly below that of minicomputers. The PC architecture leveraged the innovation and creativity of a wide range of developers with an open hardware bus for add-on cards and an open operating system that developers could use to run their own applications. The openness of the PC platform dramatically broadened available applications, unleashed creativity, and created an ecosystem of developers serving a variety of needs. The PC revolution was on, and industrial automation benefited greatly.

Human-machine interface (HMI)

The development of human-machine interfaces in process control began with a CRT-based system where an operator could read the relative position of process variables "at a glance," allowing the operator to develop a pattern recognition method



Dick (Richard) Morley, father of the PLC
Dick Morley is considered the father of the programmable logic controller (PLC), which was conceived by his team at Bedford Associates. Morley also supported ISA and encouraged young automation professionals to join.
Morley and his team of engineers developed a solid-state, sequential logic solver designed for factory automation and continuous processing applications: the first practical programmable logic controller called the Modicon 084. The company demonstrated the Modicon 084 to General Motor's Hydramatic Division in 1969 and delivered the first commercial unit to GM in 1970 to control metal cutting, hole drilling, material handling, assembly, and testing for the Hydramatic Model 400 automatic transmission. The new system replaced the large electromagnetic relay panels that GM previously used to identify where problems had occurred.
The PLC allowed those in the control industry to program the system, which was not possible with electromagnetic relay panels.

Karl Åström, father of adaptive control
Karl Johan Åström is a Swedish control theorist who made contributions to control theory and control engineering, computer control, and adaptive control. In 1965, he described a general framework of Markov decision processes (MDPs) with incomplete information, which led to the notion of a partially observable Markov decision process (POMDP). A POMDP models an agent decision process in which it is assumed that the system dynamics are determined by an MDP, but the agent cannot directly observe the underlying state. Instead, it must maintain a probability distribution over the set of possible states, based on a set of observations and observation probabilities, and the underlying MDP. The POMDP framework is general enough to model a variety of real-world sequential decision processes. Applications include robot navigation problems, machine maintenance, and general planning under uncertainty. Leslie P. Kaelbling and Michael L. Littman adapted it for problems in artificial intelligence and automated planning.

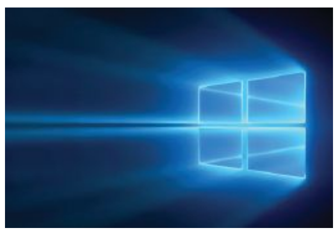

Bill Gates and Paul Allen, Microsoft founders
Microsoft Corporation, founded by Bill Gates and Paul Allen on 4 April 1975, has and continues to have a significant impact on accelerating the creation and application of valuable industrial control and automation software. Microsoft Windows and server offerings in particular are a platform for a wide range of innovative, creative, and valuable industrial applications. More continue to be developed by industrial control and automation subject-matter experts.

of analyzing the current plant operating situation. Honeywell's TDC 2000, which arrived in 1975, drastically changed the pace of operator console development.

The availability of PCs running DOS and using third-party graphic image software spawned a new breed of HMI solutions around 1985. New companies included Intellution, Iconics, and USDATA.

The next big step was in 1987 when Wonderware introduced InTouch, the first Microsoft Windows–based HMI that added significant features and open interfaces to information technology (IT) and business systems.

Microsoft Windows



Microsoft Windows, introduced in late 1985, had a profound impact on industrial automation. Starting with Wonderware InTouch software, it was later adopted by virtually all industrial automation suppliers, even though they initially took the position that it was not appropriate for industrial and process automation.

Microsoft introduced Windows on 20 November 1985 as a graphical operating system shell for MS-DOS in response to the growing interest in graphical user interfaces (GUIs). Microsoft Windows was a complete, integrated operating system that dominated the world's PC market with more than 90 percent of market share, overtaking Mac OS, which was introduced in 1984. On PCs, Windows is still the most popular operating system.

Microsoft Windows' rich environment spawned a large ecosystem of developers who wrote software for a wide range of applications. These included databases, analysis, advanced control, manufacturing execution systems (MESs), batch management, production tracking, and historians.

Microsoft Windows became the way to bridge real-time plant operations with IT and business systems for more unified and coordinated manufacturing and production. The Microsoft Windows operating system platform allowed users to leverage standard IT tools to analyze manufacturing data and share production and plant information seamlessly with business systems. Windows provided the platform for development of OPC, which significantly simplified software drivers for industrial networks and equipment interfaces.

Data historians

A wide range of scientific and engineering applications established the value of time series historic data, which became widely available for control and automation when PCs made it practical. OSIsoft, which started as Oil Systems Inc., introduced the PI System (or Plant Information System) that led to the wide adoption of historians. Patrick Kennedy founded the company in 1980 and is considered the father of plant historians. Historians have become an important tool in many types of industrial manufacturing and process control applications to improve productivity, efficiency, and profits. Historian information is used by automation engineers, operation staff, and businesspeople for many different kinds of applications. Standing the test of time and proving continuing value, historians are now being embedded in controllers and on cloud servers. Watch this great video by Pat Kennedy for more information about real-time data infrastructure: https://tinyurl.com/ISA75f1a.

Larry Evans, pioneer in process modeling

Larry Evans started as an MIT chemical engineering professor and principal investigator of the ASPEN Project, a major research and development effort. The purpose of the project was to develop a "third-generation" process modeling and simulation system that could be used to evaluate proposed synthetic fuel processes both technically and economically.

When the project was completed in 1981, Evans, along with seven key members of the project staff, founded Aspen Technology, Inc. (AspenTech) to license the technology from MIT and to further develop, support, and commercialize it. As CEO at AspenTech, Evans greatly expanded the breadth and depth of the technology over the ensuing years and brought on board a wide range of complementary products. The company grew from a 10-person startup to a public company.

Dennis Morin, founder of Wonderware

Dennis Morin founded Wonderware in 1987. His vision of Microsoft Windows–based HMI was inspired by an early 1980s video game that allowed players to digitally construct a pinball game. He figured operators monitoring factory operations would be more productive with a machine that was fun and easy to use. Wonderware marked the beginning of the Microsoft industrial software revolution that opened the industrial and process control systems architectures to third-party developers. In 2003, *InTech* magazine listed Dennis Morin as one of the 50 most influential innovators in the history of industrial automation.

In one of the great rags-to-riches entrepreneurial stories of the 1980s, Morin was 40 years old when he was terminated by Triconex and started Wonderware. He drove a taxi in Boston before coming to California in the 1970s. He told his idea to a young technology wizard, Phil Huber, who joined him in forming Wonderware.

Patrick Kennedy, father of plant historians

Patrick Kennedy, considered the father of plant historians, founded Oil Systems, Inc. (now OSIsoft), and the Plant Information System became the first OSIsoft product that was widely deployed throughout industry. Historians have become an important tool in a range of industrial manufacturing and process control applications to improve productivity, efficiency, and profits. Historian information is used by automation engineers, operations, and businesspeople for many types of applications. Standing the test of time and proving continuing value, historians are now being deployed embedded in controllers and on cloud servers.

Kennedy earned a BS and a PhD in chemical engineering from the University of Kansas.

A registered professional engineer in control systems engineering, he holds a patent on a catalytic reformer control system.

Open industrial networks

Open industrial networks that encompass sensors, control, and communications significantly simplified the applications of control and automation. This marked the beginning of being able to use sensors and devices from multiple vendors in a single system with a common communications interface. Open industrial communications networks became possible using commercial technology as general electronic and communications technologies advanced.

Starting in 1979, Modbus enabled communication among many devices from multiple vendors by leveraging the RS-485 standard. The standard defined the electrical characteristics of drivers and receivers to use in multidrop, serial communications systems to connect a wide range of controllers, sensors, instrumentation, PID controllers, motor drives, and other devices. Modbus is still prevalent in products, manufacturing, and process plant applications.

In the late 1980s and into the 1990s, there was a proliferation of fieldbus communication standards. Prominent ones that survived include DeviceNet, Profibus, SERCOS, ASi (Actuator Sensor Interface), Foundation Fieldbus, and HART (Highway Addressable Remote Transducer). The HART Communication Protocol, the only one not purely digital, is a hybrid analog + digital industrial automation open protocol. Its most notable advantage is that it can communicate over legacy 4–20 mA analog instrumentation current loops, sharing the pair of wires used by the analog-only host systems.

ISA-88 batch control standards

The ISA-88 (ANSI/ISA-88) series of standards for the design and specification of batch control systems widely used in process control industries has had a significant impact on productivity that continues with wide adoption throughout the world. The ISA-88 addresses batch process control for implementing a design philosophy to describe equipment and procedures applicable to software implementations and manual processes. The first standard in the series was approved by ISA in 1995 and adopted by the IEC in 1997 as IEC 61512-1.

ISA-88 BATCH

ISA-88 provides a consistent set of standards and terminology for batch control and defines the physical model, procedures, and recipes. The standards address a wide range of needs, including creating a universal model for batch control, common means for communicating difficulty in expressing user requirements, integration among batch automation suppliers, and simplification of batch control configuration. ISA-88 has been instrumental in bridging all aspects of batch production from the plant floor to enterprise systems. It is worth noting that the PackML standard uses ISA-88.

ISA-95 enterprise-control system integration standards

The ISA-95 (ANSI/ISA-95) enterprise-control system integration standards, which describe the interface content from sensors to enterprise systems, have been widely adopted worldwide. Notably, the Industry 4.0 initiatives reference and use ISA-95. ISA-95 increases uniformity and consistency of interface terminology and reduces the risk, cost, and errors associ-

Tom Fisher, champion of ISA-88

Tom Fisher contributed to and was a champion of ISA-88 and was a World Batch Forum (WBF) chairman. Fisher was a founder of the ISA SP88 committee, which formulated the batch manufacturing standards used worldwide. Fisher joined Lubrizol in 1967 as a process engineer and rose through the ranks during his long career to become Lubrizol's operations technology manager. He worked previously for DuPont and NASA. He also was ISA's publications VP and a member of the Process Control Safety subcommittee of the Center for Chemical Process Safety. He led the IEC's SC65A Working Group for batch control. Fisher educated a generation of batch process engineers and wrote several books on subjects including safety interlock systems, control design, and control applications (including a major text on batch control systems). Fisher was elected chairman of WBF in 1999.

Lynn Craig, champion of ISA-88

Lynn Craig was deeply involved in ISA-88, World Batch Forum, and ISA-95. Craig attended the University of Tennessee – Knoxville and was manager of process control and automation at Rohm & Haas company for more than 30 years. Craig was an originator and voting member of the ANSI/ISA SP95 standards committee (17 years), past chairman and voting member of the ANSI/ISA SP88 Batch Control committee (17 years), and first elected chairman of the WBF.

Dennis Brandl, champion of ISA-95

Dennis Brandl, BR&L Consulting, wrote most of ISA-95, as well as other important industry standards. Brandl is an active member of the ISA95 Enterprise/Control System Integration committee, coauthor of the MESA B2MML standards, a member of the ISA99 Industrial Cybersecurity standards committee, the former chairman of the ISA88 Batch System Control committee, and a contributor to the OPC Foundation and IEC 62541 standards. He specializes in helping companies use manufacturing IT to improve applications such as device connectivity, business-to-manufacturing integration, manufacturing execution systems, batch control, general and site recipe implementations, and automation system cybersecurity. He has been involved in automation system design and implementations, including Apollo and space shuttle test systems for Rockwell.

ated with implementing these interfaces. The standards also reduce the effort associated with implementing production of new product offerings.

ISA-95
Enterprise Control System Integration

ISA-95 (ANSI/ISA-95) provides consistent terminology and object models that are foundational for supplier and manufacturer communications. By helping to define the boundaries between enterprise systems and control systems, ISA-95 models clarify application functionality and how information is to be used.

Not insignificantly, the American National Standards Institute (ANSI) approved ISA as an ANSI-accredited standards-writing organization in 1976.

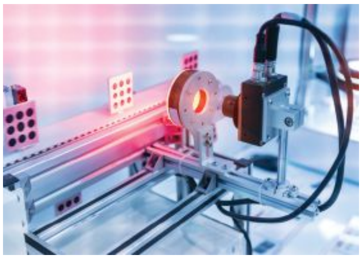
Wireless 802.15.4 enables wireless sensors

The IEEE 802.15.4 low-rate wireless personal area networks (LR-WPANs) standard and subsequent commercial chip components became the building blocks for industrial wireless sensor standards, including ISA100a and WirelessHART. The IEEE 802.15.4 is a technical standard that defines the operation of LR-WPANs. The IEEE 802.15 working group, which defined the standard in 2003, continues to maintain it.

The ISA100.11a (IEC 62734) wireless networking technology standard, developed by ISA, focused on "wireless systems for industrial automation: process control and related applications" with a focus on field-level devices. In 2009, the ISA Automation Standards Compliance Institute established the ISA100 Wireless Compliance Institute. The ISA100 Wireless Compliance Institute owns the "ISA100 Compliant" certification scheme, which does independent testing of ISA100-based products to ensure they conform to the standard.

WirelessHART (IEC 62591) is a wireless sensor networking technology based on HART. It is defined for the requirements of process field devices. A goal of WirelessHART is backward compatibility with existing HART-compatible control systems and configuration tools to integrate new wireless networks and their devices.

Machine vision and image recognition



The application of machine vision systems continues to grow with lower costs and more capability from advances in software technology, particularly image recognition. Properly configured and programmed vision systems eliminate human error, increasing productivity, quality, and profits. Vision systems have become highly intelligent, and flexible sensors in the control and automation process provide a range of input for real-time control. Applications include quality inspection, part identification, robot guidance, and machine control based on parts flow. Initially a camera was connected to a PC that did pattern recognition. Newer machine vision cameras incorporate pattern recognition and a complete IEC 61131-3 PLC in a small device mounted on machines. This is possible because of dramatic developments in computer system-on-a-chip (SoC) and miniature video camera chips.

Ed Hurd, helped birth commercial DCS
Ed Hurd was a major driver of the Honeywell 2000, which was introduced in 1975 and marked the beginning of commercial DCSs. At the 1976 ISA show in Houston's Astrodome, Honeywell formally unveiled the TDC-2000, the first system to use microprocessors to perform direct digital control of processes as an integrated part of the system. This distributed architecture was revolutionary with digital communication between distributed controllers, workstations, and other computing elements. Hurd served as president of Industrial Control from 1993 to 1995 and, before that, was vice president and general manager of Honeywell's Industrial Automation and Control Group. He won a Sweat Award in 1967 for circuitry design and was the design architect for an assignment called Project 72. After about two years, the group synthesized a next-generation control system. The project led to the TDC 2000, a DCS that took the industrial automation and control group from $5 million to $500 million in five years.

Bill Lowe, lab director for the IBM PC
IBM's personal computer (IBM 5150) was introduced in August 1981, one year after corporate executives gave the go-ahead to Bill Lowe, the lab director in the company's Boca Raton, Fla., facilities. Non-IBM personal computers were available as early as the mid-1970s, but the IBM PC launch legitimized use of this class of computers in business, scientific, and industrial applications. Lowe established a task force that developed the proposal for the first IBM PC, fighting the idea that things could not be done quickly at IBM. One analyst was quoted as saying that "IBM bringing out a personal computer would be like teaching an elephant to tap dance." The group worked with a little-known company, Microsoft, for the operating system, and the team beat the deadline, finishing the IBM personal computer by 1 April 1981.

John Berra, communication protocol impresario
John Berra, the president of Emerson Process Management and Emerson executive vice president, received ISA's "Life Achievement Award" at ISA 2002 in recognition of long-term dedication and contributions to the instrumentation, systems, and automation community. As of 2001, only seven people had received the honor, which was first given in 1981. Berra, who began his career as an engineer at Monsanto Co., played a major role in the development of three major manufacturing communications protocols: HART, Foundation Fieldbus, and OPC.

ISA-95 enterprise-control system integration standard B2MML

ISA-95 (ANSI/ISA-95) has been accepted throughout the world in a wide range of industries. The latest development, Business to Manufacturing Markup Language (B2MML), creates compatibility with enterprise computing, cloud computing, IoT, and Industry 4.0. B2MML further adds value to ISA-95 by providing consistent terminology and object models and by bridging IT and OT. B2MML expresses ISA-95 (IEC/ISO 62264) data models in a standard set of XML schemas written using the World Wide Web Consortium's XML Schema language (XSD).

B2MML is an open source XML implementation of the ISA-95 and IEC 62264 standards. The Manufacturing Enterprise Solutions Association (MESA International) B2MML is used as the de facto standard interface to exchange the contents defined in ISA-95. There is cooperation to bring this into the OPC UA framework, which provides a secure and reliable architecture for manufacturing industries.

Gaming technology

The gaming industry has pushed the envelope of computing, which industrial automation applications are taking advantage of. Developments originally intended for the video game industry are now having an impact on the cloud, artificial intelligence, data science, and autonomous vehicles. The enormous gaming industry volume, exceeding $125 billion in 2018, is pushing the performance of technology and dramatically lowering cost. All types of industries are applying these new technologies in creative ways. Video game industry hardware and software is increasingly leading to new industrial automation technology and business use cases. Particularly, virtual reality software platforms and user interfaces, such as virtual reality glasses, are being used in industrial automation in creative ways.

Over the years, the industrial and process automation industry has taken advantage of and leveraged commercial technologies as they became mainstream to create applications that deliver greater value. Augmented reality has seeped into daily life and is being used in everything from mobile games to heavy industry. These innovative technologies can assist with every phase of a project, including design, virtual commissioning, startup, troubleshooting, and quality control. Examples of applications that benefited from these technologies are:

- Machine and process simulation, including virtual commissioning, to identify issues and bottlenecks before installing real equipment, saving time and money
- Smart glasses with immediate access to manuals, instruction videos, and other materials to help on-site personnel troubleshoot problems. Coupled with communications to subject-matter experts at remote sites, this is a tremendous value to improve production uptime.
- Training simulators provide immersion learning to plant personnel before they go on the site. For example, there are many demonstrations of training people in a virtual petrochemical plant environment and giving them challenges, so they learn how to react to dangerous disruptions and operations.

Charlie Cutler, redefined APC

Charles R. Cutler, a member of the National Academy of Engineering, invented and commercialized a highly successful multivariable controller that redefined the term advanced process control (APC). In 1984 he founded DMC Corporation, and in 1999 he founded a second company called the Cutler Technology Corporation. Cutler conceived control engineering applications that have brought a competitive edge to the current oil and gas industry, namely Dynamic Matrix Control (DMC) and real-time optimization (RTO). He was honored with a membership in the National Academy of Engineering in 2000 for his contributions to a new class of advanced process control technology. Cutler graduated as a chemical engineer from Lamar University in 1961 and went to work for Shell Oil Co., where he would conceive and implement the concept of a DMC algorithm, saving the petrochemical industry millions of dollars.

Odo Struger, named the PLC

Odo Struger of Allen-Bradley is credited with creating the acronym PLC (programmable logic controller). Struger, who earned a PhD from the Vienna University of Technology, also developed PLC application software during his nearly 40-year career at Allen-Bradley/Rockwell. He played a leadership role in developing National Electrical Manufacturers Association (NEMA) and International Electrotechnical Commission (IEC) 1131-3 PLC programming language standards. After moving from Austria to the U.S. in the 1950s, he became an engineer at Allen-Bradley in 1958, retiring in 1997 as Rockwell Automation's vice president of technology.

Mike Marlowe, U.S. federal government liaison for ISA

Mike Marlowe's relationships and U.S. government contacts where instrumental to ISA gaining access to the necessary agencies and legislators to allow a partnership with the U.S. Department of Labor on workforce development and the Automation Competency Model (ACM). Additionally, Marlowe worked to get the ISA-99 standard adopted by the U.S. government as a foundational standard in the cybersecurity of critical infrastructure. Marlowe's efforts were significant in ISA-99/IEC 62443 becoming integral components of the United States Cybersecurity Enhancement Act of 2014 the federal government's plans to combat cyberattacks.

OPC UA

OPC UA (IEC 62541) is a service-oriented architecture (SOA) that bridges industrial automation with the latest computing and IoT technologies. It supplies high-quality, contextual data based on application-oriented data models. OPC UA is a unifying technology; members of the OPC Foundation include suppliers of automation, PLCs, DCSs, sensors, industrial software, enterprise resource planning, and cloud services. OPC UA is becoming a key technology for integration of IT and OT.

OPC UA can be deployed in any operating system, including Windows, Linux, real-time operating systems, and proprietary systems. Consistent with modern software practice, OPC UA is open source and available on the open source GitHub website.

The basic principles of service-oriented architecture are independent of vendors, products, and technologies for seamless interoperability. OPC UA has become the unifying system architecture to communicate data and information from many industrial automation disciplines efficiently and effectively. Working with various standards groups, the OPC Foundation jointly created standardized information models, defined in Companion Specifications, to achieve interoperability from sensors to enterprise without layers of software for translation and normalization to disparate systems.

Machine learning

The application of machine learning is accelerating with high-performance, lower-cost hardware, lower-cost data acquisition, large libraries of open source frameworks, and software modules making it practical to apply it in a significantly wide range of applications. Machine learning (ML) is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns, and make decisions with minimal human intervention. ML applies algorithms and statistical models to analyze and predict future performance without being explicitly programmed to perform the task.

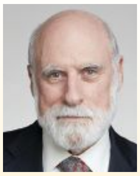
The iterative aspect of machine learning is important, because as models are exposed to new data they automatically adapt and learn from previous computations to produce reliable, repeatable decisions and results. Today the ability to automatically apply complex mathematical calculations to big data repetitively with high-performance, low-cost computing is driving applications such as:

- self-driving cars
- Amazon and Netflix online recommendations
- fraud detection.

In the past, applications had to be built from scratch. Now "off-the-shelf" solutions implemented in common open-source frameworks (e.g., TensorFlow, PyTorch, Scikit-learn) make it possible to rapidly create applications.

Predictive maintenance using machine learning is increasing the uptime of manufacturing and process production lines by eliminating breakdowns that by their nature are disruptive unplanned events. By monitoring equipment and benchmarking against models and rules, systems can predict problems and

Peter G. Martin, automation renaissance man
Peter G. Martin has been an industry contributor, innovator, author, and champion of industrial control and automation for over 40 years. Martin was named one of the "50 Most Influential Innovators of All Time" by ISA. In 2009, he received the ISA Life Achievement Award, recognizing his work in integrating financial and production measures that improve the profitability and performance of industrial process plants. Martin, who began his process control career at Foxboro, holds multiple patents, including patents for real-time activity-based costing, closed-loop business control, and asset and resource modeling. He has authored or coauthored three books: *Bottom Line Automation*; *Dynamic Performance Management: The Pathway to World-Class Manufacturing*; and *Automation Made Easy: Everything You Wanted to Know About Automation – and Need to Ask*.



Vint Cerf, father of the Internet
Vint Cerf, widely known as a "Father of the Internet," is the codesigner of the TCP/IP protocols and the architecture of the Internet. In December 1997, President Bill Clinton presented the U.S. National Medal of Technology to Cerf and his colleague Robert E. Kahn. In 2005, President George Bush gave him the Presidential Medal of Freedom. Cerf began his work at the U.S. Department of Defense Advanced Research Projects Agency (DARPA), playing a key role in leading the development of Internet and Internet-related data packet and security technologies. Since 2005, he has served as vice president and chief Internet evangelist for Google. From 2000–2007, he served as chairman of the board of the Internet Corporation for Assigned Names and Numbers (ICANN), an organization he helped form. Cerf was a founding president of the Internet Society from 1992–1995, and in 1999 served a term as chairman of the board.

advise maintenance workers to make repairs before problems cascade into larger failures. In addition, embedded processors with sensors are being added to specific pieces of equipment to analyze and alert maintenance about impending problems. Machine learning is also being applied as part of the closed-loop strategy for control and automation to improve machine and process performance.

Industry 4.0 initiatives

Industry 4.0 is focused on the application of a range of new technologies to create efficient self-managing production processes using IoT and open software and communications standards that allow sensors, controllers, people, machines, equipment, logistics systems, and products to communicate and cooperate with each other directly. Germany's Industrie 4.0 initiative has influenced thinking throughout the world and become a model for other initiatives and cooperative efforts, including Made in China 2025, Japan Industrial Value Chain Initiative (www.iv-i.org), Make in India, and Smart Manufacturing Leadership Coalition (SMLC).

A core tenant of Industry 4.0 is that automation systems must adopt open source, multivendor, interoperability software application and communication standards similar to those that exist for computers, the Internet, and cell phones. Industry 4.0 demonstrations acknowledge this by using existing standards, including the ISA-88 batch standards, ISA-95 enterprise-control systems integration standards, OPC UA, IEC 6-1131-3, and PLCopen.

The Industry 4.0 initiative started as one part of a 10-point high-tech German strategic plan created in 2006. On 14 July 2010, the German cabinet decided to continue the strategy by introducing the High-Tech Strategy 2020 initiative focusing the country's research and innovation policy on selected forward-looking projects related to scientific and technological developments over 10 to 15 years. Industry 4.0 is a vision of integrated industry implemented by leveraging computing, software, and Internet technologies. The 4.0 refers to the idea of a Fourth Industrial Revolution:

- First: production mechanization using water and steam power
- Second: mass production (Henry Ford often cited as the innovator)
- Third: digital revolution (e.g., machine tool numerical control, programmable logic controllers, direct digital control, and enterprise resource planning)
- Fourth: Industry 4.0 leveraging cyber-physical systems, embedded computing, Internet of Things technologies

The German strategy emphasizes cooperation between industry and science to promote closer links between knowledge and skills.

The vision of Industry 4.0 is significantly higher productivity, efficiency, and self-managing production processes where people, machines, equipment, logistics systems, and work-in-process components communicate and cooperate with each other directly. A major goal is applying low-cost mass production efficiencies to achieve make-to-order manufacturing of quantity one by using embedded processing and communications. Production and logistics processes are integrated intelligently across company boundaries, creating a real-time lean manufacturing ecosystem that is more efficient and flexible.

The digital twin

The digital twin has become one of the most powerful concepts of Industry 4.0. The implementation of model-based, real-time, closed-loop monitoring, control, and optimization of the entire manufacturing and production process, the digital twin concept is helping organizations achieve real-time integrated manufacturing.

The fundamental idea of the digital twin is to have a virtual model of ideal manufacturing operations and processes. This model will benchmark the actual production metrics in real time. The broadest implementation models include all of the factors that affect efficiency and profitability of production, including machines, processes, labor, incoming material quality, order flow, and economic factors. Organizations can use this wealth of information to identify and predict problems before they disrupt efficient production.

The digital twin is a prominent example of practical macro-level, closed-loop control that is feasible with the advanced hardware, software, sensors, and systems technology now available. A critical part of the creation of a digital twin is the need to have a complete information set, including the capture of real-time information with a wide range of sensors based on these requirements. Industry 4.0 is a practical application of the latest technologies, including IoT, to integrate manufacturing and business systems.

Cloud and edge computing

Cloud computing is affecting a wide range of applications, including industrial automation, by providing easy-to-use, high-performance computing and storage that does not require a large capital investment or ongoing overhead support costs of in-house computers and servers. Cloud providers, including Microsoft Azure and Amazon Web Services, have a variety of software tools (i.e., data analysis and predictive) that the general industrial sector and process automation plants can use to solve manufacturing, production, and business challenges. Many industrial automation applications,

such as historians, condition-based maintenance, predictive maintenance, asset management, and failure analysis, are now more cost effective with cloud computing technology.

Cloud computing leverages shared resources and economies of scale similar to an electric utility, providing almost limitless computing power and massive storage on demand. Edge computing, a deployment of low-cost and high-performance computing (including communications) is becoming commonplace. It brings computation and data storage closer to the location where it is needed to improve response times, add context to data, and perform functions required locally. In the history of computers and industrial automation, processing has always been pushed as far to the edge of the network as practical with the technology at the time. Today, edge devices can be small blind node computers or SoC embedded in sensors, actuators, and other devices extremely cost effectively. Putting this in context, consider the power and cost of your smartphone today.

These computing devices are platforms for a wide range of software, including IoT, IEC 61131-3 PLC, OPC UA, and MQTT, cloud interfaces, time series databases, HMIs, and analytics. ISA-95 Level 0–2 functions and portions of Level 3 consistent with the new IoT distributed computing models can be accomplished in these devices.

The growing acceptance of industrial sensor networks coupled with edge devices will see more applications deployed on these open system devices rather than PLC and DCS controllers. Edge computing devices deploy both industrial and enterprise networking and communication functions to help seamlessly integrate IT and OT.

Collaborative robots

Collaborative robots (cobots) are a new breed of lightweight and inexpensive robots that work cooperatively with people in a production environment. They are a new way to implement flexible manufacturing without extensive plant floor retrofits and large capital investment. Cobots are inherently safe; they sense humans and other obstacles and automatically stop, so they do not cause harm or destruction. Protective fences and cages are not required, increasing flexibility and lowering implementation costs.

These robots are particularly attractive investments for small- to medium-sized companies. The programming process of this new class of robots is greatly simplified and does not require programming gurus. The robots can be programmed by example or with software that is similar to gaming. Most tasks can be accomplished with no programming skills simply by moving the robot arms and end effectors, teaching the robot what to do. The robot memorizes the motions and creates the program. This is a physical form of the popular computer concept called "what you see is what you get" (WYSIWYG) programming. It is intuitive for users and has proven to broaden the application of technology. The typical cost is less than $40,000 U.S. Simplified programming means collaborative robots can be deployed without hiring specialized engineers.

The development of this new class of robots is similar to how the application of computers expanded with the development of the PC. In the beginning, computers were expensive, powerful devices locked away in special rooms and programmed by software specialists who wrote cryptic computer code. Because the cost to implement solutions was high, few applications used computers. When PCs were introduced, they did not have the computational power of mainframes and minicomputers nor the large amount of memory. But with their lower cost and flexibility, people were empowered to apply computers to a wider range of applications. This factor, coupled with simplified programming, led to a revolution in the application of computers for industrial automation.

These new collaborative robots cannot pick up an engine block, but they can perform a great variety of tasks with smaller payloads, typically 10–30 kilograms. Collaborative robots can flawlessly perform repetitive, mundane, and dangerous tasks that were previously performed by an operator. Operators no longer are forced to stand at a machine for hours doing mindless work or working in a hazardous environment. This improves productivity and quality while freeing up workers for tasks that require human skills.

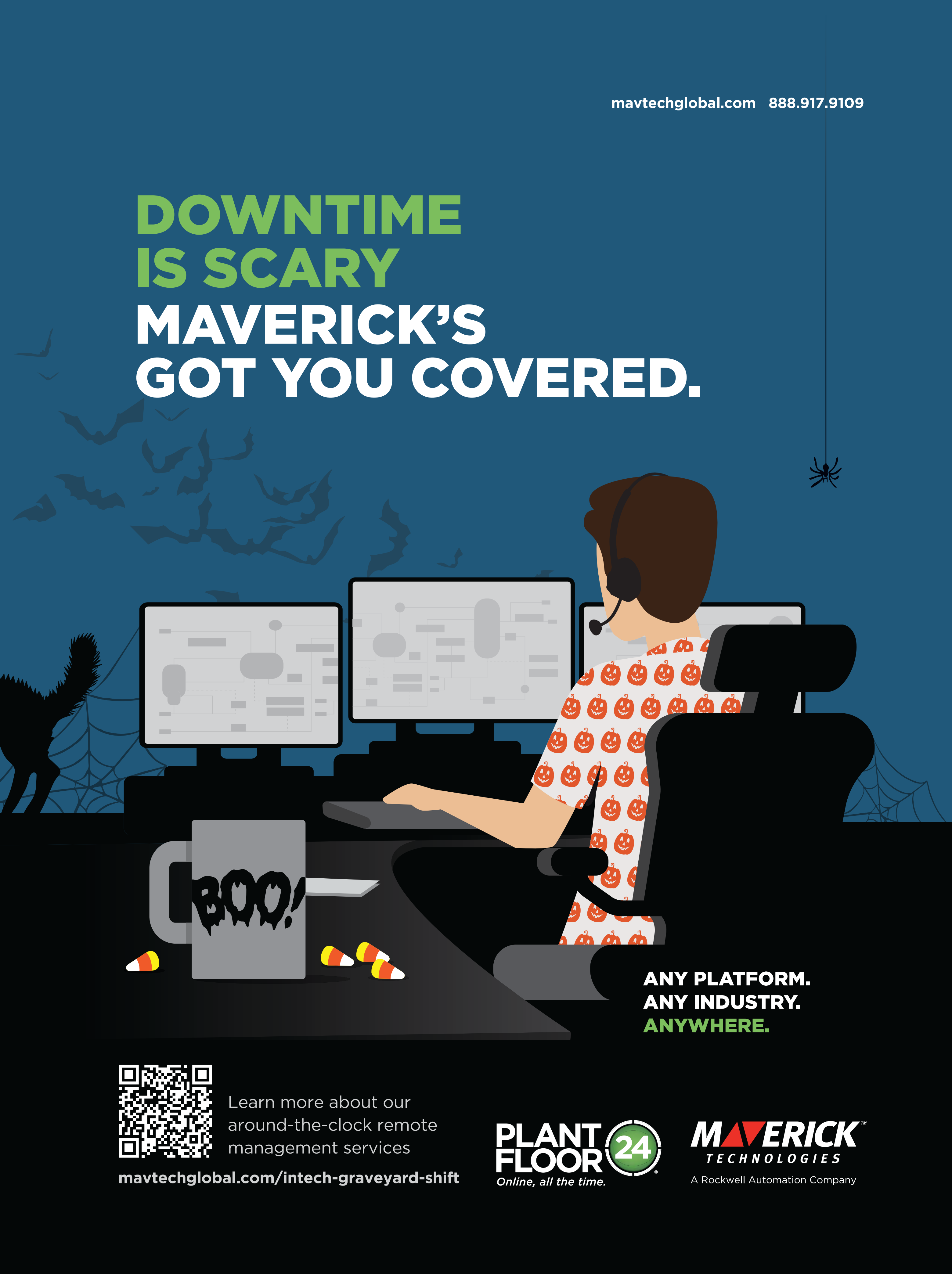
Cobots are now one of the fastest-growing industrial automation segments; it is expected to jump tenfold to 34 percent of all industrial robot sales by 2025, according to the Robotic Industries Association (RIA) (www.robotics.org/blog-article.cfm/Collaborative-Robots-Market-Update-2018/84). An exciting development is the coupling of collaborative robots with vision systems, image recognition, and artificial intelligence that replicate human manufacturing procedures.

Collaborative robots have lowered the barriers to automation. A broad range of users, particularly small and medium enterprises, can implement them without sophisticated automation personnel. The flexibility of collaborative robots enables the automation of functions that were not practical in the past. Collaborative robots are also suitable for production with make-to-order requirements, since they are easily programmed to do multiple tasks. ■

ABOUT THE AUTHOR

Bill Lydon (blydon@isa.org) is an *InTech* contributing editor with more than 25 years of industry experience. He regularly provides news reports, observations, and insights here and on Automation.com.

View the online version at www.isa.org/intech/20201001.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ISA members remember

MILESTONES

1945

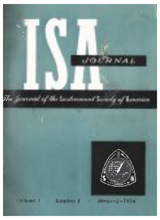
Instrument Society of America is officially founded on 28 April; elects Albert F. Sperry as president

1947

The first ISA logo is adopted

1948

ISA charters its first student subsection at Siena College, Loudonville, N.Y., U.S.



1954

ISA launches *ISA Journal*; names William Kushnick the first executive director

1955

Northern Indiana Section elects Virginia W. Zugbaum, first female president of a section

1956

Industry divisions and technical committees debut; ISA Exposition has 36,000 attendees

Whether they find ISA because they want to improve their skills, help others, advance their professional prospects, or some combination of all three, members are the heart of ISA—the International Society of Automation.

With almost 40,000 members around the world, ISA is a diverse and active community of professionals and aspiring professionals (students) who share the goal of creating a better world through automation. Professional Members come from 116 countries and gather (virtually, nowadays) in groups represented by 131 sections. Sixty countries boast Student Member groups, and thousands of Automation Community subscribers can be found in every region of the world.

For 75 years, ISA Leadership Members have been those who go the extra step to volunteer. The Annual Leadership Conference (ALC) was to have been the focal-point of in-person celebrations around this milestone 75th anniversary. But then came months of pandemic travel restrictions, remote connections via virtual meeting spaces, and social distancing requirements that made IRL (in real life) gatherings impossible. Suddenly magazines like *InTech* could fill a new role.

To give members at all levels and in all geographies a taste of the knowledge, stories, and history embedded in our membership, we reached out to past presidents, ISA Fellows, and regular rank-and-file members willing to reminisce and remember. In the following pages, you will hear stories, note a few names dropped, and get more than a little history. The shenanigans of the ALC will have to wait until next year, when the group plans to meet in Puerto Rico. That gives new members plenty of time to step up to leadership roles and make their own history.

—*Renee Bassett, Chief Editor,* InTech

Accomplishments and plans for professional success

Compiled by Renee Bassett

1966

Herbert S. Kindler becomes executive director

1967

ISA Journal is renamed *Instrumentation Technology*

1969

Lloyd F. Williams becomes the 20,000th member of ISA

1970

ISA opens a new headquarters in Pittsburgh; celebrates "Silver Jubilee" 25th anniversary

1971

ISA reports first operational cuts; membership declines in response to poor economy

1974

Mexico Section is chartered, the first section outside of the U.S. and Canada

PAST PRESIDENTS

1990: A stellar year of advancing the profession

The 1989–90 Society year got off to a great start with an almost ready-made agenda. The executive board had just culminated more than two years of effort by adopting the Society's first strategic plan. It was clear that in the coming year the first priority was to address the implementation of the plan. The Society had just ended the most successful year ever in terms of growth, income, and enthusiastic member participation in the many benefits offered by the Society. So, our second priority was to keep this ball rolling.

The Society had also recently purchased *Programmable Controls* magazine. This provided a flagship publication with an audited readership of 45,000 and the potential of adding significantly to the Society's membership. Developing and implementing a plan to take advantage of this became the third priority. The fourth priority was expanding our international membership by generating additional sections and entities we dubbed "regions" to take in expanded geographical areas. The fifth priority was a catch-all for any issues that arose in the course of the coming year.

The president's winter meeting in San Diego kicked off the strategic plan implementation. Attendance at this meeting was the highest ever and was accompanied by a report that membership in the Society was on the rise. In addition, it was reported that the annual conference and exhibit to be held in New Orleans had already sold out, the earliest in history, and had been expanded an extra 10,000 sq. ft. (to 220,000 sq. ft.) to accommodate the overflow.

In the meantime, recognition of ISA practitioners as professionals was making great strides due to the efforts of one member, Thomas Stout, PhD, who had initially organized an effort to have states recognize control system engineering as a separate discipline in the professional engineering realm. The going was slow, but Stout was patient and progress was being made in Texas and several other states. This work led to the certification program adopted by ISA to certify three levels of technicians and create the Certified Automation Professional (CAP) designation through an examination process. Stout's efforts at the state level were ultimately successful: All but three states now recognize the control systems engineering discipline.

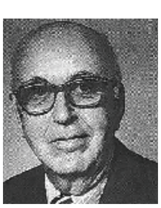
Thomas Stout, PhD, organized an effort to have states recognize control system engineering as a separate discipline.

The president's summer meeting in June, held in Williamsburg, Va., saw further development of the strategic plan implementation. The board adopted a set of goal clarifications and plans on how to proceed. Further, there were intense discussions about how to attract "computer-based" process control practitioners to the Society (priority 3). Should they form a sister Society, a division within the Society, or something else? The debate was heated at times, but there was progress toward making a specific proposal.

In the meantime, work on the expansion of ISA continued through international outreach (priority 4). At that time, District 12 vice president David Morrow had his hands full, since this work encompassed the U.K., Europe, the Middle East, and India—a rather large and diverse collection for one person to manage.

The first steps to expand and to restructure began that summer. Trips to India resulted in issuing three charters in different geographical areas of the country and also the start of the notion to consider forming regions, with India being one

MILESTONES



1974
Russel A. Schlegel appointed executive director

1976
ISA accredited by ANSI, only fourth organization to achieve this

1977
Glenn Harvey is named executive director

1978
Instrumentation Technology magazine renamed *InTech*

1978
Automation 78 held in Mexico City, first ISA expo outside of the U.S. and Canada

1980
ISA moves into new headquarters in Research Triangle Park, N.C., U.S.

of them. This idea eventually took hold, and the European Region was created, with others to follow in time. Additional efforts to organize Finland and Singapore were also pursued. In the meantime, membership moved toward 50,000.

The year culminated with the largest ISA Conference and Exhibit ever held, with the number of exhibitors and attendees breaking all records. The executive team of the Society was most thankful to the membership for their efforts in making this a banner year, as well as to the ISA staff who had done a stellar job of carrying out the will of the membership.

William Calder, 1990 Society President, ISA Fellow

View more online at www.isa.org/intech/calder

1995: ISA's 50th and the advent of 'smart'

With the initial formation of the Society in 1945, ISA celebrated its 50th Anniversary in 1995. I had the privilege and honor of being the ISA president that year.

The 1995 ISA executive board was composed of an outstanding group of individuals who served the Society well at that time and into the future. Along with past president Blair Ives, treasurer Bob Lindner, and president-elect Ron Jones, there were five future presidents of ISA on that board. They were Paul Arbuckle (1997), Perry Grady (2000), Lowell McCaw (2004), Steve Huffman (2007), and Gerald Cockrell (2009).

A coffee table book, *Milestones in Measurement and Control – Celebrating Fifty Years of ISA,* was produced by an assigned task force. This publication outlined the many achievements and activities of ISA over the first 50 years and was made available for members and others in the industry to purchase. It remains a primary document to summarize the founding, expansion, and maturity of ISA. A historical collection of technology advances, created for the anniversary, remains on display in the lobby at ISA in Research Triangle Park, N.C., U.S.

The Society was at full maturity at 50 years old, leading the industry in standards, training, credentialing, conferences, and publications.

The executive board that year approved the establishment of the Certified Control System Technician (CCST) program. This was the first step in setting up the qualifications and process for individuals to obtain this important professional credential. Lowell McCaw was the instrumental leader in coordinating this major step for ISA.

This was in the years of rapid advances in instrumentation and control technology internationally. The Foundation Fieldbus group had been formed in 1994, and its use was growing in all industry segments. The automation community was interested in more efficient and effective means of controlling processes. With the advent and application of the microprocessor technology in the 1980s and early 1990s, electronic transmitters were undergoing rapid changes. They were now "smart" and much smaller because of their digital technology, which brought about changes in engineering, design, and manufacturing processes.

The year 1995 was exciting for the automation, instrumentation, and controls industry, as well as for ISA. The Society was at full maturity at 50 years old, with a track record of leading the industry in standards, training, credentialing, conferences, and publications.

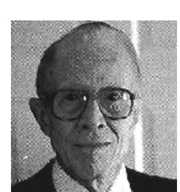
Gerald Wilbanks, PE, 1995 Society President, ISA Fellow

View more online at www.isa.org/intech/wilbanks

1982
ISA serves as admin secretariat to the U.S. Tech Advisory Group of IEC

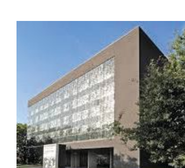
1983
ISA opens International Training Center in Research Triangle Park, N.C., U.S.

1986
ISA reaches 36,000 global members representing 97 countries



1987
ISA awards Henry C. Frost a Lifetime Achievement Award

1992
First instrumentation technicians certification debuts, now known as CCST program



1993
ISA opens European Training Center in The Netherlands

1996: Standards activity starts in earnest

As a young engineer more than 50 years ago, I was encouraged to join ISA to learn more about automation and control. It was an event that shaped my education, technical growth, and personal growth.

During my time in the Society, I was counseled and mentored by some of the most outstanding people in the automation and control technology field. I remember Paul Wing of Masoneilan, Greg Shinskey of Foxboro, Vic Maggioli, and Hans Baumann were among those giants in technology that helped shape my career. There are many others still active in the Society who are true visionaries in our technology, like Paul Gruhn for process safety and Gerald Wilbanks for technical excellence.

As the incoming section president back then, I attended my first president's meeting in Portland, not knowing what to expect or how I would be accepted. It was an experience that I have never forgotten. Everyone there demonstrated that ISA is an open Society. I could do as much or as little as I wanted, and get involved where my interests took me. Being able to expand my technical education through S&P activity and division involvement increased my technical value to my employer. The contacts developed through those activities provided long-term benefits. That is the most important contribution that ISA delivered.

As my involvement in the Society increased over the years, I was mentored by many people who helped me understand how the Society worked and why the Society operated that way. I learned that the Society was and is truly a work in progress, changing to meet both technology and membership demands. Keith Herbst and Bill Calder were some of the many leaders who provided keen insight and guidance to me.

How that technology has changed! I started out in this business with electromechanical and pneumatic controls. And not everything in a central control room. I remember the fight to standardize electronic control: 4–20 mA versus 10–50 mA. ISA's standards activity was just getting started in earnest and led the way in the industry to benefit everyone. From there the technology has advanced at a breathtaking pace. And ISA has been in the forefront! This has been a signature moment for the Society, and I believe that the Society will continue in its leadership role.

ISA is a technical organization. But more than that, it is a *people* organization, and that is where its strength lies.

I remember the fight to standardize electronic control: 4–20 mA versus 10–50 mA.

Throughout my time in the Society, it was always the people in the Society who really gave me the most benefit. The personal interactions with the members provided the most satisfaction, understanding, and personal growth that I experienced. From Brazil, Mexico, Canada, Europe, and the U.S., the members of ISA defined its strength. Unfortunately, I never had the opportunity to travel to India during my leadership time, but those contacts and visits that I did make truly made my time in ISA something that I will always cherish.

I will always view ISA's impact on my personal and technical life as wonderfully fulfilling.

Ronald B. Jones, PE (ret),
1996 Society President
View more online at www.isa.org/intech/jones

MILESTONES

1994

ISA launches ISA Online, its first web presence, at www.ISA.org

1994

The name of the Society is changed to ISA, The International Society for Measurement and Control

1995

ISA reaches 50,000 global members and celebrates its 50th anniversary

1997

ISA consolidates headquarters and training center into new building in Research Triangle Park, N.C., U.S.

ISA–The Instrumentation, Systems, and Automation Society

2000

Council of Society Delegates votes to change the name to ISA, The Instrumentation, Systems, and Automation Society

2002

Members elect first non–North American ISA President: Piergiuseppe (Pino) Zani, founder of API SRL, Milan, Italy

2001: Taking action after the twin towers fell

The most significant and memorable event of my presidential year occurred during the annual ISA Conference and Exhibit (C&E) in Houston. On Tuesday morning, the second day of the event, I was attending a breakfast meeting of the Measurement, Control and Automation Association when the master of ceremonies (MC) announced that an airplane had crashed into one of the towers of the World Trade Center.

I, and most of the attendees, assumed that it was a small plane that had somehow malfunctioned and accidently crashed into the building, so the meeting continued. A few minutes later, the MC announced that a second plane had crashed into the other twin tower. At that point, we all knew that something significant was happening.

The city council of Houston recognized our civic duty with ISA Day.

The meeting was immediately adjourned, and I returned to my hotel room to find my wife, Betty, watching horrific scenes of the burning buildings and a replay of the second plane crashing into the building. I contacted executive director Jim Pearson, and we called a meeting of key ISA leaders and staff to discuss our course of action for the C&E. By the time we met, all air traffic had been shut down, so participants were stranded in Houston. We therefore decided to continue with the "show."

By Wednesday morning, it was apparent that everyone had their minds on the events unfolding, so we decided to close the event at noon Wednesday—one day early. Everyone wanted to do something to help the victims, so we contacted the Houston blood bank and conducted a very successful blood drive at the convention center.

Those participants in the C&E who had flown into Houston initially were unable to fly back home. ISA staff chartered a Greyhound bus to transport the staff and a few volunteers back to Research Triangle Park. International visitors were forced to remain in Houston until airlines resumed flights, but some Canadians rented cars and drove all the way back to Canada. Many visitors from all over the U.S. did likewise. I was fortunate to have driven my vehicle to Houston from New Orleans, so I could return home on Thursday.

Two months later, the city council of Houston recognized our civic action to help the victims by issuing a proclamation declaring ISA Day in Houston.

Robert M. Bailliet, PE (retired), ISA Fellow, 2001 Society President

View more online at www.isa.org/intech/bailliet

2004

Certified Automation Professional (CAP) program launched

2006

Pat Gouhin is named executive director

2006

Automation Federation is founded as "a unifying force for progress in automation"

2007

ISA Security Compliance Institute debuts to bridge the gap between standards and their implementation

2008

Members elect Kim Miller Dunn, the first female ISA president

2008

Council of Society Delegates votes to change the name of the Society to ISA, International Society of Automation

2007: Workforce development, standards compliance, and more

I entered my year as president with some very definite plans to implement without realizing that a president's turn in the barrel is not very long. As president-elect secretary under president Ken Baker, I pursued the idea of creating some form of vehicle for users to assure compliance to ISA standards. With a large amount of help from Ed Marszal (ISA-84 proponent and president of Kenexis) over dinner after a day at Control Expo–Mexico in summer of 2006, we developed a proposal for acceptance by the executive committee. It was heavily aimed toward ISA-84, which was thought to be low-hanging fruit at the time.

Though circumstances changed the initial implementation plan from safety to security, the ISA Automation Standards Compliance Institute (ASCI) began life on my watch as a vehicle using industry institute members to see to compliance of ISA standards. Under ASCI, this began with the ISA Security Compliance Institute, constructed the same way, and later the ISA Wireless Compliance Institute (WCI).

My primary plan during 2007 was to create a driven workforce-development program, a plan to engage members for promotion and advancement of the profession of automation. Planting the flag for our profession with an external focus was the goal by engaging industry, academia, and government as a call to action. In 2004, we had created our own ISA Certification for Automation Professionals (CAP), which provided a lot of definition as to the perceived scope of industrial and process automation as ISA would see it. The book, *A Guide to the Automation Body of Knowledge,* edited by the late Vernon Trevathan, served to guide readers toward CAP. Many of the plans and activities were driven by CAP as a cornerstone to build upon, which included certifying practitioners from other countries or those who were working in global companies.

Beyond this aggressive plan, I was also invested in making the Society more global in stature. Trips to Mexico, Brazil, Russia, China, and Singapore were all about recognizing both automation as a career path with a growing shortage of practitioners, and ISA—by applying our core competencies—as a source of training, certifications, standards, etc. in concert with the expertise of our many active members.

In 2007, I was also chairman of the Automation Federation, founded the year before to be an umbrella organization to attract other organizations either dedicated to or with interest in some facet of automation. Much of ISA's workforce activity and advocacy was taken up by the Automation Federation in the following years. This led to numerous successes, including our development of the Automation Competency Model in partnership with the U.S. Department of Labor in 2008 and critically reviewed and reissued in 2011, 2014, and 2018. I still believe the external focus is critical for our Society to trumpet the great things ISA volunteers do for industry, our profession, and life in general.

Membership organizations are only as good as the volunteers willing to dedicate some part of themselves for the greater good.

Membership organizations are only as good as the volunteers willing to dedicate some part of themselves for the greater good.

Steve Huffman, 2007 Society President, ISA Fellow

View more online at www.isa.org/intech/huffman01

MILESTONES

2008
ISA Wireless Compliance Institute founded to bridge the gap between standards and their implementation

2014
Members elect Peggy Koon, the first African American president

2015
ISA acquires Automation.com

2018
Mary Ramsey is named executive director

2019
ISA launches the Global Cybersecurity Alliance

2020
ISA celebrates 75 years

2008: Fully in the information age

The year 2008 was the year of bailouts (Bear Stearns, Freddie Mac and Fannie Mae, Lehman Brothers); the stock market had the worst crash since the Great Depression; oil hit an all-time high of $147 per barrel, causing inflation and unemployment; Fidel Castro stepped down as prime minister of Cuba after almost 50 years of rule; Apple released the iPhone 3G; Google beta tested the Chrome browser; Hulu was launched; favorite television shows were *American Idol, Dancing With the Stars, NCIS, Sunday Night Football,* and *Desperate Housewives.* But the most controversial and hottest topic of conversation at the October leaders meeting of ISA had to be the Society name change.

It was not my idea to change our name from "Instrument, Systems and Automation" to the "International Society of Automation." I simply picked up the flag and carried through what Steve Huffman had begun a year earlier. Today, as we enter what can only be known as the Information Age, it is hard to believe it was so difficult to come to consensus on something so fundamental as a name. I don't believe the general public today has a better understanding of what automation professionals do, any more than they did in 2008, but they think they understand what the International Society of Automation means—and that is probably what counts.

In 2008, ISA was learning how to effectively use the World Wide Web to reach out to a new generation of automation professionals. As an organization, we had used Internet tools for years, but not to the full extent possible as a strong marketing arm. With a little coaxing from some very enthusiastic staff members, I am proud to say that I was the first Society president to have a presidential blog.

In 2008, a new standards war was also raging over a wireless communications standard, ISA100. It is amazing to me that what we have adopted today in our lives at home via Siri, Alexa, and Google Home is being adopted at a seeming snail's pace by industry. I can operate my HVAC, garage door, lights, and even kitchen appliances remotely and wirelessly, but I still see operators with clipboards gathering data in plants. Go figure! However, plants are realizing the benefit of the Industrial Internet of Things (IIoT), digital transformation, and extreme data crunching thanks to the foresight of people in 2008 and earlier who made "wireless" a relevant and important topic.

A few other firsts during my term: First woman to serve as Society president, ringing in an era of inclusion and diversity for ISA. The photos that line the lobby of ISA headquarters shifted from black and white to color in 2008. Most importantly, I was the first post–Baby Boomer who served as president—depending on when you declare the end of the Baby Boomer era and how much I fib about my age. But I have it on good authority that I am what is known as a "cusper"—one hovering somewhere between the Baby Boomers and Gen X on the generational spectrum.

My biggest disappointment from my term as ISA president must be not getting, "We Control the World" agreed upon as ISA's slogan. Sure, "Setting the Standard for Automation" is a great branding statement and is much more professional and slightly less egotistical. But don't we, as automation professionals, ultimately control the world today? Automation is everywhere and is advancing at a pace the founding members of the Instrument Society of America could never have imagined. And we are the lucky ones who design, build, sell, install, and operate the technology moving us forward. I will go to my grave believing that as members of ISA and the automation profession, We Control the World.

Kim Dunn,
2008 Society President
View more online at www.isa.org/intech/dunn

75 years of ISA presidents

1946 Alfred F. Sperry*
1947 C. O. Fairchild*
1948 P. G. Exline*
1949 C. F. Kayan*
1950 R. J. S. Pigott*
1951 J. B. McMahon*
1952 Dr. Arnold O. Beckman*
1953 P. Hart*
1954 William A. Wildhack*
1955 Warren H. Brand*
1956 Robert T. Sheen*
1957 J. T. Vollbrecht*
1958 Robert J. Jeffries*
1959 H. C. Frost*
1960 J. Johnston, Jr.*
1961 Dr. Ralph H. Tripp*
1962 Philip A. Sprague*
1963 Nathan Cohn*
1964 Allen E. Lee*
1965 William A. Crawford*
1966 Dr. John G. Truxal*
1967 Alonzo R. Parsons*
1968 Harold J. Bowman*
1969 Dr. Theodore J. Williams*
1970 Thomas J. Kehoe*
1971 Douglas C. Strain, PE
1972 John T. Anagnost*
1973 H.T. Marcy
1974 W. S. Bloor*
1975 Walter A. Bajek*
1976 Naumann, Albert*
1977 John R. Mahoney, Jr.*
1978 Hugh S. Wilson*
1979 Dr. Norman E. Huston*
1980 J. R. Middleton*
1981 Darrell R. Harting*
1982 Louis G. Good*
1983 Dr. Leslie M. Zoss*
1984 Max J. Kopp*

2009: From student games to Russia section programs

My year as ISA president started 1 January 2009. My ISA career focused on bringing increased awareness and interest in instrumentation and automation to students of all ages. Starting when I was District 6 vice president, a small group of ISA colleagues and I started thinking about how we could engage young people in the field and profession. Early efforts produced a competition with students solving automation-related problems and participating in a "quiz bowl." Major work on these things were completed in District 6 and 8.

These efforts eventually produced the International Student Games. The games were run in a number of districts with winners having the opportunity to travel to the ISA Conference and Exhibit to participate in the International Student Games event. It was a success as both a competition and as a vehicle to increase awareness of the profession.

Once I became ISA president-elect, my excitement was quite high to increase my focus on students and future automation professionals. But, if you remember, the huge thing that occurred in 2009 was 2008—that year of turmoil in the financial markets and the world economy. It became clear early in my year as president that this was going to become my focus. We made some very hard decisions in an effort to stabilize ISA financially. I am proud to have worked with a very effective board of directors and ISA staff to help ensure the future success of ISA.

Memories of my year as president include trips to Russia, Brazil, Mexico, India, U.S., and Canada, to name a few destinations, and special times with sections to speak to members about the Society. The chance to bring ISA to the members and speak about the great things occurring to the benefit of the members was very special.

Some accomplishments at the top of my list include my efforts with the Russia Section and St. Petersburg State University of Aerospace Instrumentation (SUAI). We still offer a Skype course for SUAI students on project management principles. The 15th class was completed in May 2019, and we look forward to the next class starting this fall. Also, an annual International Student Conference developed and offered by Indiana State University (ISU) and SUAI has given students the opportunity to present papers on projects to a global audience. This program is also still offered. The ISA Student Scholarship program is an ongoing program that awards monetary funds to top-level college and university students from around the world.

There have been a number of changes to the automation profession in the 10 years since my term in office. As a person who joined the Instrument Society of America in 1985, the changes are no less than astounding. The advances in technology are difficult to explain. It is like explaining to grandchildren that we once had cellphones that were in a bag or the size of a brick. Their look of disbelief is humorous to those who lived through that time.

The advances in computers, software, networking, and smart sensors in our field make it obvious and fortuitous that we, as an organization, had the foresight to change our name from "instrumentation" to "automation." The technology dictated this change. We are indebted to the leaders who made that decision.

From my observations, ISA beyond the 75th year is strong in terms of service to the profession. Our field of automation encompasses many new focus areas that we may not have considered part of our field. We should not hesitate to claim new and emerging automation applications as our own. After all, we are the automation society for the world.

Gerald W. Cockrell, CAP,
2009 Society President
View more online at www.isa.org/intech/cockrell

75 years of ISA presidents

1985 Marland L. Stanley
1986 Dr. Thomas J. Harrison*
1987 S. V. Weiss*
1988 Dr. Chun H. Cho
1989 Keith S. Herbst*
1990 William Calder
1991 Alan J. Robertson
1992 David N. Bishop*
1993 Howard P. Zinschlag
1994 C. B. Ives, Jr.*
1995 W. G. Wilbanks, PE
1996 Ronald B. Jones, PE
1997 Paul T. Arbuckle
1998 Hugh Roser
1999 Ron Dieck
2000 Perry Grady
2001 Robert M. Bailliet
2002 Piergiuseppe Zani
2003 Robert P. Ives
2004 Lowell E. McCaw*
2005 Donald W. Zee
2006 Kenneth R. Baker
2007 Stephen R. Huffman
2008 Kim Miller Dunn
2009 Dr. Gerald W. Cockrell
2010 Nelson Ninin
2011 Leo H. Staples
2012 Robert Lindeman
2013 Terrence Ives
2014 Dr. Peggie W. Koon
2015 Richard W. Roop
2016 James W. Keaveney
2017 Steven W. Pflantz
2018 Brian J. Curtis
2019 Paul Gruhn
2020 Eric C. Cosman

*Deceased

2012: Engaging the wider automation community

Serving as president of ISA in 2012 was a wonderful and fulfilling experience for me and my family. I was told then that a one-year term was too short to make a big impact and must admit I felt that way while it was happening. Looking back makes me reevaluate that premise.

We made significant progress in establishing automation curriculums at varying technical levels appropriate for instruction at community colleges, and as part of undergraduate and graduate degree programs.

We also instituted two new membership categories: the Automation Community Member and the Automation Affiliate Member. These new categories were developed by our ISA image and membership department to offer a broader automation professional audience a taste of the ISA experience while lowering the cost of entry to the Society. Through these new membership options, ISA laid the groundwork to engage a wider portion of the global automation community and to offer them unparalleled access to technical information, professional development resources, and opportunities to network with other automation professionals.

ISA Web 2.0 took its initial steps toward being a portal to the technical world while maintaining trusted content. The first steps were taken with the roll out of the ISA Interchange blog.

We put in place a new honors and awards program: ISA – Celebrating Excellence. Thanks to a special task force formed by the Honors and Awards Committee and headed by Peggie Koon, PhD, this new program reinvigorated our longstanding practice of recognizing individuals and companies who have made significant technical contributions in fields dealing with automation, as well as honoring members of ISA for their service to our society. Our new program includes awards for both technical contributions and ISA service recognition.

Robert Lindeman, 2012 Society President, ISA Fellow

View more online at www.isa.org/intech/lindeman

2014: Many changes, many firsts

Having been able to serve as president of ISA was one of the highlights of my professional career—a career that spanned almost 40 years. On a personal note, my presidency year (2014) marked the 20th year of my involvement in ISA. Of course, I was keenly aware that the Society had only had one previous female president in its history. More importantly, I knew that I was the Society's first African American president. I had had the privilege of working with these amazing automation professionals from around the globe and across a broad spectrum of industry sectors, government, and academia in the past, but to have the responsibility of leading teams of leaders across ISA's departments and in geographic sections was an honor.

My journey began and ended with change and several "firsts." A family conflict caused me to be unable to attend the 2012 leaders meeting, so my appearance and presentation before the Nominating Committee was done via Skype—a first.

In 2013, as ISA president-elect secretary and chief strategy officer, I began leading change, so the Society would be better positioned to take advantage of both existing and new markets by leveraging all its resources—all its entities and constituents—around a shared vision. My efforts were facilitated by the Council of Society Delegates' change in governance structure, which moved the responsibility of setting strategic direction from the strategic planning department to the executive board. ISA also made first steps toward developing a competency-based board.

In 2014, we held our first executive summit in Greensboro, N.C. Leaders identified five strategic goals: data, content, coolest delivery, global authority on industrial control system cybersecurity, and advocacy of automation as a profession. For the first time, all of ISA leadership and its constituents had a shared mission, vision, strategy, and goals. And for the first time in its history, ISA's entire strategic plan could be depicted on a business card!

At the end of my term, I said that ISA's future was bright. I still believe that to be true. As ISA moves beyond its 75th anniversary, we must remain agile and have the courage to embrace and change with the changing face of automation and the automation profession. We must continually evolve—review, analyze, and change. My advice to Society leaders is to stay agile and open minded while you embrace change and innovate. Be willing to morph and change operational paradigms. Be diverse and inclusive. Find ways to practice engagement at all levels.

Peggie Koon, PhD, 2014 Society President

View more online at www.isa.org/intech/koon

ISA FELLOWS

Harris: A practical history

ISA is celebrating 75 years as the leading authority in automation. As an ISA Fellow for 15 years, I offer the following comments about the past and future of measurement, communication, and standards.

The process under control can be very simple (i.e., opening a door or setting the temperature in a kitchen oven) or complex, with multivariable matrix optimized functions (i.e., crude oil refinery production flow and temperature controllers). ISA has been involved in making all these systems run at peak performance with high levels of reliability, availability, and safety.

Measurement. Some things have changed over the past 75 years, while others are surprisingly still very much the same. Flow measurement continues to use a handful of technologies. Orifice plates, venturi, vortex, and turbine meters are still the primary meters applied in oil refineries. More recently, some applications have been improved with the application of Coriolis, ultrasonic, and magnetic meters.

Looking to the future, it is likely that flow will continue to be considered a primary variable worth measuring. However, it could be that more and more flow information will be available using simulation and modeling to provide the missing information when a direct measurement is not available. No simple flowmeter exists for applications of two-phase flow; therefore, it is generally estimated using simulation. Direct measurement requires an elaborate system to separate the two phases and measure them.

Similar situations exist with pressure, level, and temperature measurements. Using simple physics-based applications and translating the reading to a primary process variable within a transmitter to communicate the variable is now accomplished with a microengineered mechanical system (MEMS). This has improved the accuracy, reliability, and other performance characteristics of these devices. A continued focus on key performance characteristics, along with lower power and weight, will continue. The other changes have been to move in concert with changes in the communication protocol used by automation systems.

Communication. ISA has been leading the evolution of the communication protocol for the past 75 years. Pneumatic controllers were very common in 1945. Many significant advances have occurred. These will continue, while moving toward a fully wireless communication world. Information can now be delivered anywhere on the planet virtually instantaneously. The problem used to be how to communicate the most recent information to the control system, and now the focus is how to only communicate the required information. Alarm overload is also a prominent area of communication problems for operators in 2020. As more and more applications are available from the cloud or some other virtual location, personalizing the delivery of information is a key area to establish best practices. This will enable the receiving party to easily take any action required—even if it is to do nothing.

Standards. ISA is a leading authority in the area of personalized data on many fronts. ISA symbology makes it very simple to share the process requirements between the system design and the end user. These symbols are then easily translated to the human-machine interface (HMI). In 1945, these were likely vista-green wall boards of the process with the single loop controllers embedded in the wall. Now the display could be a heads-up image that is nearing the holograms of *Star Wars* and other popular cultural views of the future.

As with many things done by ISA, symbology is backed by many different publications and ISA standards. The standards available from ISA cover alarms, safety applications, control valves, communications, cybersecurity, and many other topics. These standards provide an abundance of information. The addition of specification documents to focus the information flow from designer to vendor and end user is another area for ISA to celebrate as a beneficial achievement.

James W. Harris, ISA Fellow (2005)

View more online at www.isa.org/intech/harris

It is likely that flow will continue to be considered a primary variable worth measuring. However, it could be that more and more flow information will be available using simulation and modeling to provide the missing information when a direct measurement is not available.

2021 Executive Board

The International Society of Automation is pleased to introduce the 2021 Executive Board.

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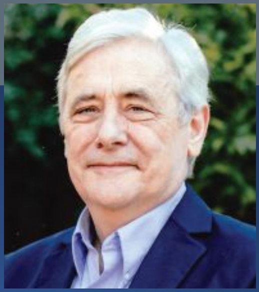

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2021

International Society of Automation
Setting the Standard for Automation™

ISA FELLOWS

Nimmo: Don't leave gold nuggets behind

It is good to know where we have come from. During my experience in over 50 years in this industry, I have observed that as we advance in technology, we also often leave some gold nuggets behind. For example, the pneumatic years had some benefits and advancements, but we moved to digital and forgot many of the advantages of the analog world. We lost the art of working with patterns (trends), as the digital world only offered poor solutions.

The electronic technology quickly evolved into computers and the birth of the DCS, which was initially a computerized version of the electronic pneumatic replacement. The DCS rapidly evolved and presented new ways of sharing the information, but now on a larger scale. Unfortunately, without any discipline or human factors, we created new issues that have led to major accidents. We created poor human-machine interface (HMI) designs, overloaded alarms, and incomplete control strategies.

We moved to digital and forgot the benefits of the analog world.

Controls have continued to improve, with new disciplines around alarm management and the high-performance HMI. The evolution will continue, and the technology will expand outside the traditional instrumentation discipline, creating new disciplines, technologies, and organizations.

In the early days it was simpler: Everyone was focused on technology within a narrow bandwidth. Today, this is very different, and it creates new challenges for a Society that has become so diverse and broad in discipline. The questions we face are: What is the next generation of technology and how does ISA as a Society continue to support the needs of such a diverse membership?

I think we need to focus on how ISA has and will continue to evolve with the evolution of its members, especially in an IoT world that answers almost any known question; however, this is limited to what is, not what will be. I am very interested in participating in anything we, as ISA, do next.

Ian Nimmo,
ISA Fellow (2010)
View more online at www.isa.org/intech/nimmo

Huffman: Automation as a core business function

ISA Fellow Steve Huffman wrote this letter in response to a Bill Lydon Final Say column in a 2019 issue of *InTech*.

I wanted to drop you a note concerning your latest Final Say article and how you could not be more spot-on with your comments. As a veteran of workforce development advocacy for a number of years in government, education, and industry, it still remains today that automation is either considered (1) someone else's problem within the decision-making ranks of the company unit, (2) a job killer from a Capitol Hill political standpoint, or (3) in need of support and a strong voice from industry in the halls of academia beyond local efforts.

Your point, enhanced by an Einstein quote regarding ability to change, is that "automation should be treated as a core business function that is critical for success . . . " in the industrial world. This would go a long way toward solving a significant part of the skills gap, now 7 million and counting, according to our friends at NACFAM [National Council for Advanced Manufacturing], regarding unfilled skilled positions available in industry.

There are some heroes out there: Don Bossi and the folks at FIRST [For Inspiration and Recognition of Science and Technology] are showing young people how exciting a technical career can be, especially for those who didn't realize they had such an opportunity. Paul Galeski first really shined the light on how to address all the considerations, monetary and manpower costs, and future-think possibilities of replacing legacy DCS [distributed control systems] in partnership with ISA. Don Bartusiak is leading a global effort with new development and education in industrial data communications, and newly minted ISA Fellow Kelvin Erickson understands the needs of industry and is single-handedly designing and constructing a world-class and very successful industrial control system lab and coursework in industrial automation at a respected Midwestern engineering university.

These are just a few of my heroes, but they all have in common a strong commitment and have invested hard work in ISA as a technical society. There are many more, but ISA is structured as an individual member organization to benefit members who through association make their companies better. I'm certain there are many CTOs and/or CIOs in large process plants who choose not to "own" the control system—the one most important thing that could make their company more successful by being more competitive.

Steve Huffman,
ISA Fellow (2016)
View more online at www.isa.org/intech/huffman02

Evely: 39 years as a member of the Power Industry Division

I retired at the end of January 2019 following 42-plus years in the power industry and more than 39 continuous years as a member of ISA and its Power Industry Division (POWID). At that time, I also retired from ISA and other professional Society activities to make room for other volunteer leaders. I was blessed to work with a great group of people over the years, and that is what I miss the most. With ISA now celebrating 75 years, it is a good time to share what ISA has meant to me and my career.

I was a student member of a different professional society during college, but it wasn't a good fit for my chosen career in instrumentation and control (I&C). A few years into my career, a coworker suggested that I join the Instrument Society of America (ISA). The monthly *InTech* magazine and the newsletters from the two ISA divisions that I also joined were my first contacts with ISA. Those publications helped me to see that I was a part of a much larger group of professionals who had the same technical interests as myself. In the pre-Internet world, the publications catalog that I periodically received by mail gave me the opportunity to purchase books that also related to my career.

A year or two after joining ISA, a change in employment brought me to Birmingham, Ala., where there was an active local ISA section. It provided regular face-to-face contact with people with the same interests who did not work for the same company; that is where my professional network really began to develop. I also had the opportunity to volunteer for leadership roles, which preceded leadership roles with my employer.

My first volunteer role with ISA was as registration cochair for the 1985 ISA Southeastern Conference and Exhibit. After that, I participated in some of the local education night activities of our local section and eventually found myself as the education chair for the section. In this role I worked with one of our state universities in continuing the production of an annual Fundamentals of Industrial I&C short course, which is still given in May each year. I retired in January 2019 as a member of the ISA POWID executive committee.

Dale Evely, PE,
ISA Fellow (2007)
View more online at www.isa.org/intech/evely

MEMBERS

Medley: Setting the standard for my life

ISA has set the standard for my professional engineer's license in the state of Texas since the year 2000. The piece of ISA that has played the greatest part of my professional life is ISA's *InTech*. I have many [past volumes of] *InTech*.

I am now 80 years old. I was an ISA member while working for 14 years at major oil and gas companies on major products with automation control systems instrumentation. I received ISA's Lifetime Achievement Award and am currently a Senior Life Member of ISA. I was also an I&E tech and ISA member during my time in the military (USMC veteran, aviation helicopters, honorable discharge, Cpl.).

ISA helped me during my years of being a technician and then as a PE in the state of Texas, current through 2020. I can thank ISA for its members across the U.S. and in foreign countries who helped me to be a better member and a better professional engineer. I can flatly thank the ISA for helping set the standard for my life.

Thanks, ISA. Safety first!

Harry J. Medley, PE
ISA Senior Life Member
Born: 4 March 1940
Texas License No. 87221/Active
View more online at www.isa.org/intech/medley

Zinschlag: Three eras of association

My long association with ISA can be divided into three eras: As a regular member who joined in 1974, as Society president in 1993, and as past-president.

Before I became president in 1993, I delivered an ISA paper that predicted the use of microprocessors to do process control. I founded the Computer Technology Division of ISA, called COMPUTEC, to bring computer technology into ISA. I also developed the Bulletin Board System (BBS) for the executive board to use digital communications to conduct ISA business.

In those early days, I also developed Student Section involvement in ISA and encouraged us to technically compete with each other—in live competitions. I coordinated with universities in Illinois and Kentucky to support ISA and to form ISA sections—from which we received recognition from state governments.

While I was president, ISA membership grew to 45,000 with an objective to bring ISA from basically a national organization to truly an international one. The goal that year (1993) was "Remember the Member." I visited many countries to bring the ISA message directly to members around the world. I also visited ISA student sections to get them involved with ISA, as well as protected ISA members from personal attacks.

Accomplishments after being president included forming the Globalization Development Council (GDC) to allow international ISA members to share their ISA values with the organization.

Howard P. Zinschlag, PE, ISA Fellow (1986), 1993 Society President, member since 1974
View more online at www.isa.org/intech/zinschlag

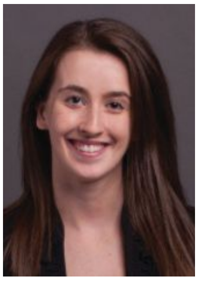
Weckwerth: Get involved early and often

I received my bachelor's degree in chemical engineering from Kansas State University in 2012 and am currently an instrumentation and controls engineer at Burns & McDonnell in Kansas City, Mo. During my first month of working, I found out that my department manager was the membership chair for the ISA Kansas City section. He invited me to a Kansas City section meeting, and from there I was hooked.

ISA has benefited me technically and professionally. I got involved in my ISA section right out of college as a new professional. This helped me meet other automation professionals from all over the Kansas City area from different companies and industries. The section's technical meetings helped me grow tremendously in my new profession, especially considering I came from a ChemE background with very limited instrumentation and control knowledge. After a few years of being heavily involved in my ISA section, I attended a fall leaders meeting, and that is where I got connected into ISA's ChemPID. Being a part of a division has helped me interact with automation professionals all over the globe.

I am just one example that shows you don't have to be an experienced professional to get involved (or even be a leader) in ISA. Pick the ISA area you want to get involved with or try them all. You will learn so much technically and professionally just by getting involved.

Ashley Weckwerth, Vice President and program chair Kansas City Section, honors and awards chair District 8, ChemPID director-elect and membership chair



View more online at www.isa.org/intech/weckwerth

ISA5, Documentation of Measurement and Control Instruments and Systems • ISA5.1, Instrumentation Symbols and Identifica
Symbols for Process Displays • ISA5.6, Software Documentation for Control Systems • ISA5.7, Process and Instrumentation Di

Speaking of standards

Modeling the boundaries between enterprise systems and control systems. Defining automation and batch processing with an object-oriented design pattern. Putting industrial cybersecurity on the map. Developing the first safety instrumented systems standard for the process industries. Creating standards and technical reports for alarms, human-machine interfaces, continuous process procedures, and more. On all these topics and more, ISA has set the standard for industrial automation.

ISA standards help automation professionals streamline processes and improve industrial safety, efficiency, and profitability. Since 1949, ISA has been recognized as the expert source for instrumentation, control, and automation consensus industry standards. Today, as the Society celebrates its 75th anniversary, there are more than 150 ISA standards and technical reports reflecting the expertise of 4,000 industry experts around the world.

ISA standards committees welcome participation from automation professionals across the globe. One of the many benefits in volunteering is to help craft consensus, balanced standards that move industry forward. Visit www.isa.org/standards for more information on participating.

The following stories from ISA standards leaders highlight standards that have had great impact over the years. For more stories, scandals, and name dropping, you can see their full essays at www.ISA.org/75in2020.

tion • ISA5.2, Binary Control Logic Diagrams for Process Operations • ISA5.4, Instrument Loop Diagrams • ISA5.5, Graphic
agrams • ISA5.8, Measurement & Control Terminology Review Subcommittee • ISA5.9, Controller Algorithms and Performance

Tales from the trenches by ISA volunteers setting the standard for automation

Compiled by Renee Bassett

The ISA-95 Enterprise-Control System Integration standards

First published in 2000. As told by Chris Monchinski, 2019–20 Vice President, ISA Standards & Practices Department.

ISA-95 from its inception sought to solve an important issue in our industry: normalizing the integration practices between isolated enterprise and control systems and, in doing so, reducing costs and increasing success rates for these efforts.

The ISA95 committee began its work by surveying existing standards and common practices. The reference models it found for integration from enterprise to control were fragmented, lacking in detail, and quite dated.

The ISA-95 Part 1 and 2 standards ultimately define only primary data exchanges between enterprise and control. In doing so, the standards have also defined an entire framework of models to describe enterprise and control system applications, operations, and functions.

Contributors and contacts

ISA-18.2 Nicholas P. Sands
ISA-101.01 Maurice Wilkins
ISA-106 Bill Lydon
ISA108 Ian Verhappen
ISA-112 Ian Verhappen and Graham Nasby
ISA-5.1 Tom McAvinew
ISA-76 James F. Tatera
ISA-84.1 Angela Summers and Paul Gruhn
ISA-88 Dennis Brandl
ISA-95 Chris Monchinski
ISA-99 Eric Cosman
Charley Robinson, ISA Standards

More information: https://www.isa.org/standards-and-publications/isa-standards

The concept of vertical levels of an enterprise, where key operations and applications interoperate in common time horizons and with common purpose, was adopted. Levels helped to define logical integration boundaries.

A lot has been discussed in recent years regarding the concept of levels, as many have observed that computing power, storage, and communications protocols have allowed a wider array of devices and systems to be connected. ISA-95 levels have always been logical boundaries that allow a practitioner to define boundaries that subsequently support the integration between systems. Viewed this way, all integration efforts begin with a definition of logical boundaries and operational space—a concept universal and still relevant to any integration effort today.

The ISA-95 equipment hierarchy model, an often-referenced model in manufacturing, expanded on an early physical hierarchy model in ISA-88 and demonstrated its universality across discrete, continuous, and logistics industries. Another key concept introduced in ISA-95 Parts 1 and 2 is the process segment, which provides a logical grouping of resources, personnel, equipment, and materials to support dynamic views of operational data—a key for supporting scheduling and resource planning activities between business planning and operational domains.

Although the ISA-95 standard title is "Enterprise to Control," ISA-95 Parts 3 and 4 formally defined the level 3 space, creating the term "manufacturing operations management" and creating complex models for resource management, quality test data management, and the representation of resource routing.

ISA-95 further evolved when Part 2 was revised to recognize the importance of equipment as a class of resources separate from a new resource type, the asset model, which facilitated new adoption of the standard for integrating production and maintenance activities.

The Part 5 standard expanded on this collection of objects and logical exchanges by contributing a transactional representation of ISA-95. Finally, we cannot overlook that the development of Business to Manufacturing Markup Language (B2MML), spearheaded by Dave Emerson and the XML-WG, encouraged the adoption of ISA-95, helping organizations, vendors, and solutions integrators realize the potential of following this industry standard to accelerate interoperability.

A "standard" can be thought of as a collection of the best ideas from across industry, and of course it helps to form those ideas around a solid architecture. The ISA-95 standards find robust adoption in manufacturing both as a reference architecture and as a facilitator of successful integration efforts.

I began my participation with ISA-95 at its earliest development, during the creation of ISA-95 Part 1. I had the fortunate opportunity to work closely with J. Keith Unger and Dennis Brandl. They both had just emerged from the successful creation and ongoing industry adoption of the ISA-88 standards. I have been the cochair of ISA-95 since 2011.

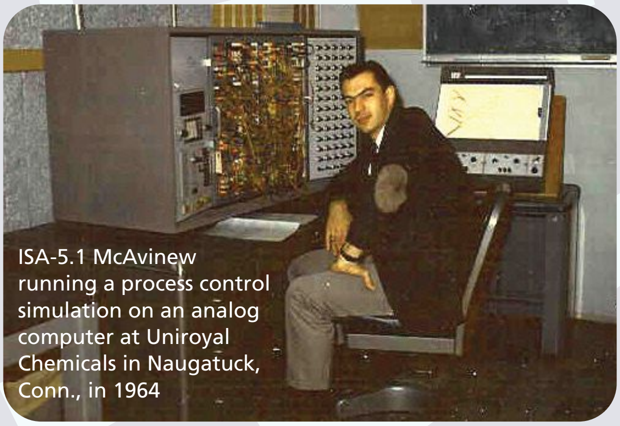
Perhaps the most challenging part of maintaining a successful standard is knowing when to adopt changes so that it remains effective and valuable to industry. Recent revisions to ISA-95 Parts 2, 4, and 5 (2018) were spearheaded by our Process Centric Messaging Working Group, led by Charlie Gifford. This group sought to reduce the complexity and granularity inherent in ISA-95 message exchanges by introducing the operations event model, which allows for a collection of data with common context to be exchanged as a single message.

ISA-95 Part 6 (Messaging Service Model) and Part 7 (Alias Service Model), put forth first as technical reports by Dennis Brandl and Alan Johnston (MIMOSA), were also driven by the real-world needs of practitioners. Most recently, the ISA95 committee is poised to release a new Part 8, which will define a framework for developing an ecosystem of "ISA-95 ready" profiles that can be adopted by integration scenario or industry type.

ISA-5.1, Instrumentation Symbols and Identification

Originally published in 1984. As told by Tom McAvinew.

The use of ISA-5.1, *Instrumentation Symbols and Identification*, originally published in 1984, is in general quite widespread. That is because it is important to consistently identify instrumentation in project documents used for specifying, purchasing, tracking, installing, and eventually maintaining them.



ISA-5.1 McAvinew running a process control simulation on an analog computer at Uniroyal Chemicals in Naugatuck, Conn., in 1964

Although often cited on project or site documents along with other standards, ISA-5.1 is often not followed completely—particularly regarding device identification tagging. Sometimes this is because a particular site may not have followed the standard in the past. Other times, operations personnel on a project may insist on using more phonetic tagging, rather than one of the basic tenets of ISA-5.1—that ID tagging be based on primary variable functional tagging.

My role with ISA-5.1 has been as a resource, based on my 50+ years of experience in the application of the standard for both operating and engineering design firms. None of this would have been possible without the tutelage of Marvin D. Weiss, one of the pioneers in process analytical instrumentation, who met a fresh-out-of-school chemical engineer with an interest in instrumentation and process control, then convinced him to join ISA in 1964.

The ISA-88 Batch Control standards

First published in 1995. As told by Dennis Brandl.

The ISA-88, *Batch Control* (series) standard, first published in 1995, introduced the ISA-88 model, recognized now as an object-oriented design pattern for defining automation. It has become the accepted standard for structuring automation projects.

Most major integrators, and all major automation vendors, support the ISA-88 model and use the models in their projects. We documented measurable benefits from applying the models, typically a 30 percent savings on the first project and up to 80 percent savings on follow-up projects due to the modular and reuse approach defined in ISA-88. Even today, work on Industry 4.0 and smart manufacturing initiatives use the ISA-88 equipment and recipe models as an integral part of their development efforts.

We found that once people learned how to apply the ISA-88 model, their personal productivity improved, and they became better engineers. The World Batch Forum, now part of MESA International, documented the greater than 30 percent improvement, in addition to throughput improvements in batch processes, better repeatability of processes, and higher product quality. These directly measurable improvements have been what has led to the widespread use of the ISA-88 series.

There were, on average, between 20 and 30 active participants in the development of the ISA-88 standard, and over 100 reviewers. Our meetings were at times raucous and noisy, but always focused on the goal of documenting the best-known practices.

My initial role in the committee was to help identify the "true-isms," the things that we could all agree on, such as "a unit only runs one batch at a time," and document what we agreed to. Where we couldn't reach agreement, we came up with the words that describe the different possible implementations.

ISA88 leaders circa 2007: front, Dennis Brandl, Dave Chappell; rear, Charlie Giffords, Lynn Craig, Keith Unger

I started as a naive engineer but listened and learned. Eventually I became the editor of the different parts in the series, and for a time was committee chairman. Often, being chairman was "herding cats," but hopefully I kept us focused on the deliverables and away from the deeper "philosophical" questions that always seem to come up when engineers get together.

There were other major contributors, including Tom Fisher from The Lubrizol Corporation, Lynn Craig from Rohm and Haas, Bill Hawkins, Rick Bullotta, Leo Charpentier, Rick Mergen, Paul Nowicki, Keith Unger, Michael Saucier, and Joel Vardy. These were only a few of the experts involved, but many of the ISA88 committee members have gone on to become some of the icons of automation and batch.

The ISA-99 Industrial Automation and Control Systems Security standards

First published in 2007. As told by Eric Cosman, 2020 ISA President.

The ISA-99 standards helped to put industrial cybersecurity on the map, leading to today's high level of awareness.

It is easy to forget that the ISA99 committee existed and our work on the 62443 standards was happening before most of the current popular or higher-profile products and technologies were even available. Pioneers in the development of solutions in this area were also involved in the early activities of our committee. A notable example is Eric Byres, who went on to develop the Tofino industrial firewall.

Members of the ISA99 committee also provided expertise to the Automation Federation in its efforts to raise awareness with politicians and public policy members. This included the development of briefing papers and visits to Washington

D.C. Our committee has been working closely with the U.S. National Institute of Standards and Technology (NIST) and other groups in the public sector for almost 20 years. This included having a major role in shaping the NIST cybersecurity framework.

All of this attention and focus by industry has led to the creation of new types of jobs in industrial automation cybersecurity. There are now several very successful companies providing consulting and advisory services to asset owners in this area, some of whom employ members of our committee. The impact of ISA-99 has been to help increase understanding of the importance of automation in ensuring safe, reliable, available, and high-performing manufacturing and operations processes.

I was one of a small group of people who came together in a conference call on 18 September 2002 to discuss how ISA could best approach the growing need for and interest in standards and practices for industrial systems cybersecurity.

The Society had considered two basic approaches. The first was to direct all existing and future subject-specific standard groups (e.g., ISA-95) to examine if and how they should revise their standards to consider cybersecurity threats and vulnerabilities. The alternative was to create a new committee to develop one or more standards devoted to cybersecurity and promote the result as a "horizontal" standard that could be applied in a range of contexts.


ISA95 team in Sun Valley in 2012

The consensus was that the second option was preferred. This resulted in the chartering of the ISA99 committee with Bob Webb as managing director and Bryan Singer as committee chair. Bryan Singer and Keith Unger developed the initial committee description. A face-to-face meeting in Chicago on 22 October attracted almost 60 people. This was the first meeting of the committee. Those present approved the formation of three subcommittees to address scope and purpose; models and terminology; and research and liaison.

I have been a member of ISA99 since its formation. I joined to represent the chemical sector cybersecurity program of the American Chemistry Council (ACC), which had decided to avoid creating sector-specific standards and practices. I served as the cochair (with Evan Hand) of the work group that developed what became ISA-99.00.01-2007, which was the first standard in what became the 62443 series. I later took on the role of committee cochair, first with Bryan Singer and later with Jim Gilsinn. Many others who attended our first meeting are still contributing today—continuity that has contributed to the success of the committee.

ISA-84.1, Application of Safety Instrumented Systems for the Process Industries

Published in 1996. As told by Angela Summers and Paul Gruhn

Dr. Summers says **ISA-84 has not simply rocked the world** of instrumentation and controls; it has affected process safety strategies across most of the process industry. It spawned an entire industry of specialized professionals and credentialing programs centered around ISA-84 compliance. It also initiated the widespread use of SIL-certified programmable controllers across multiple industry sectors. ISA-84 has become foundational to our current approaches to designing and managing instrumented safeguards.

What is really amazing, says Summers, is how impactful ISA-84 has been to other organizations that write standards and practices. "I have worked with various API, ASME, and CCPS committees on how to address their scope and stay in conformance with ISA-84. I have also worked with government agencies on incorporating ISA-84 into regulatory audits, regulations, and guidance documents."

Summers says that when she joined the ISA84 committee in the 1990s, she was fortunate enough to meet and be mentored by the thought leaders she met there: Ken Bond (Shell), Vic Maggioli (DuPont), Charlie Hardin (Celanese), and Robert Adamski (ExxonMobil). Very quickly, Maggioli, who was the ISA84 committee chair for many years, gave her opportunities to contribute. She joined the IEC 61511 committee in the late 1990s at the request of Sam Mannan, director of the Mary Kay O'Connor Process Safety Center at Texas A&M University until his death in September 2018.

Gruhn says ISA-84.1 (also known as the emergency shutdown systems standard) led to the development of International Electrotechnical Commission (IEC) standards on functional safety, product and personnel qualification programs, new books, new products, new software, and recognition by regulators around the world: “In short, it changed the industry.”

Relays have been used in safety applications for almost 100 years, says Gruhn. Solid state systems (that did not use software) were developed by several vendors in the 1970s. General-purpose programmable logic controllers (PLCs) have been used in some safety applications since the 1970s. Safety PLCs have been available since the early 1980s. Yet at that time there was no industry agreement on what steps to include in a project life cycle, how to determine the performance required of a system, how to model the performance of hardware and software, and much more.

The development of a standard was proposed to ISA in the early 1980s. The original charter of the standard was to cover software-based logic solvers only, and field devices were not included in the original scope. The scope was expanded in the early 1990s.

Ten years of deliberation brought consensus on the system life cycle, methods to determine the required system performance (safety integrity level [SIL]), methods to analyze the performance of hardware and what to include in the calculations, factors to include in the design of a system, and factors to consider in the operation, maintenance, and changes of a system. The first edition of the standard, released in February of 1996, was approximately 40 pages long, and had five informative annexes totaling almost 60 pages.

Gruhn says the IEC started developing functional safety standards in the mid-1990s. The ISA84 committee actively participated in the development of the IEC 61511 standard for the process industry. That standard was first released in 2003 and was adopted as ANSI/ISA 84.00.01-2004 one year later with the addition of one sentence. That is a three-part standard; part 1 (the normative portion) was over 90 pages. Part 2 (an informative document) was also over 90 pages. Part 3 (another informative document summarizing various SIL selection methodologies) was over 60 pages.

The Occupational Safety and Health Administration published interpretation letters stating that it considered the first and second editions of the ISA-84 standard as “recognized and generally accepted good engineering practice” (RAGAGEP). The IEC released a second edition of 61511 in 2016. After a one-year period of editorial changes, the ISA84 committee accepted the new standard verbatim (although it added a new U.S. forward in Part 2). It is now ANSI/ISA 61511-2018. The ISA84 committee has also written eight technical reports totaling more than 1,000 pages over the past 15 years. They further explain the standard and ways of implementing its requirements, says Gruhn.

ISA100.11a team

ISA-18.2, Management of Alarm Systems for the Process Industries

First published in 2009. As told by Nicholas P. Sands.

ISA-18.2 changed the world—a very small piece of the world, but a piece, nonetheless. Some companies had alarm management programs prior to the standard. Many more companies have programs now. The control system suppliers have improved the alarm functionality as well, adding shelving functionality, for example. That small part of the world has changed, and it has been kind of cool to be a part of it.

My role in ISA18, along with Donald Dunn, has been as cochair of the ISA18 committee and organizer of chaos. We started in 2003 by rebuilding the committee with real-world experience in alarm management. We added world-class experts like Ian Nimmo, Bridget Fitzpatrick, David Strobhar, and Bill Hollifield, as well as industry experts like Joe Alford, Todd Stauffer, Graham Nasby, Lieven Dubois, and Kevin Brown. We got advice from members of the ISA84, ISA50, and ISA88 committees, and we got to work. After ISA-18.2 was published in 2009, Donald and I shifted from leading the development of the standard to coaching the working group leaders and publishing the work of the committee. We also started working to publish the IEC version of ISA-18.2, IEC 62682.

My involvement with ISA-18 and my role at DuPont have grown together, so I have even become an expert in some areas, using my experience to contribute to standards, and my understanding of standards to improve the practices in my company.

Being a working group and committee leader for an industry-wide global standard has dramatically broadened my perspective. So many people participate from different companies, industries, and countries, and they all bring valuable perspectives.

ISA-101.01, Human Machine Interfaces for Process Automation Systems

Released in 2015. As told by Maurice Wilkins.

ISA-101.01 was being cited even before its release. It is now the go-to standard for HMIs for process automation systems, especially in North America. ISA-101.01 has helped people to move away from classic HMI designs toward more intelligent, high-specification HMIs. Guidelines from the Abnormal Situation Management (ASM) Consortium and the Engineering Equipment and Materials Users Association (EEMUA) in the U.K., including the latest edition of *EEMUA 201 – Control Rooms: A Guide to their Specification, Design, Commissioning and Operation*, cite ISA101 in several places. Greg Lehmann and I have contributed to the review process.

I joined the ISA101 committee in 2008 as a basic committee member and became cochair with Joe Bingham in 2009. Joe was later replaced by Greg Lehmann. We needed some "glue," so Greg and I—with the help of a wonderful group of ISA108 clause editors (Bridget Fitzpatrick, Dale Reed, Tracy Laabs, Dawn Schweitzer, David Lee, Beth Vail, Mark Nixon, Nicholas Sands, Ian Nimmo, and John Benitz)—developed a life cycle for the proposed standard based on ISA-18.2 and ISA-84. This helped us to organize the standard, and things flowed from there. We received many thousands of comments as the standard developed, but we eventually decided to make it the "what" and removed all the "how" into proposed technical reports. The standard was successfully released in July 2015. After that, four working groups were set up—Philosophy and Style Guide; Usability and Performance; HMI for Mobile Platforms; and HMI for Machine Control. The purpose of the working groups is to develop technical reports (TRs) intended to show how to implement the standard.

The initial standard had said that mobile/small platforms were excluded, but by the time the standard was released, these platforms had become ubiquitous. David Board and Ruth Schiedermayer drove the development of the *Usability and Performance* technical report (TR) on a fast timeline, doing most of the work themselves. That TR was released in 2018 and provides a very good companion to the standard. The other TRs are at various stages of development. The standard itself is now out for a reaffirmation vote, with the plan to submit it to IEC for development as a global standard.

ISA-101.01 was approved for development/adoption as an IEC standard in early 2020, which will enable it to become more globally accepted. The IEC standard is being developed by TC65/SC65A WG19, HMI for Process Automation Systems, and the standard will become IEC 63303. I am co-convenor along with Dave Board. The draft is being developed from ISA-101.01, and the ISA101 committee has an IEC C liaison with WG19. This will allow ISA101 to be involved in the development of the IEC standard. ISA101 Co-chair Greg Lehmann is the liaison coordinator. We anticipate this joint ISA/IEC work to be completed in late 2021.

ISA-108 and ISA-112: In development for intelligent device management, SCADA systems

As told by Ian Verhappen and Graham Nasby.

The ISA108 committee is working in a collaborative effort with IEC SC65E WG10 on an important emerging area of automation: intelligent device management. With large amounts of data available from a single device, being able to manage the data and its flow, as well as identify the necessary tools and infrastructure to do so, is important. ISA recently adopted the IEC document as ISA-TR 63082-1:2020 and is now working on Part 2, which will be an International Standard. ISA-108 will enable the community to use this information rather than be overwhelmed by options and stymied by "analysis paralysis." Using the information from intelligent devices will lead to higher returns on control system investments and better use of the skills of overworked support teams.

The ISA-112 supervisory control and data acquisition (SCADA) standard will help define how all the disparate parts of a control system can be and are linked together to form a single system able to communicate machine-to-machine as well as machine-to-human. With the increasing distribution of controls to the edges of a control system, being able to integrate those controls using best practices captured in this series of documents will help achieve that goal across a wide range of industries.

Work on the first ISA-112 SCADA systems standard is not completed yet, but according to Graham Nasby, a leader in the water/wastewater community, it is still having a major impact on how SCADA systems are designed, used, and implemented in several sectors. For example, large water utilities in Ontario, Canada, are already using the ISA-112 framework for managing large automation projects and SCADA master-planning activities. Many other water utilities, sewerage districts, oil/gas companies, and other organizations are now starting to look at the ISA-112 SCADA framework for managing their automation assets, he says. There is a need for this sort of guidance, and ISA112 is working to provide it.

ISA-106, Procedures for Automating Continuous Process Operations

As told by Bill Lydon.

Process plants are complex, and the majority of those in operations management agree that good operating people are valuable. Automation professionals can support knowledgeable operators with well-engineered system applications to keep production running efficiently—particularly when seldom-used procedures are required and unexpected problems occur.

Automating and clearly documenting functions that are well defined and deterministic enable operators to focus on the most important tasks, problems, exceptions, and unexpected issues. Automation professionals can take advantage of the work of ISA106, which is focused on achieving these goals with standards, recommended practices, and technical reports on the design and implementation of procedures for automating continuous process operations.

The ISA-106 models define how to capture information about physical assets, from the enterprise level to an individual device, and the requirements that define a procedure. They establish the functional requirements for the automated procedure and tie these requirements directly to objects in the physical model. The lower the level, the more detailed the association between procedures and objects. The implementation module defines a set of ordered tasks, which may have their own subtasks to perform step-by-step in a defined order.

Larger activities, such as plant startup or shutdown, are important. However, the same tools can be used for more routine procedures, such as isolating and starting up a redundant pump system, performing online maintenance on a piece of equipment, or even something as “simple” as performing an in-line valve performance test. All of this normally requires communication with someone physically at the asset to verify, or in some cases, manually intervene in, the process.

Procedural automation can be used to capture and share corporate knowledge, including best practices, and to minimize errors with a resulting decrease in incidents, improvement in safety, and increase in throughput. This is particularly important with an aging workforce and the difficulty in finding experienced operators.

Safety statistics show the majority of incidents not related to outright mechanical failures happen during abnormal situations, primarily unit startups and shutdowns. When an infrequent operation is required and key individuals are not available, inexperienced operators can be left to follow inadequate or incorrect instructions. Something can get out of control, leading to an abnormal condition with the undesirable outcomes of equipment damage, environmental release, injuries, and fatalities. By applying ISA-106, a single process plant, a complete facility, or even an entire company can achieve significant improvements in operational efficiency and safety. ■

ABOUT THE EDITOR

Renee Bassett is chief editor for *InTech* magazine.

View the online version at www.isa.org/intech/20201003.

ISA-76.00.02-2002: NeSSi

Regarding ISA-76.00.02-2002, *Modular Component Interfaces for Surface-Mount Fluid Distribution Components – Part 1: Elastomeric Seals*, this document was created in 2002 at the request of and with the help of Exxon, Swagelok, Parker, and additional users and vendors.

There was a call for a small-sampling platform that was not tube based and on which devices from multiple suppliers could be used. No vendor was willing to invest in it until the basic platform was defined in an open standard, so they would not have to make different products for different vendor footprints.

The result was the development of this standard—commonly known as NeSSi (the New Sampling Sensor Initiative)—and many vendors have made products to fit on this platform. This standard has also been published as an IEC standard (IEC 62339-1 Ed. 1).

James F. Tatera's on-line process analysis experience includes more than 27 years with a major international chemical company and years of consulting through his own firm and others. He is one of the original Certified Specialists in Analytical Technology (CSAT) and an active member of ISA and ACS. He is involved in U.S. and international standards activities and was the ANSI USNC Technical Advisor to IEC SC 65D (Industrial Process Measurement and Control – Analyzing Equipment). Additionally, he is an ISA Fellow, trainer, and winner of several honors and distinctions in the field of process analysis.

Manufacturing and automation MEGATRENDS

ISA looks toward the future through the prism of globally transformative forces

By Bill Lydon

Megatrends are revolutionary. They are powerful, transformative forces that change the global economy, business, and society. Megatrends both drive and are driven by disruptive innovations. Henry Ford's design and production methods are often cited as one of the most significant megatrend achievements of the past. They both leveraged and advanced technology, creating better jobs and stimulating societal change.

The concepts and goals of Industry 4.0—or, as the World Economic Forum terms it, the Fourth Industrial Revolution—represent a modern megatrend. As we enter this new era, innovative manufacturing and production companies worldwide are automating and digitizing operations with the aim to be more competitive. By leveraging disruptive innovations and technological developments, these companies are positioning themselves to become leaders, create new markets, and thrive.

History teaches that resisting major shifts is not productive and can be fatal. Being successful often requires rethinking fundamentals, which can lead to radical change. When faced with powerful transformative forces, the options are to change and grow, or die.

One way to reduce resistance is to prepare. To assist with that, ISA is using the occasion of its 75th anniversary to identify the megatrends impacting the world of automation. Online now and continuing into 2021 and beyond, the ISA Megatrends website (https://isaautomation.isa.org/isa-megatrends) will collect and share resources on the trends, disruptions, challenges, and solutions having the greatest effect on industries and industrial professionals around the world.

Stay on top of the changing industrial automation landscape. Bookmark https://isaautomation.isa.org/isa-megatrends.

As ISA president Eric Cosman has said, noting the 75th anniversary theme, "The ever-changing face of the automation profession is driven by forces ranging from changing markets and business models to the emergence of disruptive technology." Here are some of the forces expected to change the face of automation in the coming months and years.

Workforce of the future

Industry will require more knowledgeable personnel with practical thinking skills and manufacturing process know-how.

With the recognition that low labor cost is not a sustainable competitive advantage, manufacturers worldwide are increasing their use of automation. Greater application and deployment of technology means industry will require more knowledgeable personnel with practical thinking skills and manufacturing process know-how. Industry analyst firm The Gartner Group thinks this will come in the form of a "citizen data scientist"—a person who creates or generates models that leverage predictive or prescriptive analytics, but whose primary job function is outside of the field of statistics and analytics.

The most important areas for automation engineers and technicians to focus on in the future are analytics, data science concepts, and manufacturing and production process knowledge, as well as how to apply skills in those areas to increase productivity, quality, profits, and flexibility. The availability of no-code development tools that empower subject-matter experts to create applications is another major trend. The simplest longstanding example of that is the spreadsheet, which enabled a wide range of people with subject-matter expertise to leverage computing.

A 2019 survey in the pharmaceutical industry reported the following six skills as necessary for success in the future: understanding equipment and processes; strong communications skills; firm understanding of software development and programming concepts; creative and detail-oriented thinking; ability to troubleshoot equipment; ability to perform complex system tests. The survey respondents noted that mentoring and Internet-based online training will continue to grow, since it is responsive, immediate, and efficient.

The growing application of mechatronics and collaborative robots will require automation personnel to understand the applications of these technologies. Automation professionals are essential to successfully selecting and applying these and other technologies, and important guides for management looking to maximize productivity.

The lack of a skilled local workforce will drive the need for training, as well as the use of remote-work processes, virtual assistants, artificial intelligence applications, and more.

Key elements and drivers

- No-code development tools
- Need for ongoing process optimization
- Robotic and mechatronic applications
- Accessible documentation and frictionless collaboration
- On-demand and remote learning

Impact for industry

- Manufacturing executive management needs to functionally understand automation possibilities.
- Manufacturers need to educate employees about production processes.
- Scaling and standardization of processes and technology solutions must occur.
- Increased collaboration between humans and technology will happen.

For ISA members and leaders

- Standardization potentially needed in new areas
- Development of analytics strategies for production processes focused on industry applications
- Functional data science training programs for operational technology and automation professionals
- More and better online, on-demand training programs

> **"The ever-changing face of the automation profession is driven by forces ranging from changing markets and business models to the emergence of disruptive technology."** *– ISA president Eric Cosman*

Manufacturing technology transformation

Digitalization will accelerate, pushing manufacturers to transform and enabling innovation.

Whether it is consumer and commercial tech moving onto the production floor or into the field, or rapid advances in artificial intelligence and cyber-physical systems, the digital transformation of industry will accelerate.

Cyber-physical systems involve transdisciplinary approaches, merging the theory of cybernetics, mechatronics, design, and process science. Examples of cyber-physical systems include industrial control systems, smart grids, autonomous vehicles, medical monitoring, robotics systems, automatic pilot avionics, and other targets of Industry 4.0.

Rapidly advancing technologies provide the means for manufacturing companies to achieve highly efficient, real-time synchronized production as a holistic enterprise rather than as a collection of functional silos. This is driving the integration of supply chain, operations, automation, customer service, and logistics.

Industrial operations are experiencing a massive shift toward digitalization made possible through multivendor open solutions. Open systems enable efficient and frictionless integration—a path the information technology (IT) industry has been on for many years. In manufacturing, the use of open source code and standards has been accelerated by the Internet of Things.

Understanding new technology solutions and creatively applying them to improve manufacturing and production processes will become a key success factor to sustain a competitive advantage. Communication is being commoditized, enabling low-cost data acquisition and linkage of real-time business systems with production from sensor to enterprise.

Controls and automation previously done by programmable logic controllers, distributed control systems, and other dedicated controllers is being replaced by edge and embedded computing. Analytics and advance control incorporated into edge computers and smart sensors create more responsive and efficient systems.

> **"New tools will be enabling users to directly create applications without programming."** *– Francisco Betti of the World Economic Forum*

With greater customization of products and processes, there is pressure to develop faster and more adaptable production environments. These incorporate flexible process production technologies, including 3D printing, robotics, collaborative robots, and mechatronics.

The commoditization of manufacturing technologies will enable small and medium enterprise manufacturers (SMEs) to compete with large manufacturers and broadens the base of the automation industry. This is a parallel to what happened in the computer industry with the advent of the PC, bringing large-company efficiencies with business systems, computer-aided design, and machine tool controls to small companies.

Key elements and drivers

- Make-to-order manufacturing and demand for customized products
- Real-time digital integration, sensor to enterprise
- Communications flexibility, including wired Ethernet and wireless (e.g., Wi-Fi, 5G, Bluetooth)
- Increasingly intelligent robots and collaborative robots
- Subject-matter experts empowered by no-code programming
- Multivendor integrated systems and open standards

Impact for industry

- Manufacturing business and production integration and digitalization required to be competitive
- Competition will come from a widening base, including worldwide and small and medium enterprise manufacturers
- Because developing economies will leverage the latest technologies, established organizations need to rethink manufacturing automation investment strategies

For ISA members and leaders

- Understanding of and leadership participation in evolving world standards
- Educate manufacturing general management and automation professionals about integration of business systems, operations, and automation
- Educate manufacturing general management and automation professionals about investment analysis
- Training for the application of analytics and data science concepts as functional building blocks
- Automation certification programs elevating the profession

Standards under pressure

Global standards are emerging, driven by Industry 4.0 and IoT concepts and an influx of open standards-based hardware and software.

Industry recognizes the need to modernize. This results in open manufacturing initiatives, which lead to new worldwide standards led by the Industry 4.0 movement. Open standards enable manufacturers to achieve the goal of holistic and adaptive automation system architectures. Germany's "Industrie 4.0" initiative ignited worldwide cooperative efforts among European countries, China, Japan, and India. The Internet of Things (IoT) is having a big influence on standards for industrial sites, because many commercial application requirements match those for manufacturing: real-time responsiveness, sensing, ruggedness, and open communications.

History has proven the impact: In the computer industry, the transition to open source standards resulted in a significantly larger selection of lower-cost hardware and advanced software that did not require programming. This increased the number of applications possible (again, think spreadsheets) and expanded the industry dramatically. Manufacturers should not hesitate to follow their example.

> **"Imagine our frustration if lightbulbs didn't fit into lamps, or if there were no common-sized spark plugs for automobiles, or if trains couldn't move from one state to another because the tracks were a different gauge."**
>
> *—www.StandardsLearn.org*

Increasing numbers of people newly entering the industrial automation industry are already using IoT sensors, cloud computing, and edge computing to create more responsive applications for control and automation. The collaboration of industrial automation veterans with younger professionals who understand the open IoT and computing industry technologies have led to the creation of highly effective solutions.

Manufacturing open-architecture initiatives are driving industrial control and automation standards. See key drivers (below) for some of the more prominent examples.

Key elements and drivers

- **MTConnect.** The MTConnect standard (ANSI/MTC1.4-2018) has a semantic vocabulary for manufacturing equipment to provide structured, contextualized data with no proprietary format.
- **OPC Foundation.** The OPC Foundation OPC UA semantic models and schema from industry organizations further global standardization interoperability (sensor to enterprise). It can be communicated with most communication methods, including modern industrial protocols, Ethernet, cellular, and wireless.
- **Industry 4.0 for Process – Modular Production.** The application of Industry 4.0 concepts to improve process automation is driven by NAMUR, ZVEI, VDI, VDMA, and ProcessNet. The "module type package" (MTP) is a central concept for a standardized, nonproprietary description of modules for process automation.
- **RAMI 4.0 Reference Architectural Model.** RAMI 4.0 gives companies a framework for developing future products and business models. It is designed as a three-dimensional map showing companies how to approach the deployment of Industry 4.0 in a structured manner.
- **The Open Group's Open Process Automation Forum.** The Open Group's OPAF formally launched in November 2016 by publishing the first standard in a series. OPAF continues to advance. The group is focused on a multivendor, standards-based, open, secure, and interoperable process control architecture.

Impact for industry

- Open standards broaden the number of solutions available to increase productivity, profits, and competitiveness.
- The influx of new technology suppliers brings more responsive and cost-effective solutions.
- Increased ease-of-use empowers users to focus on improving their specific manufacturing processes.

For ISA members and leaders

- Embrace and become knowledgeable about open manufacturing concepts and initiatives.
- Foster active participation, leadership, and knowledge of new standards to deliver programs for members to apply the right technologies to increase profits and efficiency.
- Participate in the integration of enterprise computing, operations technology, and automation standards.

Environmental, safety, and security evolutions

Societal and business concerns about cybercrime, worker safety, sustainability, and more will require a response from manufacturing and production companies.

Processes for engineering design and operations change not only because of technological advances but also in response to economic and societal forces. As societies place more value on protecting the environment, for example, more investments will be made in the development of alternative energy technologies. Emissions and fossil fuel use will gradually be replaced by alternatives, and this worldwide effort will dramatically reduce carbon emissions. Automation professionals will be required to focus on efficient energy use and reduced emissions, as well as productivity.

Global pandemics, cyberthreats, workplace shootings, calls for accommodating differently abled or culturally diverse workers—all these forces and more will push manufacturing and production facilities to adapt. Companies must keep workers and facilities safe, keep processes and products secure, and support corporate goals like carbon-neutral operations or diversity in hiring. Being able to evaluate technology solutions, combine big-picture thinking with practical implementation and management skills, and engage in global collaboration will be required of automation professionals.

For example, companies will need an integrated, cohesive cybersecurity approach that encompasses all manufacturing and production operations, including supply chain, production, quality, outbound logistics, product life-cycle genealogy, and customer service. The emerging organizational management model is one leader responsible for coordinating all cybersecurity with all stakeholders, deploying a holistic cybersecurity strategy. The chief information security officer (CISO) is most likely to take on this responsibility, coordinating activities among functional areas such as information systems, operations, production, and automation.

Organizations like the ISA Global Cybersecurity Alliance will influence industries to get beyond technology fixes to deliberately and purposefully develop cultural norms that improve cybersecurity. Cybersecurity will be synonymous with a safety culture. Policies for all stakeholders in the value chain will provide prevention and escalation procedures to ensure the safety and security of assets, people, and the environment. Cybersecurity certification of control and automation equipment based on international standards will become a primary purchase requirement.

> **"As the world of production faces a perfect storm wrought by the Fourth Industrial Revolution, the accelerating climate emergency, raising trade tensions, and growing economic uncertainty, manufacturers must develop new capabilities and adapt."** *– Francisco Betti*

Key elements and drivers

- Affordability and accessibility of alternative fuels and energy sources
- Aggressive robotics and mechatronics application
- Holistic cybersecurity protection achieved with the collaboration of all stakeholders
- Cybersecurity built into edge computers and intelligent sensors
- Pervasive Internet Protocol (IP) communications, both wired and wireless

Impact for industry

- Organizational changes to achieve cybersecure digital manufacturing
- Energy-efficient production methods become essential to be competitive
- Business computing systems integrated from sensor to enterprise, with processing happening from the edge to the cloud

For ISA members and leaders

- Expanded cybersecurity training and expansion of practical guides for end users
- Collaboration with IT cybersecurity standards and groups
- Development of intelligent sensor standards (ISA99 Level 0,1). ■

ABOUT THE AUTHOR

Bill Lydon (blydon@isa.org) is an *InTech* contributing editor with more than 25 years of industry experience. He regularly provides news reports, observations, and insights here and on Automation.com.

View the online version at www.isa.org/intech/20201004.

How industrial automation suppliers can accelerate the adoption of emerging technologies

By Rajabahadur V. Arcot

Manufacturing companies expect industrial automation system suppliers to stay current with technological developments and offer state-of-the-art solutions. They believe that the automation systems built around industrial Internet technology—which include Industrial Internet of Things (IIoT), edge computing, cloud computing, big data and analytics, artificial intelligence, machine learning, and autonomous robots—will improve the performance of industrial automation systems. Although there are many possibilities with industrial Internet, configurable and integration-ready automation systems built with industrial Internet capabilities are not yet available from traditional automation suppliers.

It is necessary to identify upfront the new functionalities and performance improvements that such systems facilitate. Either the suppliers have to discover functionalities that enrich the user experience, or the automation-system users have to specify their expectations.

A good example of the end user taking the lead in this regard is the ExxonMobil case. ExxonMobil Research and Engineering Company (EMRE) entered into an agreement with Lockheed Martin to design an automation system architecture for its plants, which—while ensuring modularity, interoperability, expandability, reuse, portability, and scalability—will provide intrinsic cybersecurity protection that is adaptable to emerging threats. ExxonMobil specified its system requirements, and the supplier had to meet them.

The basic competencies required for architecting industrial automation systems to meet customer needs are automation fundamentals covering various types of sensors and transmitters, basic and advanced control principles, signals and communication protocols, control system architectures, and knowledge regarding the controlled processes and its safety, among others. However, information technology is the foundation on which the industrial Internet–based control systems rest. Hence, those having the comprehensive skills in both automation and information technologies are better equipped to leverage it. Information technology (IT) companies are making the bulk of the investments related to the industrial Internet, edge computing, cloud computing, big data and analytics, and artificial intelligence. So, it should be obvious that industrial automation companies and IT companies have to collaborate to incorporate IIoT into the industrial automation architecture. Such collaborative efforts are in evidence:

- In conjunction with Microsoft, ABB developed its Ability Platform, which enables customers to integrate data, apply big data and predictive analytics, and generate insights. IBM is ABB's preferred partner for artificial intelligence solutions.
- GE has announced that it will operate its software and services, including Predix Application Platform, on Amazon Web Services and Microsoft Azure public cloud data centers.
- Emerson is working with Microsoft to help industrial firms realize the value of the Industrial Internet of Things.
- Yokogawa has announced agreements that envision "process co-innovation" for integrating its IIoT architecture; it has entered into agreements to use Microsoft's Azure IoT Suite, FogHorn's fog computing software, Bayshore's security technology, and Telit's communication modules, sensor onboarding, and device management with respective companies.

In the past, industrial automation suppliers have shown their adaptability to using various developments taking place in different disciplines of science and technology. They moved from local, mounted gauges and meters to panel-based pneumatic indicators, recorders, and controllers. Then they introduced electronic instruments and controllers. The advent of microprocessors contributed to the introduction of distributed control systems, programmable logic controllers, and supervisory control and data acquisition systems.

The convergence of information and communication technologies saw automation suppliers develop Fieldbus protocols in place of electrical signal transmission. It is now time for them to incorporate industrial Internet into their automation system architecture to enhance its value to end users.

For that to happen within a short time, apart from collaborating with information technology companies, automation suppliers must make their devices (sensors, transmitters, and human-machine interfaces) compatible with the industrial Internet, so that third parties can develop the applications or build interface devices.

The industrial Internet can enhance automation system capabilities associated with connectivity, data gathering, data processing, visualization and much more.

ISA MEGATRENDS

A call for speed and openness

In the past, automation suppliers had the luxury of taking their time to acquire the required competencies, introduce new systems with the existing system as a backup, and validate the reliability and superiority of new systems. They had the luxury of deciding on the functionalities and features of the automation systems and building them accordingly.

Now customers want their specific requirements to be fulfilled. Since they are already used to the rapid pace at which the new information technology products and gadgets are entering the market and becoming obsolete, they expect similar instant fulfilment from automation suppliers.

The other challenge for automation suppliers is that they have a large installed base that has significant economic value. The way forward for them to meet customer needs, without discarding their existing architecture, is to open their architecture so that others can develop new applications and add-ons. For example, automation suppliers can allow connectivity to smartphones and other portable devices and help collaborative partners to develop applications.

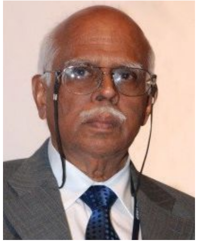
Process experts and maintenance personnel who may not be available on site all the time can be brought into the decision-making loop with the help of mobile devices. With an app on a mobile device, one can access and visualize specific information with a touch and share it while simultaneously communicating by voice. In many process plants, auxiliary equipment, such as an air compressor or ash handling plant, often comes packaged with its own automation system and asset management software. However, it is necessary to access that information from the central control room. By incorporating industrial Internet connectivity, it is possible to access required information remotely.

The issue of building cybersecurity into automation system architectures is a work in progress. Automation suppliers' traditional way of undertaking to design almost everything for their own drawing board may have to change. The commonly used system integration/application engineering approach to meet end user requirements serves the purpose only when all the building blocks are available and solutions are well known and already deployed. Incorporating industrial Internet and other adjacent technologies requires missing blocks links to be identified and developed quickly.

To quickly gain a foothold into the future, automation suppliers must adopt system engineering methodologies and work with system engineering partners with niche and complementary competencies.

A systems engineering approach focuses on analyzing and eliciting customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with further work. With such an approach, automation suppliers can build configurable and integration-ready automation systems that include industrial Internet capabilities, and manufacturers can get the performance-enhancing automation systems they need.

ABOUT THE AUTHOR



Rajabahadur V. Arcot (rajabahadurav@gmail.com) is a life member of ISA, a member of the ISA Smart Manufacturing & IIoT Division, and an ISA-accredited mentor and trainer. Arcot writes industry and technology trend articles and market research reports.

AUTOMATION INNOVATORS SHOWCASE

In conjunction with ISA's celebration of 75 years of automation and control innovation, Automation.com presents a showcase of vendors offering their own innovations. From open control systems to IIoT, enabling remote access to empowering robots, these members of the greater automation ecosystem provide solutions that enable digital transformation.

Look inside for stories from:

- CODESYS
- Endress + Hauser
- FDT Group
- Harting Technology Group
- Honeywell
- Moore

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Benefits of an Industrial Internet of Things platform

Using the possibilities of Industrial Internet of Things (IIoT) and CODESYS cloud-based administration, systems integrators and their customers—machine operators of all types—can benefit from sophisticated remote operations.

An example of what is possible comes from AWT, a global manufacturer of automated car wash facilities, and Inasoft, the systems integrator who developed and optimized the control applications created entirely on CODESYS-based systems. Inasoft has been a CODESYS Premium System Partner for many years and has implemented numerous successful CODESYS projects.

Inasoft is in a good position to solve typical tasks that operators and manufacturers of remote machines have to face, because they used the CODESYS Automation Server for cloud-based system administration. CODESYS is constantly adding new features, and the latest examples are remote debugging and remote access to the controllers' HMI interfaces and the data analyzer.

AWT equipment is found in facilities in more than 40 locations spread across two countries. But AWT needed an overview of the delivered control systems that allowed them to be accessed and managed in a central location. Updates of the control application software need to be deployed quickly on previously installed washing systems—without requiring an employee on site to work with a PLC programming tool. AWT wanted to be able to remotely adjust system parameters to optimize the washing results without having to travel to the respective production site.

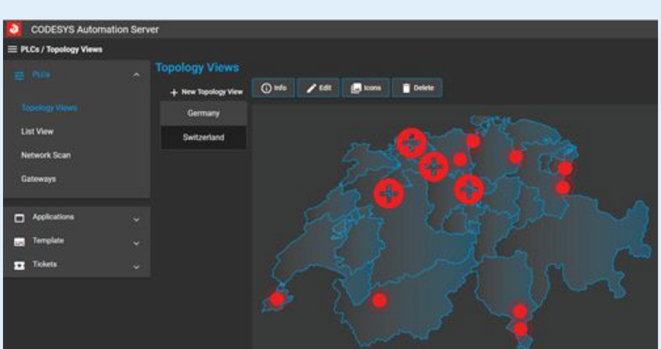
Combining IIoT and cloud-based administration enables remote operation of car wash control systems.

Could an IIoT platform help with all these tasks? The system integrator knew it could. That's why Inasoft started early to connect the car washes with the CODESYS Automation Server, as part of a pilot project for AWT. An IIoT platform has the added benefit of protecting equipment manufacturers and operators against loss of operating income due to a control defect. In other words, the software side of device replacement could be completed swiftly so that an affected system could be brought back into operation quickly.

Using CODESYS, Inasoft programmers could connect the CODESYS controllers to the Automation Server in just steps:

Create an account. Accounts are set up in the CODESYS Store, where the entire administration of the accounts takes place.

Connect the controllers to the cloud server. A range of security measures are available for CODESYS controllers to protect the devices and applications. First, the CODESYS Edge Gateway creates an additional layer of security by separating the controller networks from the Internet. Inasoft installs this gateway as a software service either on a special controller or separately on dedicated Linux or Windows devices. The gateway is the transition point or "edge" between the local controller network and the cloud platform. All communication to the cloud is encrypted and signed with X.509 certificates—the same security standards used by online banking applications. The same security measures can be implemented for programming the devices and communicating to the local control network.



CODESYS Automation Server enables an overview of all system locations.

Register the edge gateways. The CODESYS Development System allows the system integrator to register edge gateways at different car wash locations in the account of the Automation Server.

Add controllers to the CODESYS Automation Server. A network scan through the web interface shows all controllers connected to the gateways. Inasoft can add these controllers with a simple mouse click. This creates a central list of the devices that can be displayed in the browser on a PC, laptop, or mobile device. To improve clarity, Inasoft additionally structured the controllers graphically in topology views, e.g., with map views for their locations in two countries. It is also possible to group the display according to different types of facilities.

For more on this case study and CODESYS products, as well as a multipart tutorial on object-oriented industrial programming (OOIP), visit https://www.automation.com/en-US/Suppliers/SISP07/CODESYS.

CODESYS

50 years of innovation: Endress+Hauser Liquid Analysis looks back

Endress+Hauser Liquid Analysis is celebrating its 50th anniversary. The success story began in 1970 in Stuttgart, Germany with the production and sales of pH measurement transformers and gas alarm instruments under the name "Conducta." Seven years later, the company was integrated into the Endress+Hauser Group and moved to Gerlingen, Germany. The liquid analysis specialist now has 1,000 employees at five production locations in Germany, the U.S., and China.

Endress+Hauser Liquid Analysis has built modern production and office facilities in Gerlingen over the years. An additional five-story building with office space, laboratories, and technology is currently under construction with completion scheduled for 2021.

The liquid analysis portfolio ranges from standard sensors to complete measurement stations. "In addition to measuring the process conditions, our customers also want the ability to determine material characteristics and product quality while the process is running," says Matthias Altendorf, CEO of the Endress+Hauser Group.

The liquid analysis portfolio, which is manufactured at five production facilities, ranges from standard sensors to complete measurement stations for demanding measurement tasks.

Digital from A to Z

Especially when it comes to digitalization, Endress+Hauser is establishing milestones in the area of liquid analysis. The company revolutionized the market in 2004 with the introduction of Memosens technology. Sensors convert the measurement value into a digital signal and convey it to the transmitter via wireless communications.

With Heartbeat technology, instrument inspections can be performed without interrupting the process, while the Netilion IIoT ecosystem allows the measurement values, process data, and diagnostic information to be used with cloud-based applications.

Endress+Hauser became a forerunner in the digital instrumentation and solutions market with the introduction of Memosens sensors in 2004. The technology "redefines the concept of liquid analysis as it converts the measured value to a digital signal and transfers it to the transmitter without contact," said Janani Balasundar, a Frost & Sullivan Industry Analyst. The consulting firm awarded Endress+Hauser its 2020 Global Liquid Analyzer Company of the Year Award recently.

Said Balasundar, "Endress+Hauser is developing the next generation of Memosens technology with additional diagnostics and functionality. Such initiatives enable it to stay ahead of the product innovation curve." The global Company of the Year Award recognizes a high degree of innovation with products and technologies and the resulting leadership in terms of customer value and market penetration.

Endress+Hauser eliminates key maintenance challenges through its analyzers. The Liquiline System CA80PH orthophosphate analyzer decreases operating costs through its low reagent consumption. It also ensures high equipment availability through automatic calibration and cleaning, and easy, tool-free maintenance. For quick troubleshooting, the multiparameter, handheld Liquiline Mobile CML18 can be combined with Memosens sensors to help plant technicians swiftly check any plant measuring point.

Additionally, Endress+Hauser's new-generation Heartbeat Technology offers continuous process and device diagnostics, documented verification without process interruption, and information for predictive maintenance. "It enhances the functions of devices by using process data to support process optimization and predictive maintenance strategies," said Balasundar.

With the IIoT ecosystem Netilion, all measurements, process data, and field device diagnostics can be used for cloud-based applications. For example, the company's digital services monitor the health status of devices, analyze the installed base of instruments, and help organize asset files and documents.

"We have been inspiring our customers with innovative products for 50 years," says Dr. Manfred Jagiella, Managing Director of the liquid analysis business and a member of the Endress+Hauser Group Executive Board. "We maintain a constant focus on research and development, state-of-the-art technologies, and a high degree of automation in production."

For more, visit https://www.us.endress.com/en/field-instruments-overview.

Endress+Hauser

Remote monitoring enabled by a secure and open standard

By Glenn Schulz, Managing Director, FDT Group

Secure remote monitoring. Secure remote process optimization. They used to be a nice to have, but in this year of pandemic-induced travel restrictions and work-from-home imperatives, they're suddenly essential. In order to keep our facilities running, remote access digitalization is becoming key.

FDT has long been known as an open standard, enabling easy device and network integration into automation solutions. It's established on desktop devices with hundreds of thousands of installations. But we saw the coming requirements for mobility and remote applications years ago, so we evolved FDT to enable the next level of secure remote connectivity.

The new FDT 3.0 standard has been dramatically improved with built-in web and OPC UA servers. It's divorced from the desktop, with graphics that can be rendered in any web browser. The new architecture is completely mobile-enabled, supporting the digital worker in the field and all communications standards, including 5G.

We've gone to a server environment so there's only a single instance of FDT, and it has all the necessary security. No longer a Microsoft-centric technology, the FDT 3.0 Server can run in a Linux or Apple environment and serve up device DTMs. This enables full remote capabilities and gives diverse deployment options.

The ability to deploy FDT 3.0 on Linux in the cloud, for example, makes a robust web service. It also scales well the opposite way, so original equipment manufacturers (OEMs) can enable access to just a specific section of equipment—for example, a bottling line.

To help a customer optimize an asset like a bottling line for both utilization and availability, OEMs need the capability to securely keep an eye on that asset remotely. They need to alert the customer when there's an issue, or maybe carry out a maintenance or optimization activity. By installing a small Linux card with an FDT Server on it, they're able to completely monitor the productivity and health of that asset. Since FDT Server also comes with a built-in OPC UA server, all the device and network data is available through OPC UA for aggregation into dashboards or higher-level applications.

Remote operations like these have been tried for years, and it usually comes down to concerns about security. OEMs are asking that bottling line customer to give them access to something that's inside their facility. However, FDT provides well-vetted standards that both IT and OT professionals recognize as strong—and it's all pre-engineered. FDT 3.0 implements TLS encrypted communications with 509v3 certificates for authentication as well as role-based access control.

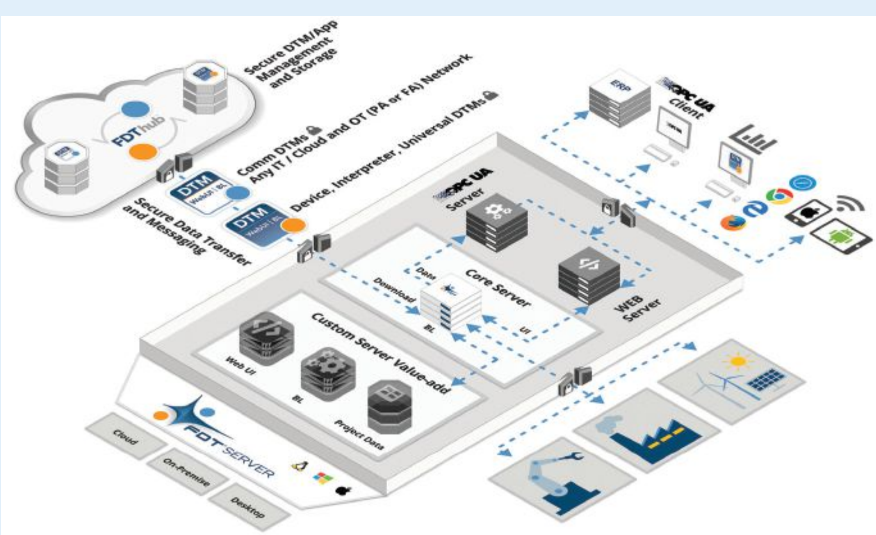
Lastly, the number one complaint about the FDT standard has been how difficult it was to find the device type managers (DTMs) or device drivers for all devices. Some manufacturers put them all on their website, others in a library, and still other vendors scatter them around. So even if you knew where to get them, it could take a week to gather them. To eliminate device management headaches, we invented the FDT*hub***,** a unified portal enabling automatic device discovery for all certified FDT 3.0 DTMs.

Now when you're configuring a project, the FDT Server assisted by the FDT*hub* automatically retrieves the right DTM and downloads it securely. For facilities like petrochemical plants that have an air-gap requirement, they can deploy a local version of the FDT*hub* to access the DTMs.

Secure, remote access, whether through web browsing, or through OPC UA, is a reality with FDT 3.0. Machine builders and end users now have secure remote access without having to alter the PLC or DCS to gain access. With the FDT Server sitting at a peer level to the PLC to the DCS, you don't have to disturb those environments to gain these benefits.

Glenn Schulz is the Managing Director of FDT Group. More information is available at www.fdtgroup.org.

FDT 3.0 specification license agreements and developer toolkits in addition to a few communication annexes are now available, including HART and Profibus on the FDT website (www.fdtgroup.org). IO-Link and CIP networks are slated for release in the latter half of 2020 in addition to an IO-Link Interpreter DTM.



FDT 3.0: Secure remote access without having to alter the PLC or DCS to gain access.

Empowering the Intelligent Enterprise

75 ISA AUTOMATION INNOVATOR

Connectivity in the changing robot industry

By Guido Selhorst, Head of Marketing Services, HARTING Technology Group

Quality, competence, and trust: These factors form the foundations and guarantee for a good partnership. More than ever before, with today's industrial world characterized by digitalization, cooperation and partnerships are essential. Specialists with a wide range of competencies and skills are needed. This is clearly demonstrated by the large number of platforms and exchange formats that exist for Industrial Internet of Things (IIoT) systems. This understanding of the bundling of competencies and requirements has shaped the cooperation between KUKA and HARTING from a very early stage.

HARTING has developed into a global technology group within the span of 75 years. Today, the company ranks as one of the world's leading suppliers of industrial connection technology for the three lifelines of power, signal, and data related to robots. In addition, the technology group also manufactures checkout zones for the retail trade, electromagnetic actuators for automotive and industrial series use, charging equipment for electric vehicles, as well as hardware and software for customers and applications in automation technology, mechanical and plant engineering, robotics, and transportation, among others. The success formula: HARTING has constantly "reinvented" itself over its 75-year history.

HARTING Han-Yellock® connector system on a KR AGILUS robot system from KUKA.

KUKA is one of the world's leading suppliers of intelligent automation solutions, offering everything from robots and manufacturing cells to fully automated production systems and networking. Since beginning to cooperate more than 20 years ago, HARTING and KUKA have always created new solutions with a view to market requirements.

One example is the special EMC housing designs for connectors, which have since become a standard. In the field of robotics production, KUKA and HARTING created a specific component, the so-called multifunctional housing, which optimally combines the connector function and IP67 sealed electronics housing. HARTING now offers this in various application areas such as data cabling in the controller, power cabling to a robot, or specific transition elements for a PROFINET infrastructure on axis 3.

In recent years, HARTING and KUKA have focused on the miniaturization trend. The KR AGILUS is a new compact robotic system ideal for use in flexible production environments. The requirement for the plug-in connection here is fast and intuitive handling, in which the design aspect also plays an important role. The new Han-Yellock® connector system provides a completely new locking technology for this new robot series.

Flexibility, miniaturization, and modularity are trends that are driving joint development. Ten years ago, the robot control cabinet was as large as a standard industrial control cabinet; today's solutions are no larger than a desktop PC. Because application areas for small robotics call for the controller to be more compact, KUKA launched the KR C5 microcontroller family, and HARTING KUKA provided the new "har-motion connector." Adapted both to the power requirements and space available to compact robots, it can be used flexibly for transferring the lifelines of the robot.

Even the larger robots are subject to the miniaturization trend. The KR C5 control system offers the option of operating up to three machines in one control cabinet. A performance adjustment can also be easily and flexibly accommodated by selecting different controllers. This is enabled by a completely new modular and scalable structure of the cabinet system and a new Han® Board connector. Special mechanical guides, as well as the design structure of the connector solution, ensure smooth mechanical plugging.

Regarding Industry 4.0 developments, KUKA and HARTING worked on their first joint solutions at a very early stage. For example, KUKA equipped the HARTING I4.0 demonstrator—the HAII4YOU Factory—with new LBR iiwa type sensor-based robots. The system became the ideal platform for an integrated Industry 4.0 approach for individual and cooperative production systems all the way through to quantity one.

HARTING®
Pushing Performance

Connect digital twins to support the autonomous oilfield

By Vineet Lasrado, Honeywell Oil & Gas Technical Solutions Consulting, Houston

Much has been written about the promise of digital technology in the upstream industry. The terms "autonomous well" or "autonomous oilfield" are being used, but is that really possible?

The technology to automatically adjust the operating conditions of wells and process equipment (i.e., closed-loop process control) has existed for decades. Honeywell's Advanced Process Control (APC) technology has been used by a major offshore operator in its Ula, North Sea, and Marlin, Gulf of Mexico, offshore assets. Another industry example of APC implementation in artificial lift is the use of APC technology for adjusting set points of electrical submersible pumps to optimize production while minimizing electrical power consumption. APC goes beyond integrated production modeling to provide closed-loop process control. This technology is also routinely applied in the downstream oil and gas and process industries.

Honeywell has worked on such projects across multiple industries. But in a world inundated with an increasing number of digital twins and AI/ML vendors, what differentiates the leaders from the rest? The answer is deep domain knowledge, industry experience, and a track record of building digital twins—in particular, connected or composite digital twins. Because various simulation models are available that are purpose-built/best-in-class for specific types of equipment or processes, one or more of these models can be combined to better represent the performance of equipment or processes.

In upstream oil and gas, fluids move from the reservoir through downhole completions into the wellbore, and through manifolds into the production separator, and may also go back (injected) into the reservoir. This is one reason for connecting or integrating the digital twins. Wells can have a combination of advanced completions, such as inflow control valves and electrical submersible pumps. Chemical inhibitors may also be injected into the well for flow assurance.

Here is an example to better understand a connected digital twin. ESP producer wells flow into the gathering network. Using algorithms that look for patterns in data, it is possible to predict a likely ESP failure a few days before the actual event occurs—something many predictive analytics point solutions can do to help users plan for a replacement ESP. More importantly, however, is extending the equipment's run life—keeping the ESP running within its operating envelope—beyond just raising alarms when important ESP parameters go out of range.

Now let's understand possible linkages between the ESP, chemical injection, and pipeline integrity as a "connected" example. Because ESPs are driven by motors, thermal energy released by the motors raise the temperature of the production fluids. Corrosion inhibition chemicals are often injected to minimize corrosion in the production pipeline network, but they lose their effectiveness above a certain temperature. The corrosion inhibitor also loses effectiveness in certain flow regimes, which requires an understanding of the flow conditions within the production network. If a digital twin were to be built to monitor this process, we would need to connect the data from the ESP (i.e., equipment digital twin) and the production system, including fluid flow, fluid temperature, concentrations of chemical inhibitor, and corrosion rate (i.e., process digital twin).

In this example, the ESP motor temperature could have an adverse impact on pipeline integrity. This is where a connected digital twin and domain knowledge help realize integrated operations or integration across disciplines. The process digital twin can also provide useful information about whether chemicals are being over- or under-injected when combined with surveillance data. This capability has the potential for huge savings from reduced chemical usage while mitigating asset integrity risks.

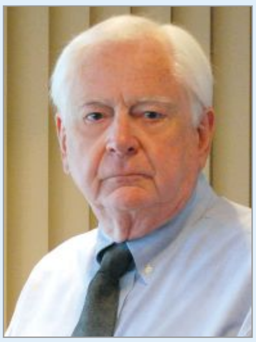
Typical benefits of using Honeywell technology include increasing production by four percent, reducing energy costs, and saving $1 million USD per year in taxes due to CO_2 reductions. Additional benefits from improved equipment conditions and process and corrosion monitoring can result in an estimated $8–10 million in savings.

Honeywell has been delivering digital twin technology for over 20 years, and last year signed a 10-year partnership agreement with ADNOC Group for one of the world's largest predictive maintenance projects in the oil and gas industry. As technology advances and engineers become more comfortable with these technologies, we expect to see increased adoption of connected digital twins in the oil and gas industry.

Vineet Lasrado has worked on several digital oil field projects for upstream oil and gas producing and oil field service providers for two decades. His experience includes strategy and business case definition, technology selection/definition, process improvement, technical workflows design, solution architecture definition and implementation. Lasrado is a frequent speaker at Society of Petroleum Engineers (SPE) events and has several technical papers authored in digital fields. He is a core member of Honeywell's Oil & Gas Technical Solutions Consulting group based in Houston.

Honeywell

Remembering Leonard W. Moore: 1934–2019



Moore Industries started out with three employees in a garage in California in 1968. Founder and then President Leonard W. Moore established the company with a focus on product quality, reliability, and customer service. But the industry was dealt a blow on 6 September 2019 when this pioneer of industrial process control, system integration, and factory automation died. On the occasion of ISA's 75th anniversary, it's worth remembering the loves and legacy of Len Moore, who was elected an ISA Fellow in 1996 for his contributions to the advancement of signal conditioning instrumentation and monitoring systems, including radio frequency interference and electromagnetic interference protection. He was awarded an ISA Honorary Membership in 2009, a distinction that recognizes individuals who profoundly support and/or contribute to the advancement of the arts and sciences of instrumentation, systems, and automation.

At the time of his honorary award, Moore said, "When I learned about this honor, and this might sound corny, the first thing that came to mind was all of the talented people that have come through our door to earn an honest living, and that we have supported them with a great place to work . . . . While I have been involved with many exciting product and business development pursuits during our 40-year history, I think what I am most proud of is the culture we have created at Moore Industries."

That culture includes a strong focus on customer relationships with Moore Industries continuing to provide quality in process industry products and services for customers worldwide.

Starting with one signal isolating/converting instrument in early days—the SCT Signal Converter and Isolator—Moore and his "troops" went on to design, build, and support more than 225 different products that isolate, protect, convert, alarm, monitor, control, and interface with any industrial or automation control and monitoring system. Moore held several patents related to electronic instrument packaging, signal conditioning, and instrumentation and monitoring systems. In fact, in the late 1980s, Moore patented and introduced the Cable Concentrator System, which allows dozens of I/O to be transmitted on a single, twisted-wire digital pair.

Moore Industries products today include alarms, HART interface devices, temperature sensing and transmitting products, signal conditioners, and isolators with an expanding line of IEC 61508–certified Functional Safety devices.

After graduating from Iowa State University with a BS in electrical engineering, Moore entered the Army in 1953 as a weapons guidance specialist and spent time at Fort Sill, Okla., and Fort Bliss, Texas. He then served in Japan, training and teaching soldiers how to operate, calibrate, and repair various guidance and artillery weapon systems. It was here where Moore realized he had a passion for instruments and control circuits. After his tour in Japan, he left the Army and returned home to Iowa. In 1958, newly married to wife Martha Moore, he took a job with Hughes Aircraft in El Segundo, Calif.

Moore's goal when founding Moore Industries-International, Inc. in North Hills, Calif., was to design rugged industrial instrument solutions that he knew the industry needed. He used to say that at Moore Industries "we are an engineering company that solves customer's problems by manufacturing bulletproof solutions."

Moore's rugged outlook extended to his hobbies. He was an accomplished race car driver who competed on the Trans Am Race Circuit, and capable flier who got his pilot's license in 2005 at the age of 73. Today, Moore Industries employees worldwide strive to carry on Len Moore's legacy and original mission: creating tough and reliable products for one of the most respected companies in the process control industry.

DIGITAL TRANSFORMATION of batch review improves operations efficiency and release time

Three strategies help life sciences companies implement more successful review by exception

By Emilee Cook

Biotechnology and pharmaceutical companies are under more pressure than ever to safely develop new medicines as quickly as possible. In response, many of these organizations are reexamining their manufacturing strategies with digital transformation in mind to ensure each batch leaves the plant quickly and safely.

One large, global biopharmaceutical manufacturer has begun to improve operations performance by implementing a live review-by-exception (RBE) process. The process is integrated into the plant's production review and allows the plant's quality assurance (QA) team to identify process deviations and their severity as they occur. Previous approaches required waiting for a batch to complete, and then reviewing all exceptions line by line.

The organization focused on three strategies to make sure a shift away from paper records toward live digital RBE would deliver the desired results. By expanding automation to empower employees, building staff support with user-friendly solutions, and standardizing technology for fast return on investment (ROI), the QA team accomplished a 200 percent ROI in the first month after implementing live RBE.

Expand automation to empower employees

Before the biotech organization implemented RBE, a typical batch release took three to four weeks to complete. The QA team ran a batch report—typically hundreds of pages long—and reviewed, logged, and manually cleared each exception. Batches were held until review completion, making the cumbersome manual review process a bottleneck for timely release.

Streamlining batches with review by exception

Moving to RBE digitalized and automated many of the steps necessary to safely improve and expedite batch releases. Now, within 10 minutes of an exception, the software identifies it, logs it, and notifies the team. With faster notification of exceptions, QA personnel can fix problems faster, and track patterns to identify process problems and eliminate them earlier.

Right after implementing RBE, the team identified a problem with a salt feeder not responding properly. Fixing the problem required an operator to manually open and close a butterfly valve. This manual intervention created more than 150 exceptions for each buffer prep application. Once the team began using RBE, another exception was identified almost immediately.

These fast alerts enabled a quick response, which in turn helped QA isolate and diagnose the root cause. The QA team changed the feed mechanism, ultimately improving the quality of the buffer solution. The change also improved efficiency, as the operator was no longer required to manually adjust the valve.

Digitalization of the review process has allowed the QA team to safely auto-release 50–60 percent of batches immediately after completion (figure 1). Average batch release time went from four weeks to six hours.

The organization saved millions of dollars in finished goods inventory, and QA personnel

gained more time to focus on manufacturing performance and product quality.

Build staff support with user-friendly solutions

Before implementing RBE, QA personnel were frustrated with the time it took to manage exceptions, with manual logging taking upward of 15 minutes per exception. Logging also required manually annotating exceptions with essential metadata—key performance indicators, quality attributes, and variables—to provide the full context of the production process around the exception. Because the process was so complex, the team typically had to run the batch reports multiple times to ensure they caught all the exceptions.

Automation systems handle the busywork

The live exception notifications available in the RBE process helps the team release batches in hours rather than weeks. Having a live RBE system integrated with the organization's production review not only identifies exceptions, but also helps the QA team resolve them.

Figure 1. Traditional batch review can delay product release by weeks as teams review reports. Live review-by-exception software—such as Emerson's Quality Review Manager—identifies issues, enabling auto-release and reducing time to market.

Figure 2. Operators use Emerson's Syncade Quality Review Manager on tablets to review and resolve exceptions while collaborating live with the QA team. Both teams can add comments and answer questions to speed exception resolution.

Exceptions delivered by the RBE system come with a severity level and associated resolution process. For example, a high severity exception might require a staged process including an operator signature, QA review signature, QA verifier signature, and management-level signature. The live RBE software automatically guides this process, so QA members do not have to spend time searching for people in the plant and gathering information and signatures manually. Not only does RBE identify exceptions automatically, it also logs them and records all necessary metadata as the event occurs, helping with batch record accuracy and efficiency.

Personnel quickly embraced the digital transformation of batch review, because it made their jobs easier. Operators no longer spend time logging exceptions; they simply record a comment and move on. They also have more accurate records, making it easier to trend production problems and quickly identify solutions.

Now, the majority of exceptions are cleared by the time a batch is finished. QA team members collaborate live on the floor with operators using tablets with RBE software installed to view and resolve exceptions. Both QA members and operators can add comments and answer questions, significantly shortening the time it takes to reach resolution.

Standardize technology for fast ROI

The QA team has created a dashboard showing open and close times for exceptions. The team has visibility to the work that needs to be done and can quickly resolve exceptions and return its attention to any manufacturing quality issues. The constant visible reminder of the increased performance and efficiency has generated a significant morale boost.

When the QA team initially considered digital transformation of their processes, they planned to write and build a custom RBE application. Fortunately, before they began that process, they were introduced to an existing RBE solution designed to integrate with the existing manufacturing execution system (MES) and distributed control system (DCS).

Choosing a solution specifically designed to work with the existing MES and DCS benefited the team in several ways. It required no additional complex engineering, because it seamlessly integrated with the organization's MES and DCS. This reduced the project time and made the RBE system easier to maintain over its life cycle. The team also pulled alarms and OPC exceptions into the RBE system in real time, helping them stay better informed.

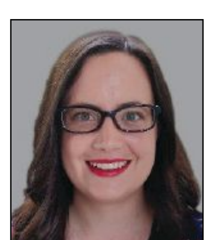
The software also uses an interface already familiar to plant personnel, as it is similar to the MES and DCS interface, so it is easy for users to understand how to incorporate it into existing practices. The plant had planned a four-month adoption curve for RBE, but personnel were already comfortably using the system after only two weeks.

Faster implementation means faster benefits, with the team seeing a 200 percent ROI in the first month after implementation of the RBE. In addition, the QA team has moved away from addressing exceptions and back toward a focus on reducing manufacturing issues, resulting in better quality and increased performance across the plant.

RBE technologies operate directly at the intersection of automation and personnel to help plants make the efficiency gains necessary to improve processes and dramatically cut release times. When an RBE system empowers personnel and smoothly integrates with existing tools, operators not only perform their tasks with more confidence, but also have the process history and task flexibility to focus on other critical issues affecting performance and quality. In addition, digitalized production boosts morale and increases collaboration among plant personnel, improving the overall plant experience for operators, QA team members, and other plant staff.

All these benefits helped the biotechnology manufacturer rapidly expand and evolve to meet the demands of patients facing newly discovered illnesses. Digitally transforming processes using technologies such as RBE is critical to meeting these needs quickly. Digitalized production ensures plants can quickly, easily, and safely scale production up or down without affecting quality or performance. ■

ABOUT THE AUTHOR



Emilee Cook is a product manager for life sciences software at Emerson. She has a BS in chemical engineering, a master's degree in engineering management, and certifications in human-centered design, user research, and technology management. She studies industry problems in depth and designs, creates, and tests solutions with users to develop products that keep the pharmaceutical and biotech industries moving forward.

View the online version at www.isa.org/intech/20201005.

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Temperature and pressure monitoring with IIoT sensors

Low-power, wide-area industrial temperature and pressure sensors enhance monitoring capabilities, leading to clearer understanding of maintenance needs and improved decision making

By Takayuki Sugizaki

Walking through most process plants or remote facilities, an observer will encounter a sizeable collection of temperature and pressure instruments. Without knowledge of the two critical parameters of temperature and pressure, it is often impossible to properly monitor a process and maintain equipment.

Temperature is primarily measured by one of two methods in a plant environment, by either a thermocouple or a resistance temperature detector. Pressure can be measured by a variety of methods, but each involves measuring the force a product process exerts on one side of a medium relative to the force on the other side. The medium can be a fluid or a diaphragm, and the force opposing the product process force may be a spring, a fluid, the atmosphere itself, or another product process force. A pressure sensor resolves the forces at play into a pressure value.

Inconvenient wired practices

Traditionally, transmitting a temperature or pressure measurement to a central plant control location required a wired line from an instrument to a host, such as a basic process control system, an asset management system, or a process historian. While this method works well in some parts of existing plants, wired instrumentation is not always practical or possible.

It can be difficult to run conduit, power, and communication lines to distant locations, and the cost may be prohibitive for one or two instruments. Furthermore, wired solutions place constraints on instruments' physical locations, restricting flexibility if monitoring requirements change.

Some applications do not require continuous monitoring at a host system but may require manual readings of gauges to be performed and recorded on a regular schedule to keep a general watch on equipment health. In these situations, equipment may be located in confined spaces or hazardous environments that may pose safety risks to plant personnel when gathering data.

Modern wireless solutions

Spurred by a globally increasing desire to boost productivity and improve the efficiency of equipment maintenance in plants, there is a need to detect and analyze abnormalities and identify

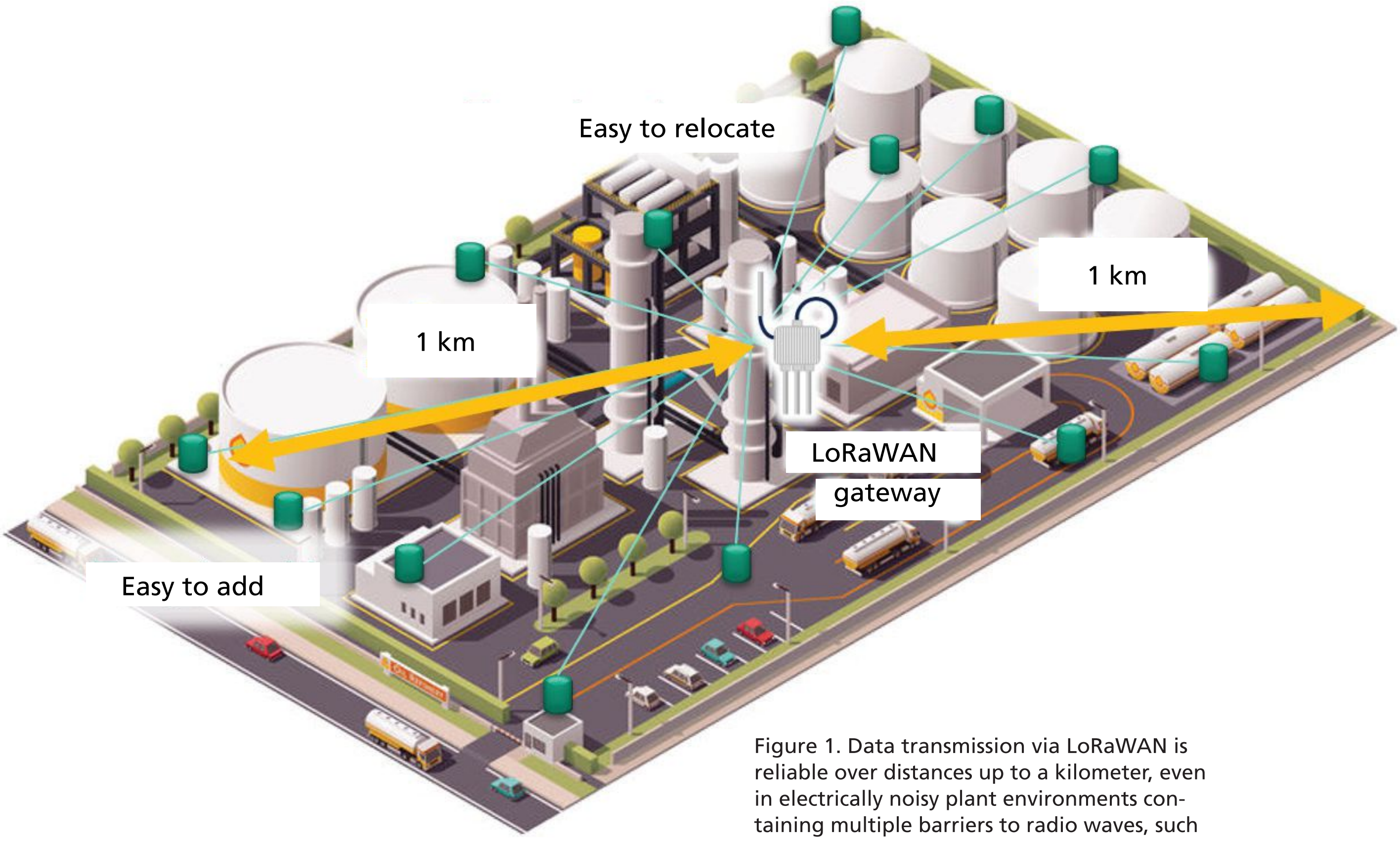

Figure 1. Data transmission via LoRaWAN is reliable over distances up to a kilometer, even in electrically noisy plant environments containing multiple barriers to radio waves, such as walls, tanks, and process equipment.

Source: Yokogawa

degrading equipment. In hard-to-reach locations—such as distant sites, confined spaces, or dangerous environments—there are advantages to be gained by introducing sensors that utilize modern wireless technologies.

The two wireless instrumentation technologies most often used in process manufacturing are in-plant networks, such as ISA100, and long-range wireless networks. In-plant networks are more capable but require more effort and resources to set up than their long-range counterparts. This article will focus on long-range wireless networks and show their advantages in certain applications.

Low-power, wide-area (LPWA) industrial sensors for Industrial Internet of Things (IIoT) applications address the obstacles faced when making measurements in hard-to-reach or distant locations. They are compact, lightweight, battery powered, and durable. They can transmit data wirelessly to a long-range, wide-area network (LoRaWAN) gateway. Data transmission via LoRaWAN is reliable over distances up to a kilometer, even in electrically noisy plant environments containing multiple barriers to radio waves, such as walls, tanks, and process equipment (figure 1).

A host system, whether on premises or in the cloud, can continuously monitor data formerly read on gauges and limited by operator rounds.

Sensor anatomy

LPWA industrial sensors comprise a module for temperature or pressure measurement coupled with a wireless communication module. When the modules are connected, program and parameter settings stored on the measuring module are copied to the wireless communication module for transmission (figure 2).

By storing configuration parameters on the measurement module, wireless communication modules may be easily swapped without disrupting the product process. The dual-module setup also allows personnel to replace batteries without taking the product process offline. During battery replacement, the wireless communication module—containing the battery that powers both modules—is decoupled from the measuring module. Once battery replacement is complete and the modules are reconnected, the measurement module transfers its program and parameter settings to the wireless communication module.

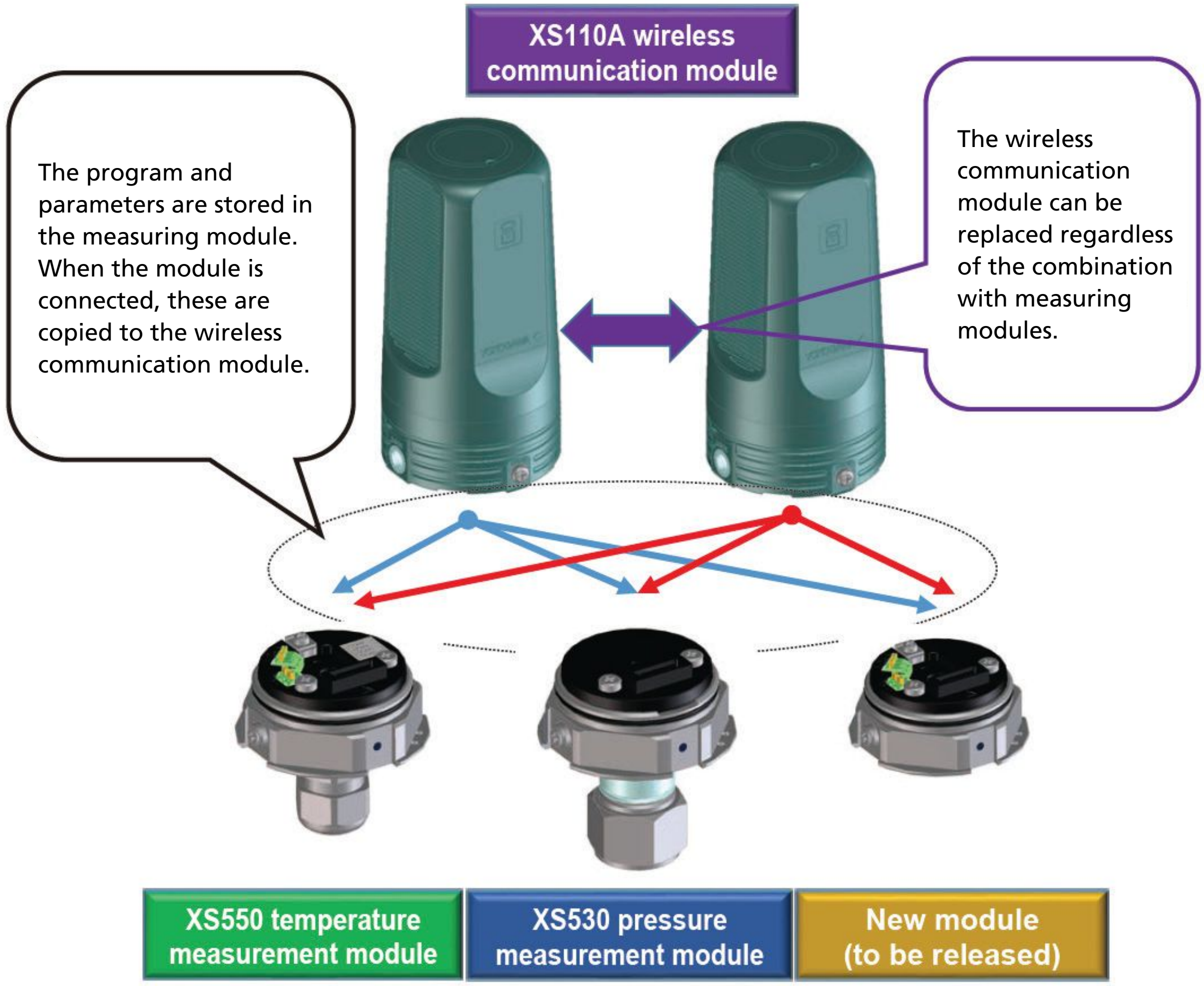

Figure 2. Some temperature and pressure measurement modules, such as the Yokogawa LPWA industrial Sushi Sensors, can be coupled with a wireless communication module to transmit equipment data. Wireless communication modules may be swapped or replaced without disrupting the production process.

Source: Yokogawa

The wireless communication module handles data transmission to the LoRaWAN gateway and incorporates a near-field communication radio for sensor configuration from a compatible mobile device, such as a smartphone. When coupled, the communication and measurement modules are encased in an IP67/NEMA 4X–rated waterproof, dustproof, and explosionproof housing for use in harsh environments.

LPWA industrial temperature sensors accept input from a thermocouple, making them compatible with instrumentation found at most plants. They convert the voltage input to a temperature value using reference junction compensation and built-in conversion tables, and then send this value to the LoRaWAN gateway.

An LPWA industrial pressure sensor uses a piezoresistive diaphragm for lower power consumption and noise reduction compared with other diaphragm types. The diaphragm's degree of deflection varies the electrical resistance within the sensor, which is converted to a pressure value based on factory configuration. As with its temperature sensor counterpart, the LPWA industrial pressure sensor transmits its pressure value to the LoRaWAN gateway at a user-defined update time.

Data is normally collected and transmitted by LPWA industrial sensors at a period ranging from every minute to once every three days. An LPWA industrial sensor containing a single D-size battery may last up to 10 years without battery replacement when transmitting one equipment data point per hour, depending on ambient temperature.

Application cases

When multistage heat exchangers are used in a plant, the first stage input and last stage output temperatures are usually monitored online. By installing LPWA industrial temperature sensors in the tight spaces between stages, it is possible to increase data capture and better understand equipment conditions in the heat exchanger. This enables anomaly detection at every stage, knowledge that can improve operational and maintenance efficiency.

In another scenario, leaks or clogging can degrade dust collectors and their piping, decreasing operational efficiency. Pressure gauges are usually mounted to detect such abnormalities over wide areas within plants, with visual observations made during operator rounds. Replacing these pressure gauges with LPWA industrial pressure sensors increases the frequency, ease, and reliability of measurement. Additionally, the data is optimized for immediate use by a plant historian or other software system, without requiring human effort to input or translate individual data points.

Benefits gained

By capitalizing on wireless technological advances in temperature and pressure sensors, plant owners can move beyond the obstacles inherent with wired sensor architectures. Increased freedom to deploy sensors that reliably transmit data for seamless integration into host systems leads to clearer understanding of equipment maintenance needs. It is this understanding—as well as the ability to detect abnormalities—that enables plant owners to remain a step ahead in regard to equipment maintenance, while continuously refining and improving product process efficiency. ■

* Sushi Sensor is a registered trademark or trademark of Yokogawa Electric Corporation.

* LoRa is a registered trademark, and LoRaWAN is a trademark of Semtech Corporation.

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ABOUT THE AUTHOR

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Looking for more automation basics?

InTech FOCUS, an electronic periodical from ISA, is a series that focuses on the fundamentals of essential automation components, such as instrumentation, final control elements, and more. Become a member of ISA to get subscriptions to both *InTech* and *InTech FOCUS*. Find past ebooks in the series at **https://www.automation.com/en-us/resources-list-pages/intech-focus-ebooks**.

ISA adds four to distinguished list of ISA Fellows

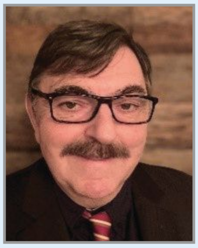
The esteemed member grade of "Fellow" is one of ISA's highest honors. To earn this distinction, a Senior Member must possess "outstanding and acknowledged engineering or scientific attainments [and] must receive peer evaluations leading to recommendation for election by the Society Admissions Committee." The nominations are reviewed annually, and those receiving a majority vote of the Society's executive board are elected.

The Admissions Committee, chaired by Bridget Fitzpatrick, and the ISA executive board are pleased to announce that four outstanding individuals have been elected as Fellows for 2020:

Donald Dunn of Waldemar S. Nelson & Co. in Highlands, Texas. Recognized for the education and standardization of terminology, as well as requirements and guidance related to alarm management and process industry safety.

John Sorge, retired, of Birmingham, Ala. Recognized for leading, advocating, sponsoring, and technically contributing to activities, projects, and organizations to advance instrumentation and control research on and application of new power-generation technologies.

David Rahn of the U.S. Nuclear Regulatory Commission in Rockville, Md. Recognized for developing and implementing new methodology and acceptance criteria to establish the reliability of critical safety equipment of nuclear power plants.



Richard Van Fleet of Andritz Inc. in Cumming, Ga. Recognized for providing subject matter expertise and technical support relating to sensor development and implementation of advanced process control and sustained process optimization of pulping and bleaching processes.

Upon being elected an ISA Fellow, Rahn said, "I am very honored to be recognized by my colleagues . . . and feel very fortunate to be a part of the good work that is being accomplished by ISA to identify and establish good standards and practices in the instrumentation and automation field."

In ISA's 75-year history, this professional recognition has been bestowed on 495 distinguished individuals. See the entire list at www.isa.org/members-corner/isa-honors-and-awards/fellow-member. Profiles of 2020 ISA Fellows will appear in future issues of *InTech*. ■

2020 'Celebrating Excellence' award winners announced

Annually, ISA recognizes and honors the outstanding efforts of ISA members to support and advance the Society and the automation community at large. This year, the Honors & Awards Committee, chaired by Brian Curtis, is pleased to announce 14 Celebrating Excellence award winners.

"The Celebrating Excellence awards stimulate, enhance, encourage, acknowledge, and reward outstanding contributions to ISA and the automation profession by providing an avenue for individuals to compete for recognition within established categories," said Curtis. The 2020 winners are:

Excellence in Technical Innovation (endowed by Honeywell UOP) to *Soliman Almadi* of Saudi Aramco in Dhahran, Eastern Saudi Arabia.

Excellence in Technical Presentation to *Abdulkadar Susnerwala* of Air Liquide in Houston.

Excellence in Education to *Himanshu Patel* of the Institute of Technology at Nirma University in Ahmedabad, Gujarat, India.

Mentoring Excellence to *Greg McMillan* of Emerson in Austin, Texas.

Excellence in Enduring Service to *Catherine Andrews* of Hile Controls of Alabama in Pelham, Ala.; *James Haw* of La Porte, Texas; *Ian Verhappen* of Industrial Automation Networks in Calgary, Alberta, Canada; and *Clifford Wuertz* of Cypress, Texas.

Division Excellence to ISA's Analysis Division.

Division Leader Excellence to *Ed Naranjo* of Honeywell's Process Measurement and Control Division in Eagan, Minn.

Section Excellence to ISA's Bangalore section in Karnataka, India.

Section Leader Excellence to *Dattatray Sawant* of the ISA's Maharashtra section in Mumbai, Maharashtra, India.

Standards Excellence to *Donald Dunn* of Waldemar S. Nelson & Co. in Highlands, Texas.

Volunteer Leader of the year to *Cheri Haarmeyer* of Pearland, Texas. ■

Digital Transformation in Deepwater Production Virtual Conference debuts

ISA hosted the Digital Transformation in Deepwater Production Virtual Conference on 16 September 2020, featuring 11 speakers and panelists representing Shell, VisCo, BP, and more. "This program has been carefully crafted to offer a broad-based overview of the latest technology and best practices in this critical area of automation," said Ken Nguyen, conference chair and program manager at BP. He said the speakers were asked to keep their presentations brief to allow more time for questions and interaction. Like ISA's previous virtual conferences, the event featured a virtual Exhibit Hall as well as several chat rooms for networking opportunities.

In the opening presentation, Andrea Course, venture principal for Shell Ventures, described Shell's digital transformation, highlighting lessons to encourage success in the increasingly IoT-connected digital era. Course has 14 years of experience in the energy sector and worked with Schlumberger Technology Investments before joining Shell.

Shell IT CTO Johan Krebbers spent his presentation exploring the following question: What is the role of standards and technology in getting data ready for analytics? He asserted that good models start with good data and that sharing data can help identify megatrends. Setrag Khoshafian, PhD, who has 30 years of experience as a senior executive in the software industry, discussed virtualizing access to data, championing the importance of preserving a single version of the truth (master data).

The final three sessions focused on digital twins. Satyam Priyadarshy, PhD, the first chief data scientist in the oil and gas industry, spoke about the digital twin value chain. Digital maturity and disruption in this field "unlocks the potential to structurally lower costs, shorten time to first oil, increase optionality in exploration and production, and enhance performance across the entire value chain," he said. VisCo CEO Oystein Stray and Bendik Bendiksen presented a digital twin and augmented reality case study.

To find out about the next webinar or conference in ISA's Digital Transformation event series, visit https://isaautomation.isa.org/virtual-events-program-digital-transformation. ■

SMIIoT:
ISA's newest division turns one

A two-and-a-half-year journey to create the Smart Manufacturing and IIoT Division of ISA resulted in big news to report: As of 15 September 2020, this newest ISA division has 822 members from 54 countries, with membership steadily increasing.

Sujata Tilak is cofounder and director of the division. Carlos Mandolesi, ISA president-elect secretary 2021, is also a cofounder. According to Tilak, "My company started working in the Industrial Internet of Things [IIoT] space as early as 2012. I would often think about how industrial automation and control systems play a very vital role in IIoT and is the foundation for IIoT. Conversely, all major areas of automation are impacted by IIoT. I remember my conversation about this in Mumbai with Jim Keaveney, then ISA president, in October 2015. He agreed that ISA should look at these areas."

Tilak said she talked up the idea of a new division during SLM in 2017 and got mixed reactions, but that is when Mandolesi came forward to work with her on it. The SMIIoT division was approved in October 2019. Now more than IIoT, SMIIoT encompasses eight aspect of smart manufacturing: IIoT, cloud technologies, artificial intelligence (AI) and machine learning (ML), communication and networking (industrial Internet), cybersecurity, cyber-physical systems, digital twin and simulation, and virtualization technologies (virtual reality and augmented reality).

Division members have formed technical committees focused on the above areas, each with a leader and eight to 10 members. The largest TC has 28 members. Adds Tilak, "We hope to catch all the action happening in the SM and IIoT space via our diverse membership and contribute to this action." ■

Carlos and Sujata celebrating after division approval.

Inclusion, diversity, and mentoring: A Q&A with ISA member Rhonda Pelton

Rhonda Pelton, the operational excellence leader for the Global Process Automation Technology group at Dow and a former director of ISA's Chemical & Petroleum Industries Division, was recently named eighth on the EMPower Top 100 Ethnic Minority Future Leaders list for 2020. This list honors outstanding business leaders who use their platform to make significant contributions to ethnic minority people at work in the U.S., Canada, the U.K., Ireland, and Europe.

Pelton serves on the leadership council of the Global African Affinity Network at Dow and on the Dow Promise Advisory Council. She also volunteers with the Dow Promise Program, which seeks to mitigate educational and economic challenges faced by African American communities near Dow sites. Pelton has worked with Dow University relations as a team lead for diverse talent recruitment, resulting in a record number of minority interns and co-op students during the 2018–2019 school year. She is a Dow STEM Ambassador, a facilitator at Girls Construction Camp, and a Girls STEM Academy speaker at NASA Space Center Houston.

ISA staff writer Kara Phelps interviewed Pelton for the ISA Interchange blog. The full text of her interview is at https://blog.isa.org/.

ISA: Describe your career at Dow.

RP: I started my career at Dow as a process control developer in our engineering services group, developing software solutions for various Dow businesses. I progressed from a developer to a process control project lead and a Six Sigma Black Belt. Dow provides a wide array of opportunities, and I served as a production engineer in a manufacturing facility before returning to a role as a process automation lead in one of Dow's Technology Centers. In my current role, I ensure effective and consistent implementation of process automation technology and resources.

ISA: Describe your involvement in the Dow Promise Program.

RP: Dow Promise started as a vision of Dow employees to positively impact African American communities near Dow locations, where economic and educational challenges may be barriers to success. It was a promise to give something back to kids and their communities. As part of the Dow Promise initiative, I have worked with students in the African American community to deliver projects addressing financial literacy, STEM education, health and safety, and college and career preparation.

ISA: What does diversity and inclusion mean to you?

RP: In engineering and other STEM fields, we are problem solvers. Diversity and inclusion in these fields means that all people and perspectives are considered. It means we invite everyone to the table and work together to find solutions. Diversity and inclusion do not start in the workplace, but in our homes, our communities, and our classrooms.

ISA: What can leaders do to help create/sustain an inclusive environment in their organizations?

RP: As engineers and scientists, we are conditioned to follow the data. In discussing what leaders can do to create and sustain an inclusive environment, leaders should start not with "what," but with "why." When a leader understands why an inclusive environment in the organization is important, then the "what" will be driven by the value that inclusivity brings. When the leader understands the "why," then the "what" can be measured and sustained. Eventually the "what" becomes the culture of the organization. Building a pipeline of diverse talent is critical for our future. I challenge ISA leaders to explore the ways that you can use your influence to bring the best STEM minds to your organization or to your committee. ■

The importance of the Fundamentals of Engineering Exam

Graduations may have been disrupted in this pandemic year, but one ISA member wants to make sure engineering grads remember that in addition to whatever form the celebration takes, there might be one more thing to do to help ensure their future success: "You ought to think about taking the Fundamentals of Engineering (FE) exam, also called the Engineer in Training (EIT) exam," says Brad Stephen Carlberg, PE, a control systems engineer with more than 30 years of experience and a volunteer ISA leader. "You owe it to yourself, after spending all that time in engineering school, to get this certification."

Many U.S. universities have a class for the FE exam review, but many engineers do not take it, says Carlberg. They think they will never need it.

"I was lucky that the professors at my alma mater, Washington State University, told us all to take the EIT exam our last semester in college," Carlberg says. "Over the past 36 years since I graduated, however, I am often amazed that so many people—recent graduates as well as those who graduated many years ago—claim that they did not need to take [it]." They say they see no need to proceed to the next step, which is to sit for the Professional Engineer (PE) certification.

"For me, getting a PE was my default goal after graduation," Carlberg says. "Maybe it had something to do with the fact that I was a pretty poor student and I simply felt I had to show people I was a real engineer—but that's a discussion for later. It comes down to the basic fact that, throughout the United States, every state's Board of Engineers legally requires those who practice engineering to have a PE."

Carlberg says the FE exam is actually harder than the PE exam, because it is so much broader. "It's best to take it as close to graduation as you can, with all that schooling still fresh in your mind," he says. ■

Professional Development

ISA young professionals create 'fireside chat' video series

Learning from the wisdom of those who have come before is a long and useful tradition within associations and good advice for life. Add a little new technology, and the wisdom can be shared farther and wider than before.

Invoking the spirit of U.S. President Franklin D. Roosevelt who conducted a series of evening radio addresses between 1933 and 1944, ISA's newly created Young Professionals (YP) committee has begun conducting "fireside chats" with former ISA presidents.

Radio was the new technology then, but today's young professionals are asking their questions via the 2020 virtual meeting platform of choice for everything from the Emmys to campaign conventions: Zoom. The format is socially distant, 20- to 40-minute video interviews distributed via the Internet. Most of these are prerecorded and will be shared over the next couple of months. The group will also be doing a couple live versions, where people sign up to watch at a scheduled time and can ask their own questions.

"Although we were forced to cancel our annual leadership conference planned for Puerto Rico, we are committed to accomplishing as much as possible using virtual meetings," said ISA president Eric Cosman earlier this year. "I am particularly pleased with the emergence of a formal Young Professionals group in our Society, bringing a fresh perspective on how to create a valued experience for those who are the future leaders in our profession."

A list of on-demand and upcoming fireside chats was being compiled at press time. Find out more about them and all the YP Committee initiatives and activities by visiting www.isa.org/membership/young-professionals. ■

ISA members elect 2021 officers

Fall is time for leadership changeover within the International Society of Automation, so ISA members are welcoming a new executive board for 2021. The executive board is the managing body of the Society and as such sets the strategic direction for ISA, approves the annual budget, and acts on matters of policy to advance Society objectives as specified by the bylaws.

The makeup of the board includes four Society officers: president, president-elect secretary, past president, and treasurer. For 2021, Eric Cosman becomes past president, allowing Steve Mustard to take on the mantle of president. Carlos Mandolesi joins the presidential chain as president-elect secretary, and the fourth officer is treasurer Scott Reynolds.

The rest of the board is made up of six members with experience in geographic aspects of ISA, three members with leadership experience in operational aspects of ISA, three members with leadership experience in technical aspects of ISA, up to three at-large members, an executive board parliamentarian, and ISA executive director Mary Ramsey.

Look for more information about them and other executive board members in the coming months. In the meantime find out more about society governance groups at https://www.isa.org/governance. ■

2021 ISA Virtual Conferences

Tentative schedule

ISA virtual conferences are a safe, convenient alternative to in-person conferences, providing attendees with insight into key operational and business topics through online sessions, panels with live Q&A, virtual exhibits, and networking opportunities.

ISA Data Analytics Conference

22 February 2021

This all-new conference will use case studies from early adopters to identify real-world applications that help asset owners shift their focus to building and implementing more robust analytics models, rather than cleaning up and formatting data. The conference will address these emerging issues from both the data capture and data analytics perspective.

ISA Analysis Division Conference

22 April 2021

This industry event is recognized as the outstanding forum for discussions of new and innovative analytical techniques, developments, and applications for process and laboratory applications.

ISA Cybersecurity Standards Implementation Conference

20 May 2021

Join ISA, the developer of consensus-based industrial cybersecurity standards (ISA/IEC 62443), for a rapid fire, elevated conference event, focusing on expert discussions surrounding awareness and solutions for organizational threats/vulnerabilities with the implementation of a standards-based cybersecurity program.

ISA IIoT & Smart Manufacturing Conference

24 June 2021

This technology-focused event will encompass topics regarding advances in connectivity, automation, and security within the operational context of hybrid manufacturing applications across multiple vertical industries.

ISA Digital Transformation in Deepwater Automation Conference

19 August 2021

An abundance of recoverable reserves offshore has presented its own challenges to the upstream oil and gas industry. The new watch word is "efficiency," as operators focus less on discovery and more on efficient, uninterrupted production. ISA looks at applications of technology that accelerate the facilities design, certification, and startup processes, while improving safety and efficiency. Operators will discuss applications of enabling technology that have made deep water projects financially viable.

ISA Energy & Water Automation Conference

23 September 2021

This industry event will highlight infrastructure supporting power generation and municipal water and wastewater systems, which are at the heart of "smart city" initiatives, as well as critical industrial water process applications, processes, and concerns.

ISA Process Industry Conference

18 November 2021

This event offers comprehensive technical content from experts in the energy processing and process manufacturing industries covering critical areas including: process instrumentation/control, cybersecurity and safety systems, open architecture and infrastructure, and operational excellence in light of our change to "new normal" operations.

See the full calendar of ISA virtual conferences, webinars and other events at https://isaautomation.isa.org/virtual-events-program. ■

ISA Certified Automation Professional (CAP) program

Certified Automation Professionals (CAPs) are responsible for the direction, design, and deployment of systems and equipment for manufacturing and control systems.

CAP question

The greatest probability of error being introduced into the "open-loop" method of tuning comes from determining the:

A. process time constant
B. reaction equilibrium
C. actual dead time
D. system gain

CAP answer

The answer is *C*, actual dead time. In open-loop methods of tuning, like Ziegler-Nichols, the dead time derived from the open-loop response is a part of the calculation of all of the tuning parameters for P-only, PI, and PID (proportional, integral, derivative) controllers. Often, the dead time is small (flow and pressure loops), and defining the quantity of the dead time from response curves can be tricky. Depending on how the tangent to the response curve is drawn, a very small dead time may be off by a factor of two or more, leading to an inaccurate calculation of the tuning parameters. Because the dead time is in the denominator of the equation for the proportional gain, the difference between 0.1 and 0.2 minutes can be insignificant on the response plot but would yield gains that differ by a factor of two.

Because the values of the process time constant and system gain are usually quite significant, those quantities can be determined with open-loop methods fairly accurately.

Reference: Sands, Nicholas P. & Verhappen, Ian, *A Guide to the Automation Body of Knowledge, Third Edition,* ISA Press, 2019.

ISA Certified Control Systems Technician (CCST) program

Certified Control System Technicians (CCSTs) calibrate, document, troubleshoot, and repair/replace instrumentation for systems that measure and control level, temperature, pressure, flow, and other process variables.

CCST question

Approximately what is the pressure, in psig, on the bottom of a 10-ft, flat bottom, open tank filled to 100 percent of capacity with a fluid that has a specific gravity of 1.1?

A. 2.50
B. 4.76
C. 9.50
D. 25.4

CCST answer

The correct answer is *B*, 4.76 psig. A column of water exerts a pressure on the bottom of the tank according to the formula below. The level at 100 percent will be 10 feet.

Therefore,

PSI = [height in feet × SG] / 2.31 feet/psi

= [10 feet x 1.1] / 2.31

= 4.76 psi

Reference: Goettsche, L. D. (Editor), *Maintenance of Instruments and Systems, Second Edition,* ISA, 2005.

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See more at Jobs.isa.org, where you can search for available jobs or advertise positions available within your company. ISA Members post resumes at no charge.

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Alliant Group: This consultant, based in Houston, will be a lead for project teams. He or she will build service-oriented relationships with clients, travel to client sites to identify and assess qualified activities and emerging technical advancements in the company's field, and substantiate and present findings to company executives. The position requires a four-year degree, excellent verbal and written communication skills, strong analytical, research, and organizational skills, and a high sense of urgency and ability to meet deadlines. A Professional Engineering license is a plus . . . see more at Jobs.isa.org.

Mechanical integrity engineer

Amphenol: Based in Nashua, N.H., this position is part of the mechanical integrity and reliability team. The engineer will lead in the qualification of new optical transceivers and components and be responsible for understanding the FIT rate and MTBF analysis of products. Qualifications for the position include an MS or PhD in materials, optics, or mechanical engineering; a strong background in optoelectronics and optical material properties; significant experience with reliability calculations, and ability to work in a team environment . . . see more at Jobs.isa.org.

Process sustaining engineer

Dexcom: The senior engineer in Mesa, Ariz., will use sound and proven engineering principles to assist in designing and developing processes and requirements. The projects and activities will focus on the company's sensor technology. The engineer will lead efforts to prove out manufacturing and automation processes to achieve the design requirements specified by R&D. Required qualifications include the ability to deal with ambiguity and a willingness to try new/challenging things, a proven ability to work hands on in a fast-paced environment, proficiency in SolidWorks or equivalent CAD software, and excellent communication skills. Up to 25 percent travel is required . . . see more at Jobs.isa.org.

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I certify that these statements are correct and complete:
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ISA at 75 years: Valuing control and automation professional development

By Bill Lydon

ABOUT THE AUTHOR

Bill Lydon (blydon@isa.org) is an *InTech* contributing editor with more than 25 years of industry experience. He regularly provides news reports, observations, and insights here and on Automation.com.

ISA is celebrating its 75th anniversary. It is a time to reflect on the past and look forward to the future. ISA has been an influential organization throughout my career—as it has for many other members of the organization.

Can ISA help you be more effective in the automation field? My opinion, based on experience, is a resounding yes!

This is how ISA had an impact on my career. I was first introduced to ISA as a young engineer at Johnson Controls in the 1970s by a vice president who was an active member of the organization. The first formal contact, on his recommendation, was attending an ISA three-day short course funded by my company on the application of microprocessors for control, which was a leading-edge topic at the time.

The information and knowledge I learned was valuable for my career and the company, leading to my selection as part of a five person "skunk works team" for two years. The team designed and spawned a new automation architecture and microprocessor-based control and automation solutions. Later this led to becoming product manager for the company's computer and microprocessor-based automation system products.

Subsequently, as cofounder and president of a software company in the industry, I stayed involved in ISA presenting at the conferences, as a session reviewer, and in other activities.

I have many long-term friendships with automation professionals from around the world who I met when attending and participating in local chapter events and the annual international ISA expos. Learning, sharing information, and gaining knowledge and know-how from others was extremely valuable. The relationships with fellow automation professionals are a priceless source of learning, as are opportunities to cooperatively and creatively solve problems and develop new solutions.

As usual, Morley was ahead of the curve, and open systems are becoming a reality 13 years later.

One of the most memorable roundtable sessions I participated in that illustrates ISA leading-edge thinkers was moderated by the legendary Dick Morley, father of the PLC. It was at the 2007 ISA Expo in Houston, Texas, on the topic "Do Standards Kill Innovation?" Morley provoked productive discussion at a time when vendors were greatly resisting multivendor interoperable open standards. A counterpoint to the resistance was the question, what industry has ever embraced open systems, only to later change its mind, turn around, abandon the pursuit, and revert to former proprietary ways? As usual, Morley was ahead of the curve, and open systems are becoming a reality 13 years later. These kinds of forward-thinking forums are a hallmark of ISA, adding value to the industry.

Less obvious are all the discussions, debates, insights, and ideas that come from ISA members interacting in many ways to advance the industry at events, forums, and in continuing communications. This is the hallmark of a strong organization made up of engaged, passionate people dedicated to the profession.

In the world of Industry 4.0 and digitalization, ISA standards are standing the test of time. ISA-95 and ISA-88 are being used and referenced throughout the world, for example. ISA members identified cybersecurity as an issue incredibly early, before it became a hot topic in recent years, and formed the ISA99 committee, which since 2002 developed ANSI/ISA-62443.

Automation professionals are major contributors to a manufacturing and process company's competitiveness and are vital for success. Automation improves productivity, quality, the environment, and profits. Automation's positive effect on the environment may not seem obvious, but properly done, automation lowers energy requirements, optimizes raw material utilization, and lowers emissions.

The ISA ecosystem of automation professionals is a culture that helps members increase their knowledge, grow in their careers, and drive positive industry change. Whether you are a young person just entering the workforce, new to the industry, or an experienced veteran, ISA can help you navigate industrial automation challenges and new technology. ISA is the only organization dedicated to automation professionals.

If your career is in automation, it is well worth investing your time and contributing knowledge and know-how by participating in ISA. You will gain far more than you invest. ■

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