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FEBRUARY 2023

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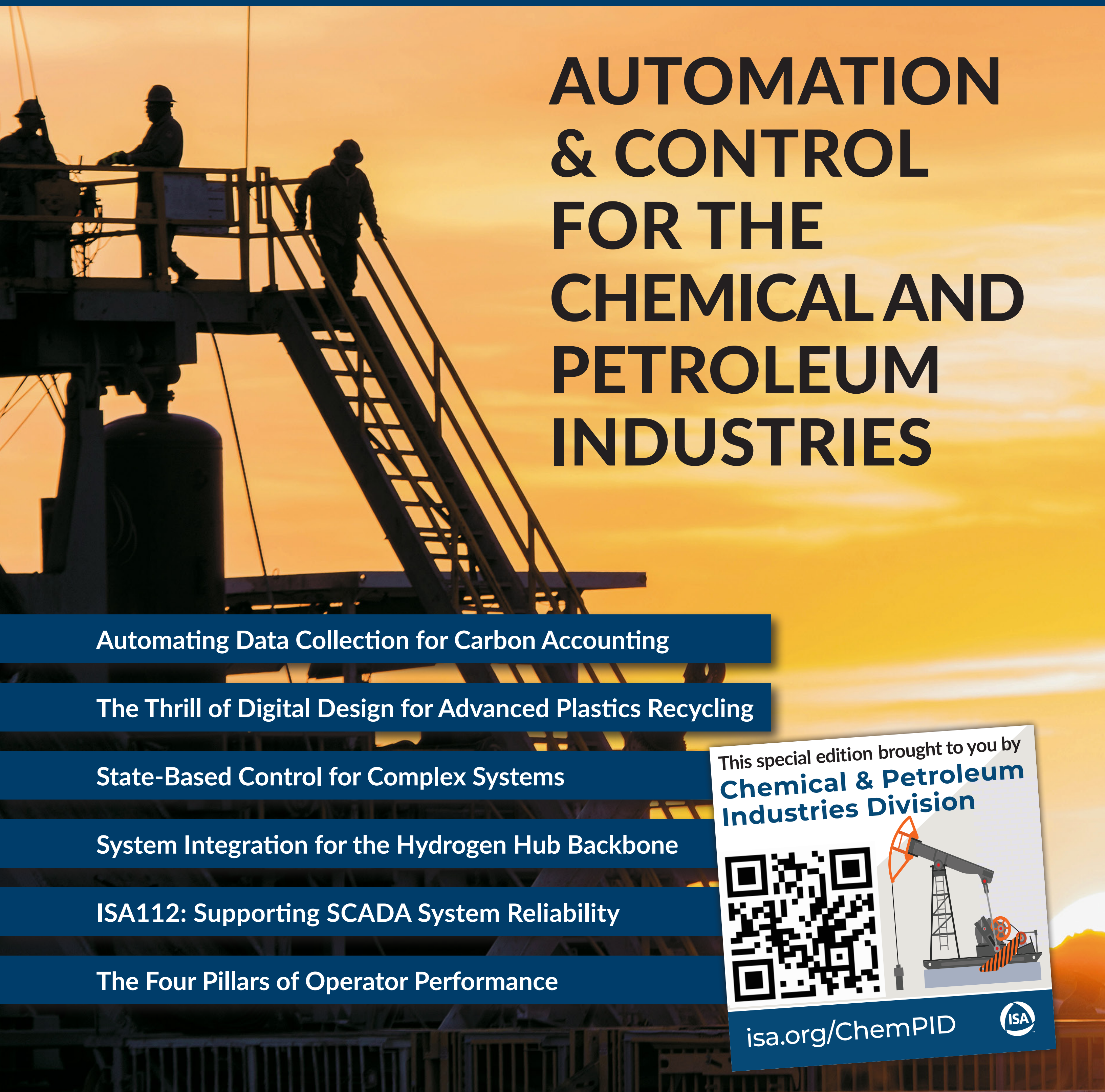

AUTOMATION & CONTROL FOR THE CHEMICAL AND PETROLEUM INDUSTRIES

Automating Data Collection for Carbon Accounting

The Thrill of Digital Design for Advanced Plastics Recycling

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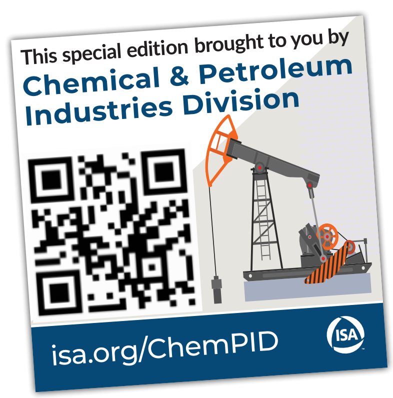

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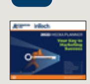

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Connection and Conversations

By Renee Bassett, *InTech* Chief Editor

Technology continues to advance by leaps and bursts, challenging us all to not only keep up but also try to capitalize on what's possible. Discussions of the metaverse, ChatGPT artificial intelligence and data analytics appear regularly in consumer news sources. Conferences like ARC Advisory Group's 2023 Industry Leadership Forum discuss industrial IoT, edge and cloud computing, 5G communications and other high-tech advances that may (or may not) be coming to your facility anytime soon. Automation professionals are the ones who have to sort it all for their companies.

Making the connection between new technologies and day-to-day operational needs can be tough. It helps to find peers who are wrestling with the same problems. It helps to find experts willing to share their experiences and talk through solutions. That knowledge sharing is a big reason why the International Society of Automation exists—to bring together professional peers.

In this issue of *InTech*, we're focusing on the petrochemical industry so we can go deep with the knowledge being shared, and I've called on the members of ISA's Chemical and Petroleum Industry Division (ChemPID) to help.

Whether building a network of advanced plastics recycling plants or the hydrogen hub backbone, ChemPID members readily share their experience and look to ISA and each other to find the standards, best practices and innovative insights they need to keep their projects on track. ChemPID members also provide useful insight no matter what your industry affiliation: Graham Nasby explains the ISA112 SCADA standard, while David Lee covers the fundamentals of ISA standards overall, for example.

Technology is moving forward drastically, so it's good to hear from others who have been there before. Read these articles. Connect with you peers. Continue the conversations. And consider sharing your own insights and project successes in the pages of *InTech*. The project you advance just might be your own. ■

Chemical and Petroleum Industries Division in Focus

By Alan Bryant

Welcome to the February 2023 issue of *InTech*, focused on the Chemical and Petroleum Industries Division (ChemPID). You can learn more about the division in Association Spotlight department that follows.

It is a privilege to include an interview with Nick Sands, an ISA fellow, for this issue (see Final Say on page 66). His work on the ISA-18.2: Management of Alarm Systems for the Process Industries standard has been influential in the process industry. Nicholas led the committee to create this much-needed guidance on alarm management. After the standard was approved, he worked to gain adoption by IEC, which expanded its influence globally. It is now recognized by many government safety agencies. Vendors and service providers have updated products and services to help end users implement this standard.

This issue features articles by ChemPID leaders from each of the ChemPID working groups:

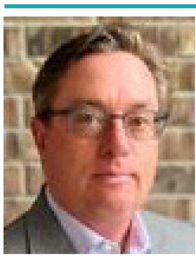
- Young Professionals: Prabhat Behera (Occidental)
- Standards: David Lee (Emerson)
- Digitalization: James Haw (PureCycle)
- Sustainability: Nishadi Davis (Wood)
- Sustainability: Alan Bryant (Occidental)

As director of ChemPID, I want the division to be a strong community of automation professionals with common interests. There are opportunities to network with other professionals to share and learn, to publish, and to volunteer.

Last year, we assembled a strong team on the division board to carry out our goals. This year, I hope to provide more opportunities to expand and accomplish our mission. Watch ISA Connect for updated volunteer postings.

By being active in ISA standards committees, the divisions, and my local section, I have met some amazing people.

By being active in ISA standards committees, the divisions, and my local section, I have met some amazing people who shared their experience with me. I have been inspired by, and learned much from them and made some good friends. I hope this division can provide opportunities for you to do the same, and I hope this ChemPID issue of *InTech* provides something useful to each of you. ■



ABOUT THE AUTHOR

Alan Bryant, PE, PMP is director of ISA's ChemPID and is a voting member on multiple ISA standards committees. He has more than 30 years of experience managing projects and automation initiatives in upstream oil and gas. In his role as an engineer at Occidental, he is a technical SME, he establishes new programs such as alarm management, develops company practices, and automation standards.

How ChemPID Helps You Create a Better World through Automation

Have you ever wondered if someone else already has it all figured out when it comes to being an automation professional within the petrochemical/oil and gas industries? Why reinvent the wheel? The key to success is to capitalize on problems that have already been solved and focus your engineering talent on problems that require innovation.

ISA technical divisions are communities of members who have common technical interests covering a wide variety of industries and technologies. ISA's technical divisions are free-to-join for ISA members, and members are encouraged to join as many divisions as they choose. For example, you might be interested in both an industry division and a technology division.

Through a division, you can:

- Build a network of peers with similar technical interests.
- Participate in online technical discussions.
- Receive access to the division community and communications.
- Learn through ISA OnPoint technical presentations.

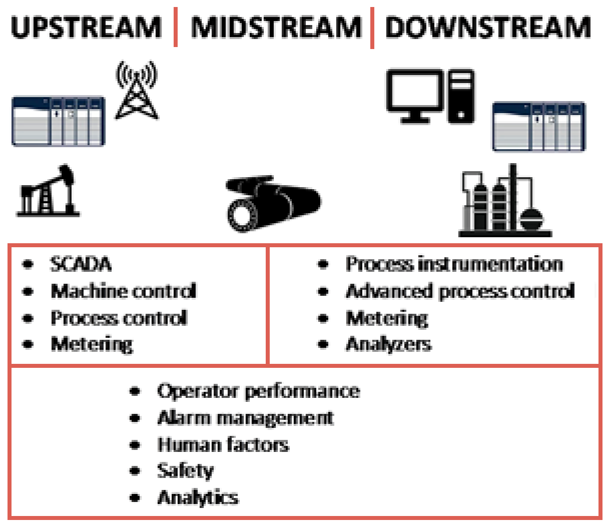


Figure 1. ChemPID areas of focus.

- Discover opportunities to be a leader through the division board.
- Share your expertise to help others.

The Chemical and Petroleum Industries Division (ChemPID) within the International Society of Automation (ISA) is a community of professionals involved in the extraction, production, transport, and processing of chemicals, petrochemicals, petroleum, and natural gas. From raw materials to products, ChemPID members seek to advance best practices in safety, environmental protection, production efficiency, operations, process control, and automation (Figure 1). ChemPID is one of the largest divisions within ISA, with over four thousand members strong.

ChemPID volunteers join various technical committees or focus on specific roles that align with their areas of interest. Any of the https://connect.isa.org/chemicalandpetroleum/about/leaders can tell you more about their area of focus and the division as a whole. Numerous benefits and professional opportunities are available when you join ChemPID:

Networking: Increase your visibility in within the petrochemical and oil and gas industries to benefit you and your employer, and have a positive impact on the industry.

Valuable information resources: Member events such as Connect Live discussions and OnPoint presentations learning the latest in the industry. Access to ISA standards and publications, and peers who can recommend and explain concepts are available.

Leadership opportunities: You can improve your personal leadership skills, participate in panel discussions, or serve as a session developer for an ISA conference.

Technical writing: Review papers, make presentations, lead discussions, or write articles for *InTech* magazine.

ChemPID Leaders 2022-2023

Alan Bryant
Director

Jagdish Shukla
Director-Elect

David Lee
Past Director

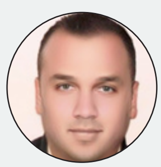
Denise Sherrod
Secretary

Nick Sands
Program Chair

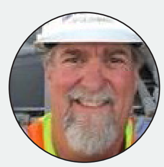
Christi Mezzic
Membership Chair

Dean Bickerton
ISA Connect

Nishadi Davis
Publications

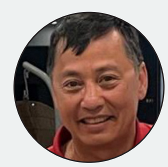


Ahmed Abdelrahman
OnPoint Coordinator



Greg Lehmann
Section-Division Liaison

Prabhat Behera
Young Professionals



Trung Nguyen
Technical Lead: Sustainability

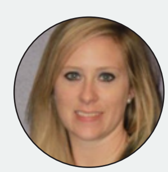
James Haw
Technical Lead: Digitalization

Anil Pushkaran
Board Member

Charlie Souza
Board Member

David Lee
Scholarship Chair, Technical Lead: Operator Performance

Katie White
Volunteer Coordinator



Cheri Haarmeyer
Volunteer Coordinator

Strategic Plan 2023

Vision:

Create a better world through automation

Mission:

Empowering the global automation community through standards and knowledge sharing

Values:

- Excellence - We provide industry leading unbiased content developed and vetted by a community of experts
- Diversity and Inclusion - We are committed to being a global, diverse, and inclusive organization
- Professionalism - We uphold the highest standards of competence and skill in everything we do
- Integrity - We act with honesty, integrity, and trust, respecting others in all that we do
- Collaboration - We seek out opportunities to work together for the benefit of the Society, its members, and our profession

Objectives:

Outreach, Awareness, and Advocacy - Be recognized as the leading, global, independent source of automation knowledge.

Vibrant Community - Grow a consciously inclusive community to enable collaboration and foster the development of leadership skills

Innovation Insights - Proactively identify and foster evolving and emerging technology, processes, and business practices related to ISA's mission.

Financial Stability - Foster a sustainable financial position that continues to support ISA's mission.

Remote Asset Monitoring and Operations in Oil & Gas

By Roland Plett

"Remote asset operations" was seen as the highest return on investment out of all 10 use cases described in a 2020 survey by JWN Energy. The Digital Oilfield Report that published these findings goes on to identify "remote asset inspection" and "remote asset monitoring" to be the second and third choice by survey respondents.

A few years ago, everyone believed the way to achieve remote operations was in an integrated remote operations center (iROC). All the expensive and hard-to-get experts would make that their primary workplace and they could apply their expertise across all assets without the need for frequent travel.

The iROC has definitely proven to be useful in a number of ways. *Oilman* magazine published the following list of iROC achievements:

- Reduced the likelihood of events that cause non-productive time
- Reduced costs by improving operational efficiency
- Helped operators gain a better understanding of complex well sites
- Used advances in technology to obtain 3-D visualization and improved models
- Prevented wellbore collisions
- Increased effectiveness of drilling operations

Remote operations are key to leveraging digital technology in the oilfield.

Over the last few years, we've learned to operate more effectively from a home environment, which has opened a new train of thought for many operators. Can our experts be anywhere? If all the operating tools can be put in a remote operations center, can they also be accessed from a laptop or mobile device anywhere an expert happens to be?

In many ways, this concept of hybrid work that we've learned about during COVID applies to remote operations as well.

Industry POV

Operators continue to struggle with achieving remote operations in an operations center without even considering wide deployment of the hybrid work scenario from anywhere. The good news is, companies like Cisco have an ecosystem of partners that can collectively deliver a remote operation center experience, as well as a full hybrid work experience. Here are a few key elements to consider.

Actionable data. Remote work depends on accurate data and insights from remote assets. Somehow, this data must be reliably acquired and transported to where artificial intelligence (AI) engines can consume it and provide insights. After that, the insights need to be delivered to decision makers. This data movement is essential.

Cisco's industrial network portfolio of switches, routers, and wireless access points are capable of acquiring and processing data at the edge as required. In most cases, this data will also be transported back to a central data store for processing. A variety of validated designs meet specific industry specifications, as well as a variety of service level requirements. This ensures the data reaches the intended destination while keeping with business requirements.

Secure remote access. Most modern assets are capable of remote management when connections are available. Partners understand the security requirements of industrial environments, including oil and gas sites. Cisco's validated designs for secure access comply with industry standards and ensure remote experts are able to access assets without compromising cybersecurity requirements of regulators and corporate security frameworks.

Final thoughts

The oil and gas industry has identified remote operations as a key requirement for efficient, safe, and sustainable operation in the future. A broad ecosystem of products and partners can deliver validated remote access solutions and make data available to the systems and decision makers that need it. And it can be done anywhere they happen to be.■

RESOURCES

cisco.com/go/oilandgas

cs.co/oilandgasportfolio

Energy - Oil & Gas, Mining and Utilities

ABOUT THE AUTHOR

Roland Plett is industry lead, oil, gas, and mining at Cisco Systems and last year gave a Technical Talk to the ISA Calgary Section called "Keeping Our Utilities Safe. He brings together the products of Cisco and its partners in the oil, gas and mining industries. He loves moving valuable business data from the dirtiest and most hazardous environments on earth to the operator screens and OT applications of Cisco customers. Over the last 25 years Plett has been an active part of the data networking industry including eight years at Bell Canada and 13 years at Cisco Systems.

Young Automation Professionals: Let Uniqueness and Competency Be your Guides

By Prabhat Behera

After graduating in electronics and telecommunication engineering, I landed my first job in process automation. It wasn't a field I had particularly aspired for at the time, but fate had chosen an exciting and fulfilling career path for me. Although I barely had any industrial experience at the time, it was the encouraging words from my mentors that facilitated my journey over the next 25 years. Over the years, I have had a great experience growing as a process automation professional. The takeaway here is that at the early phase of our career, some of us are unaware of the career path that should be followed, and often it is shaped by our environment. It is important to keep the doors open and choose the career option that advances the skills you gained from education.

Process automation involves a unique mix of process, mechanical, electrical, instrumentation, and information technology skills, bringing a multidiscipline perspective. In many ways, it was the precursor to the now popular discipline of mechatronics. It is currently at the forefront of the industry and influences an array of business goals including health, safety, and environment (HSE); business efficiency; sustainability; and optimization. The career options in automation are plentiful and the technology is futuristic, with artificial intelligence (AI) and digital twins being the most active areas of research, development, and deployment. Jobs in process automation also bring accomplishment and satisfaction with direct impact on life. An example is when I received feedback from coworkers in the control room that a recently implemented automation project reduced stress levels and had tangible benefits to their health, well-being, and quality of life.

With this background, let us dive into the roadmap to help you succeed in your career journey.

Process automation involves a unique mix of process, mechanical, electrical, instrumentation, and information technology skills.

Courage to be unique

One reflection from the show "The Buried Life (starring Ben Nemtin, Dave Lingwood, Duncan Penn, et. al.)" is "What do you want to do before you die?" It is true and inspiring that the quartet have crossed off most of the 100 things they listed to complete in the lifetime. Since our birth, we have passed through unique challenges in the personal, educational, and professional domain to get to where we are today, and it is a testament to your ability to overcome the odds

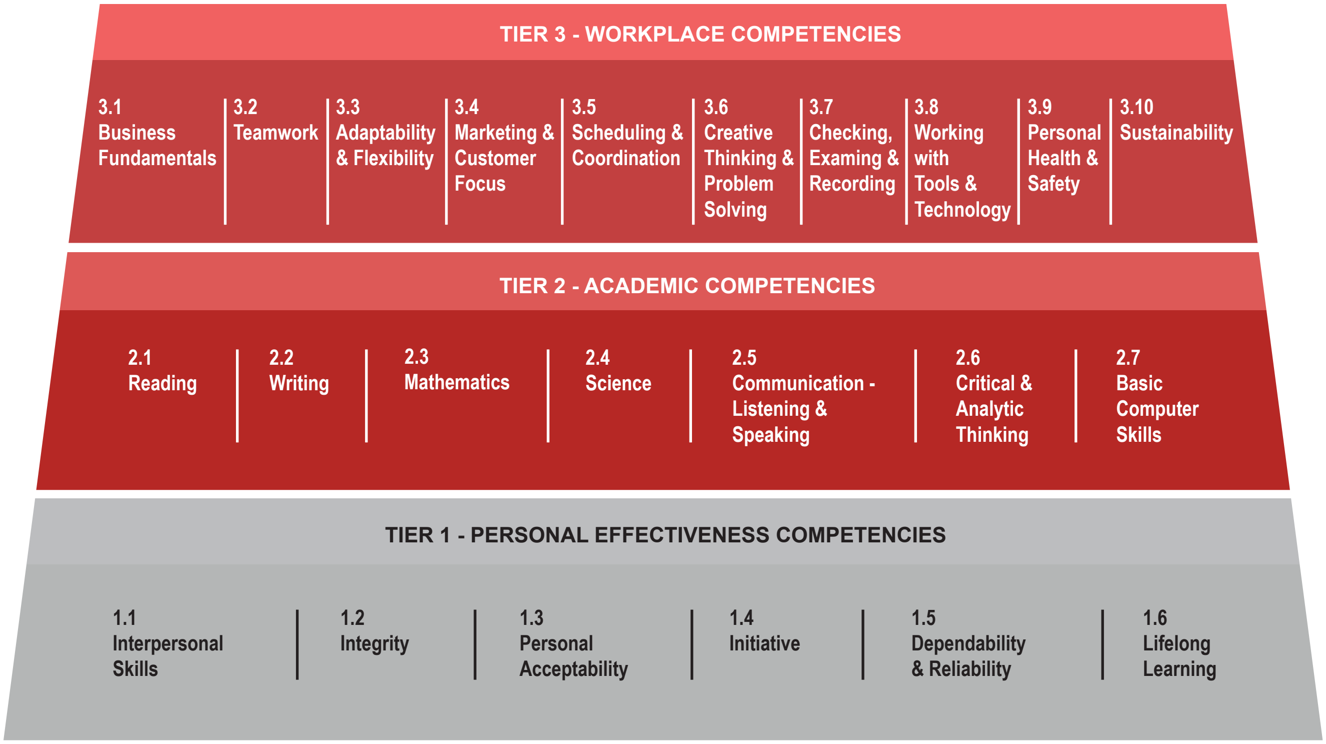


Figure 1. A portion of the automation competency model. See the full model at http://www.careeronestop.org/competencymodel/competency-models/automation.aspx.

of survival that you are today reading this article as an automation professional. Yet every one of us is unique in our capabilities and it is important that you identify your core strengths and proceed on the unique path that best aligns with your passion.

Positivity

"If you fail, never give up because F.A.I.L. means "First Attempt in Learning." *—Dr. A.P.J. Abdul Kalam*

This has been a guiding principle for me and the reflection on the quote confirms that we need to look at the life's episodes in a positive way. Often, people get stressed due to a single failure and take a step back. If we learn from the failure and take on the next project with a positive attitude, then challenges become opportunities and we successfully achieve results that were never imagined. Let's be positive and advance on the journey on the path of sustainability for a better world.

The automation competency model

The automation competency model (figure 1) has been developed by the International Society of Automation (ISA) and is recognized across the industry. It is important to recognize that once you have embarked on the career path of process automation, there is an abundance of resources and support to help you realize your goals. You're not expected to know everything, and therefore collaboration with colleagues is essential. Break your tasks in small and manageable chunks that are manageable.

	Data acquisition: Obtains all the required process variables such as pressure, level, temperature, and flow.
	Process control: Regulates the process to stay close to the desired process variable (PID: proportional [present], integral [past], and derivative [future]).
	Instrumented protection systems: Automated executive actions to mitigate process excursion beyond safe operating limits.
	Human-machine interface (HMI): Monitor and intervene to manage the operating envelope.
	Historian: Reflect on past operation and assure future performance in terms of improvements and statistical analysis.

Figure 2. The five pillars of process automation.

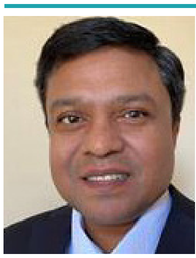
These competencies are generally acquired while executing projects. This is augmented with having a development plan in place that includes reference books, industry codes and standards, best practices, case studies, tips and tools, and discussion forums. Access to these resources can be easily leveraged through membership in organizations such as ISA.

Pillars of automation

Let us imagine a level control scenario as depicted in Figure 2. It involves risk of overflowing, could cause burnouts, and is not sustainable with manual actions. These five pillars provide the possibility to control the process safely anytime and from anywhere.

Final thoughts

The automation industry is currently trending and offers opportunities that will continue to impact our society toward a better world. Every individual is unique, and those unique perspectives bring diversity that facilitate amazing innovations. Let's not deviate from "the original YOU." The competency model presented in this article may be used to guide the journey. ■

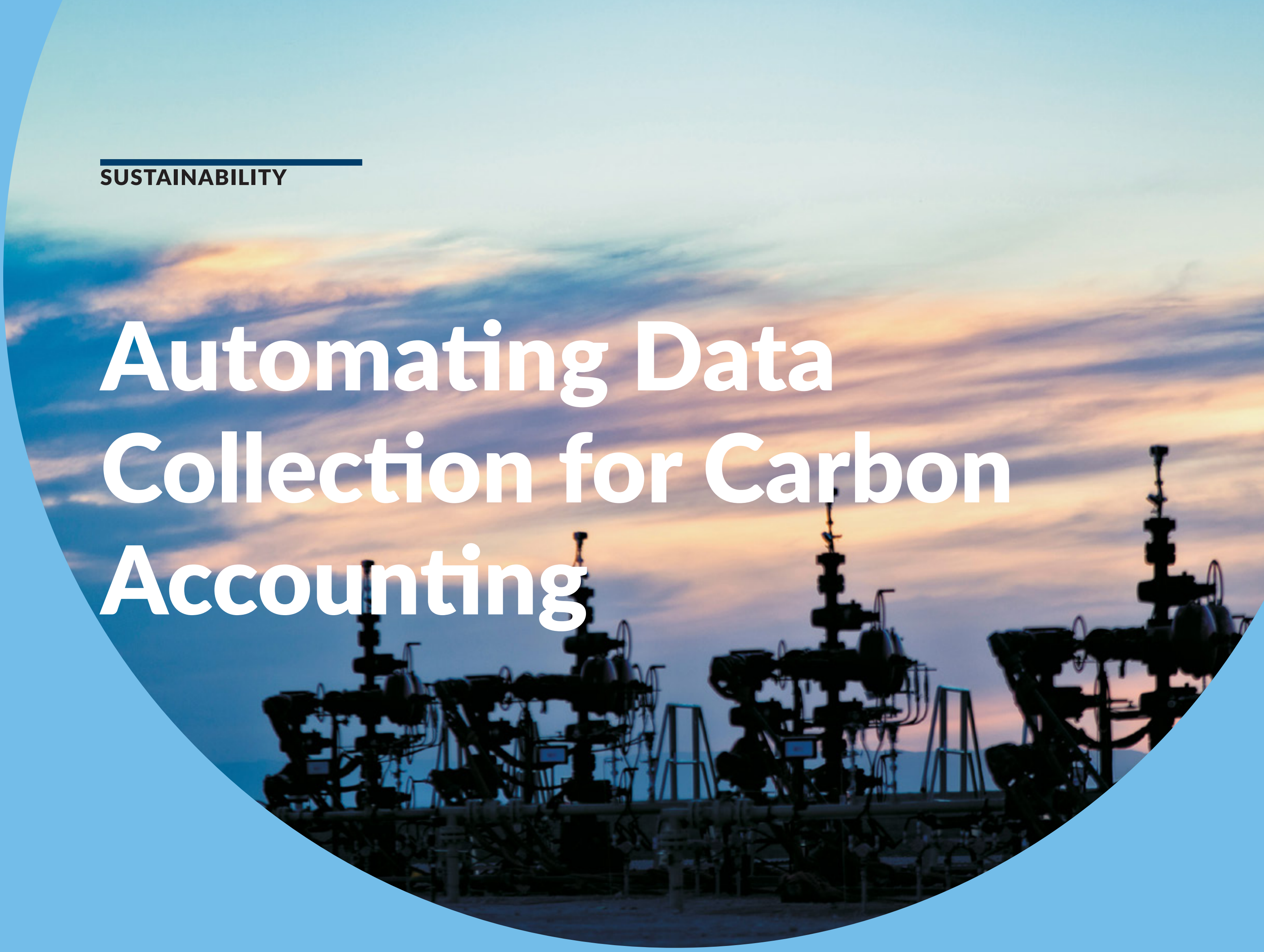


ABOUT THE AUTHOR

Prabhat Behera, BS, MBA, PGP (AI/ML) is an Automation Engineering Advisor at Occidental. He serves as the leader of ISA ChemPID's Young Professional committee. He has 27 years of international experience in the Oil and Gas industry in the areas of project management, reliability, advanced automation, and process safety . His multi-discipline efforts focus to eliminate vulnerabilities while minimizing the impact on our planet in terms of Environmental, Social, and Governance (ESG).

SUSTAINABILITY

Automating Data Collection for Carbon Accounting



Using CO_2 in enhanced oil recovery is an important component of carbon capture, utilization and storage projects for greenhouse gas reduction.

By Alan Bryant

Oil companies have long used carbon dioxide (CO_2) in enhanced oil recovery (EOR) projects to produce additional oil that is not producible by conventional methods like waterflooding. The technology is widely used and well understood, so these active EOR fields constitute the bulk of today's carbon capture, utilization, and storage (CCUS) projects. CCUS involves the capture of carbon from a variety of sources: large point sources, such as power generation or industrial facilities that use either fossil fuels or biomass as fuel.

At the same time, many industrial processes emit greenhouse gases including CO_2, methane, and volatile organic compounds (VOCs), so over the next several decades, many projects are planned to reduce emissions by capturing carbon from these processes or directly from the atmosphere and transporting CO_2 to locations where it can be utilized or sequestered.

That means the carbon intensity of oil, gas, and fuels can be reduced by capturing and sequestering the carbon dioxide associated with their production. The amount of CO_2 sequestered is deducted from the carbon impact of manufacturing and using those products. Complex accounting systems keep track of the amount of CO_2 sequestered and credited to products, while automation systems capture the data required for monitoring, verifying, and reporting the stored volumes of CO_2 along with the associated carbon crediting.

Enhanced oil recovery

Enhanced oil recovery fields historically use CO_2 produced from naturally occurring reservoirs. However, capturing CO_2 from industrial processes is becoming economically viable with recent incentives and provides environmental co-benefits. Significant infrastructure is in place for delivering CO_2 to producing fields. Of the possible storage and utilization opportunities (Figure 1), EOR is the most mature and readily available.

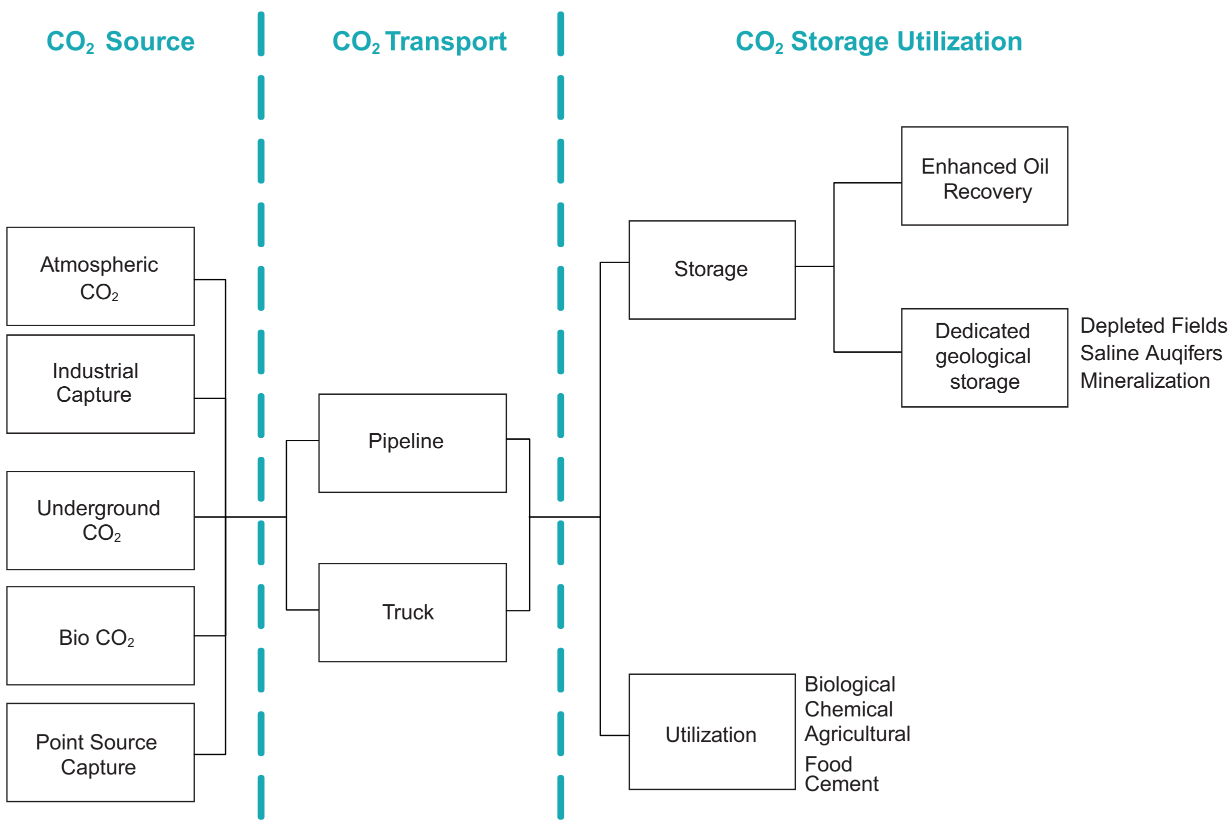


Figure 1. CO_2 source, transport, and use options.

Supercritical CO_2 injected into a reservoir swells the hydrocarbon, because unlike water, it is miscible in the hydrocarbon phase at reservoir conditions. Then, the injected CO_2 sweeps the hydrocarbon to the producing wells, producing more reserves, thereby increasing the field's overall hydrocarbon recovery factor. The recovery factor is the percentage of hydrocarbon in place that can be recovered.

Later in the life of the CO_2-EOR flood, a substantial amount of CO_2 is produced with the incremental hydrocarbon. This CO_2 is separated from the hydrocarbon phase and recycled back into the reservoir CARB CCS. Not only does this recycled CO_2 reduce the amount of purchased CO_2 required to maintain the flood, but the recycling can also promote additional trapping within the reservoir. Eventually, the CO_2 replaces hydrocarbons in the pore space, resulting in long-term storage within the natural trap of the reservoir.

One example is from the California Air Resources Board (CARB) Carbon Capture and Sequestration (CCS) protocol. Other states and government agencies have similar guidelines or are in the process of developing them. The CARB CCS protocol applies to CCS projects that capture CO_2 and sequester it onshore, in either saline or depleted oil and gas reservoirs, or oil and gas reservoirs used for CO2-EOR. The system boundary for CO2 capture and sequestration in oil and gas reservoirs is shown in Figure 3. The CCS Protocol applies to both new and existing CCS projects.

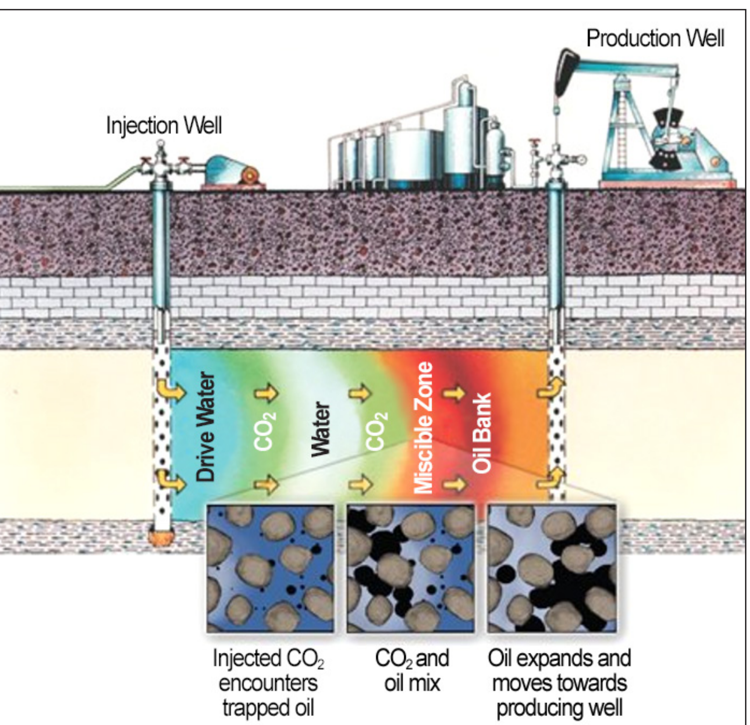


Figure 2. Carbon dioxide and water can be used to flush residual oil from a subsurface rock formation between wells, making excess carbon a resource for enhanced oil recovery projects. *Source: U.S. Department of Energy*

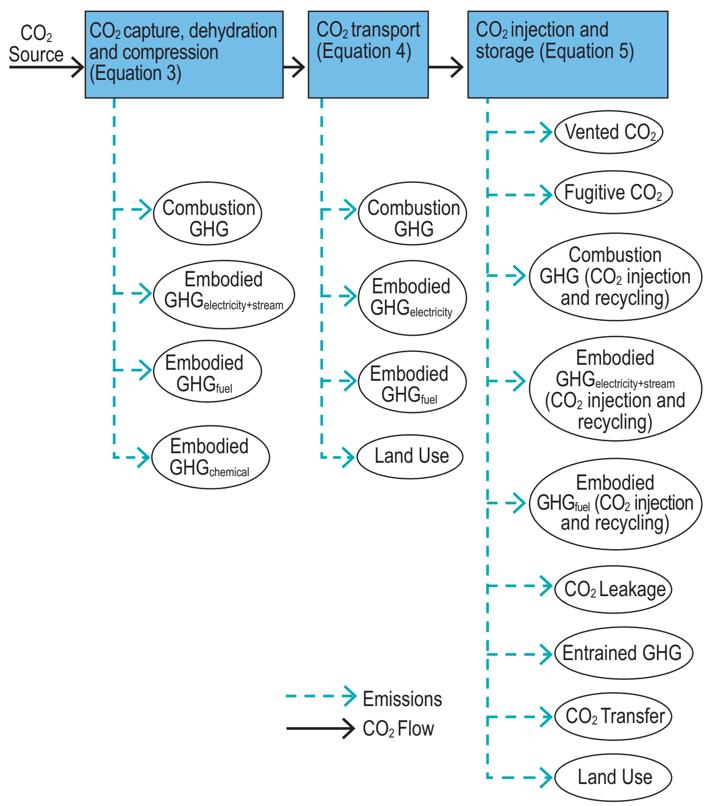


Figure 3. System boundary for CO_2 capture and sequestration in oil and gas reservoirs used for CO_2-EOR.

California's Low Carbon Fuel Standard (LCFS) is designed to encourage the use of cleaner low-carbon transportation fuels in California. The LCFS standards are expressed in terms of the "carbon intensity" (CI) of gasoline and diesel fuel and their respective substitutes. The program is based on the principle that each fuel has life cycle greenhouse gas emissions that include CO_2, CH_4, N_2O, and other GHG contributors. This life cycle assessment is used to account for the GHG emissions associated with the production, transportation, and use of a given fuel. The life cycle assessment includes direct emissions associated with producing, transporting, and using the fuels, as well as significant indirect effects on GHG emissions, such as changes in land use for some biofuels.

The carbon intensity scores assessed for each fuel are compared to a declining CI benchmark for each year. Low carbon fuels below the benchmark generate credits, while fuels above the CI benchmark generate deficits. Credits and deficits are denominated in metric tons of GHG emissions. Providers of transportation fuels must demonstrate that the mix of fuels they supply for use in California meets the LCFS carbon intensity standards, or benchmarks, for each annual compliance period. A deficit generator meets its compliance obligation by ensuring that the credits it earns or otherwise acquires from another party is equal to, or greater than, the deficits it has incurred.

Data collection occurs via the SCADA system throughout the CCUS process (Figure 4). In a typical EOR application, the process follows these steps:

1. CO_2 is sourced from direct air capture, and capture from industrial processes.
2. CO_2 is cleaned to pipeline specifications and compressed to supercritical phase.

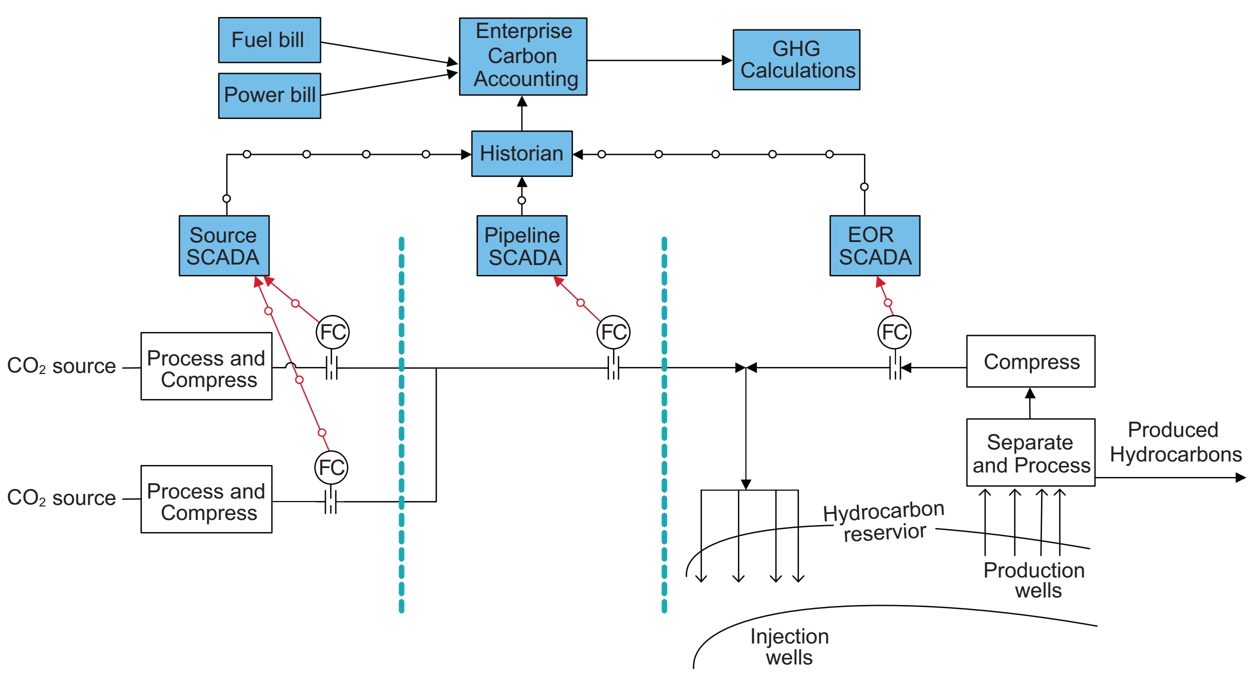


Figure 4. Data collection via SCADA through the CCUS process.

3. CO_2 is transported, typically by pipeline, to EOR fields. CO_2 is typically transported and injected in supercritical phase.
4. CO_2 from the pipeline is mixed with CO_2 produced in the field and injected into the reservoir.
5. Produced gas is separated from oil and water, CO_2 is processed, compressed, and recycled to the injection system.
6. Custody transfer meters measure the amount of gas delivered from the source to the pipeline, the pipeline to the field, and the amount recycled.
7. Flow measurements are delivered to the carbon accounting system, usually via the various SCADA systems. The data can be collected and organized in a data historian for transfer to the carbon accounting system which is doing the carbon intensity calculations.
8. The custody meter from the pipeline to the EOR field is a measure of the amount of CO_2 sequestered.
9. The custody meters from each source to the pipeline are used to allocate the sequestered CO_2 mass to each source.

Energy is required at each stage, contributing to the GHG emissions of the sequestration process. Per the CARB protocol, the GHG reduction credited to the project is the difference between the amount of CO_2 sequestered and the amount of GHG created in capturing, transporting, and injecting it (Equation A).

The CO_2 from the pipeline is metered with a custody-quality flow element and flow computer. The CO_2 injected that is credited to the project does not include the volume of recycled CO_2 that gets injected.

The amount of sequestered CO_2 can be allocated back to the sources if each source's contribution to the pipeline is metered. The CI reduction attributed to each source is calculated from the total GHG reduction of the project and the ratio of that source's contribution to the sequestered amount.

The GHG from operating the project includes GHG emissions from fuel combustion, electricity use, and chemical use (Equation B). Each of these must be measured and recorded at each stage.

$$GHG_{reduction} = CO_{2_{injected}} - GHG_{project} \quad (1)$$

Where:

$GHG_{reduction}$	=	Net GHG reductions (MT CO_2e/year).
$CO_{2_{injected}}$	=	Amount of injected CO_2 (MT CO_2/year). Excludes recycled CO_2 in the case of CO_2-EOR (equal to purchased CO_2 per year measured before the point of injection and after transportation[3]).
$GHG_{project}$	=	CCS project GHG emissions (MT CO_2e/year).

Equation A

$$GHG_{project} = GHG_{capture} + GHG_{transport} + GHG_{injection} + GHG_{dLUC} \quad (2)$$

Where:

$GHG_{project}$	=	CCS project GHG emissions (MT CO_2e/year).
$GHG_{capture}$	=	GHG emissions associated with carbon capture, dehydration, and compression (MT CO_2e/year).
$GHG_{transport}$	=	GHG from CO_2 transport (MT CO_2e/year). Transport can be by pipeline, ships, rail, or trucks.
$GHG_{injection}$	=	GHG emissions from injection operations (MT CO_2e/year).
GHG_{dLUC}	=	GHG emissions from direct land use change (MT CO_2e/year).

Equation B

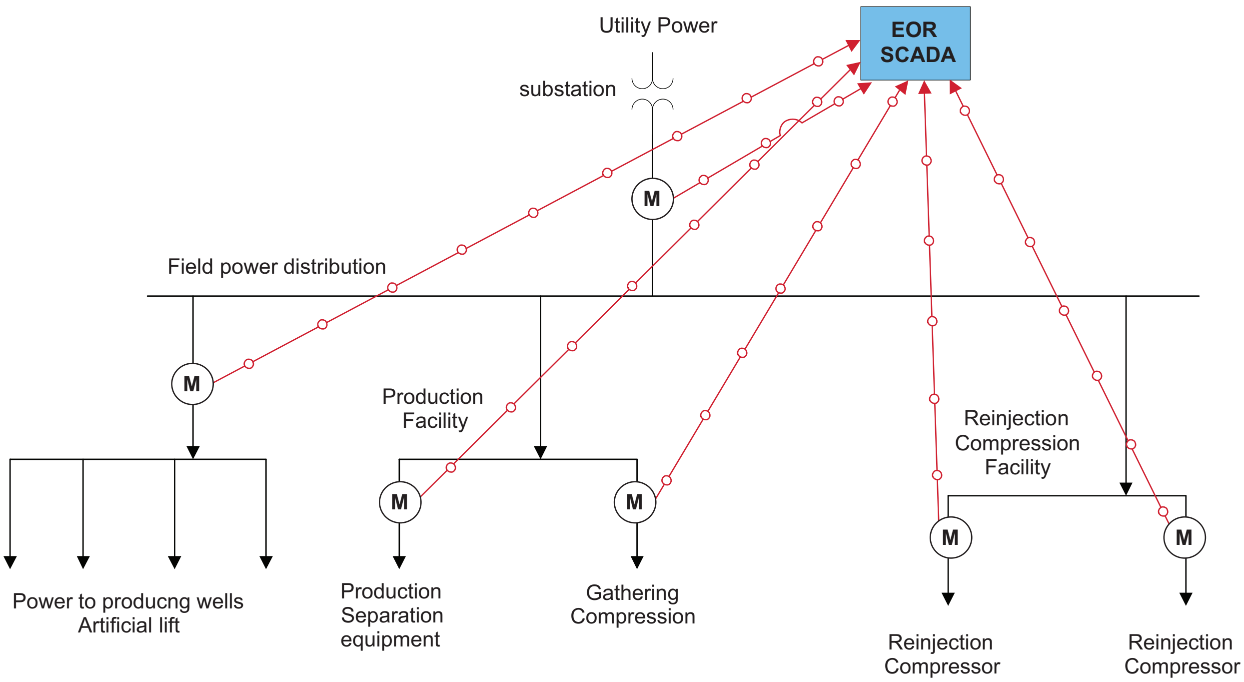


Figure 5. Simple one-line power flow for EOR field.

In many cases, the production facilities and injection facilities share the same utility power source. The metered power for the site must be segregated into production and injection power. If the site has a smart MCC or protective relays, the measured energy data can be read directly by the local automation system. If there are not smart devices, current transformers can be used to measure power loads for the injection-related equipment, or the loads can be estimated.

In the example in Figure 5, the total power delivered to the field comes from the utility bill. The amount of power used for CO_2 injection is measured from the smart MCC and motor protective relays, collected by SCADA, and delivered to the data historian. The accounting system can then allocate energy used for injection and attribute the appropriate amount of GHG to the CO_2-EOR process.

Data from various sources are consolidated into an enterprise system for accounting:

- Metered contribution of each source to the transportation system
- Total amount delivered by the pipeline to the project
- Total amount injected
- Measured power, fuel, and chemical use
- Utility power bills
- Fuel gas invoices
- Chemical invoices

Measured data from the sites might already be delivered via the existing SCADA infrastructure, so it would only require some database work to get it to the system.

A method to verify each input to the system is required. A backup plan for missing data must also be in place in case of instrument or communication failure. An example is shown in Figure 6.

Final thoughts

To measure the amount of GHG reduction accomplished with sequestration in CO_2-EOR, data must be consolidated from multiple sources, including power utility and fuel gas invoices, source control systems, transportation, and production SCADA. In many cases, the data are already available, but it is spread across

CCS PROJECT PHASE	CO_2 SOURCE AND TRACKED EMISSIONS	EMISSION SOURCE	NET GHG VARIABLE	RELATED VARIABLES	VERIFICATION
CO_2 Capture and Processing	Captured CO_2	Source 1	Amount injected	Allocated portion of total power to captured volume Allocation factor for this CO_2 source	Calibrated flow meters and monthly sales transactions
	Captured CO_2	Source 2	Amount injected	Allocated portion of total power to captured volume Allocation factor for this CO_2 source	Calibrated flow meters and monthly sales transactions
	Process equipment	Electric power Fuel gas	GHG-electric GHG-fuel	Used to calculate GHG project	Utility power bill Fuel gas meters
	Compression	Electric power Fuel gas	GHG-electric GHG-fuel	Used to calculate GHG project	Utility power bill Fuel gas meters
CO_2 Transport	Compression	Utility power	GHG-electric	Used to calculate GHG project	Utility power bill
CO_2 Injection Operations	Purchased CO_2 volume	NA	NA	Compared to total captured CO_2 to confirm injection volume	Calibrated CO_2 pipeline flow meter
	Production artificial lift and process equipment	Utility power	GHG-electric	Used to calculate GHG project	Utility power bill allocated per measurement at MCC
	Injection process equipment	Utility power	GHG-electric	Used to calculate GHG project	Utility power bill allocated per measurement at MCC
	Recycle compression	Utility power	GHG-electric	Used to calculate GHG project	Utility power bill allocated per measurement at MCC
	EOR Reservoir leakage	Wellbore leakage	CO_2 leakage	Used to calculate GHG project	Leakage model and monitoring program per CCS Protocol

Figure 6. A method to verify each input to the system is required.

multiple systems that must be integrated. The automation team's role is to identify the necessary data in the SCADA and electrical systems, then make it available to the enterprise, perhaps via the data historian. ■

Photos courtesy of Occidental

ABOUT THE AUTHOR

Alan Bryant, PE, PMP is director of ISA's ChemPID and is a voting member on multiple ISA standards committees. He has more than 30 years of experience managing projects and automation initiatives in upstream oil and gas. In his role as an engineer at Occidental, he is a technical SME, he establishes new programs such as alarm management, develops company practices, and automation standards.

Important Definitions

Greenhouse gas (GHG) emissions reduction can be accomplished by lowering the carbon intensity of fuels, e.g., adding carbon capture to ethanol production.

Carbon dioxide equivalent or CO_2 equivalent (CO_2e) converts the impact of known GHG emissions to an equivalent amount of carbon dioxide emissions in metric tonnes using the known GHG's potential for global warming evaluated over the same period in the atmosphere, e.g., 100 years.

Carbon intensity (CI) is the measure of greenhouse gas emissions associated with producing and consuming a transportation fuel, measured in grams of carbon dioxide equivalent per megajoule of energy (gCO_2e/MJ).

Carbon capture and sequestration (CCS) means the process of concentrating CO_2 present in flue gas, exhaust gas, or air via chemical and/or physical separation methods, transporting the CO_2 to an injection site, and injecting and sequestering the captured CO_2 underground.

CO_2 Enhanced Oil Recovery (CO_2-EOR) means the injection into and storage of CO_2 in conventional hydrocarbon reservoirs contributing to the extraction of hydrocarbon reserves.

Scope 1 emissions are direct greenhouse (GHG) emissions that occur from sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles).

Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although Scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization's GHG inventory because they are a result of the organization's energy use.

Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain. Scope 3 emissions for one organization are the Scope 1 and 2 emissions of another organization.

FURTHER READING

Enhanced Oil Recovery, from U.S. Department of Energy

Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard, from the California Air Resources Board

LCFS Pathway Certified Carbon Intensities, California Air Resources Board

"Can This Carbon Capture Technology Help Create **Negative Emissions**?" from Forbes


The Plant Floor in Your Pocket
Get an overview of your process at a glance.
Control your SCADA with a swipe.
Ignition!
Perspective
See the live demo now.
Scan this QR code with your phone
or visit demo.ia.io/tech

Plastics Recycling:

No Digital Transformation Needed

I remember it like it was yesterday. In late 2020, I got a text from Dustin Olson, now the current CEO of PureCycle Technologies, Inc. He and I had worked together at a local Houston refinery about 18 years prior. He wanted to tell me about a new technological breakthrough in plastics recycling and he wanted advice on current automation technologies that could be applied to this new technology. The ensuing conversation touched on how we could deploy automation to set the company up for long-term success by avoiding "digital transformation" and essentially being "born digital" from the get-go.

I set out to write a white paper on the subject. I jotted down some of my own ideas, as well as the solutions to many of the problems I had encountered over my 31 years as an automation professional, and I asked several

The mission to accomplish advanced plastics recycling keeps the automation pro responsible for project/program execution focused and committed.

By James Haw

colleagues to weigh in. The result marked the beginning of a remarkable opportunity to work at PureCycle and implement something I never thought I would get to in my career—an automated industrial process using cutting-edge foundational technologies to help create a "planned digital community" that would make costly transformations less likely, or at the very least, easier to implement.

The journey since has been incredible. We've assembled an amazing team of tenacious automation professionals, and our vision has drawn the attention of industry professionals who have partnered with us to make this dream a reality—all at an implementation cost of approximately one-tenth of what we would likely incur if we were forced to get the same result by transforming legacy systems. I'll tell you how we did it.

Developing the digital ecosystem

First, we had to develop a digital ecosystem with interfaces to other business systems. Within this ecosystem, we create a true digital thread such that each system digitally extracts or writes information in a consistent way. In other words, the entire digital footprint for the entire operation is coordinated, designed, and built like a planned community—or more precisely, a planned *digital* community.

Why? Because mismatches in applications or systems, and the integration work undertaken to force them to work with one another after the fact, have historically increased budget and schedule dramatically. This also has resulted in a unique system requiring increased maintenance and development over its entire lifecycle, i.e., the "transformation" we want to avoid.

While my love of the craft of automation is what drew me to PureCycle, what keeps me dedicated to its success is the company's mission of revolutionizing plastic waste into a renewable resource.

What it means for us in the short term is that we get all the great things that provide value now, all from the beginning: Highly integrated basic process control systems; digital twins; high-performance graphics; alarm rationalization, management, and adherence to alarm philosophy from the start; ergonomic control room and building design; building management; central hub support to worldwide facilities; mobility concepts as part of our culture; harnessing artificial intelligence to reach higher levels of autonomy; etc.

But while my love of the craft of automation is what drew me to PureCycle, what keeps me dedicated to its success is the company's mission of revolutionizing plastic waste into a renewable resource by utilizing a ground-breaking, patented recycling process.

PureCycle's process dissolves polypropylene (PP) plastic waste feedstock using a proprietary solvent, which then separates color, odor, and impurities from the PP to transform it into an ultra-pure recycled (UPR) resin (shown at the beginning of this article). After spending 10 years of my career in virgin plastics production, knowing that there was a technology that could stem the tide of landfilled plastic waste (or worse, that waste which makes its way into the ecosystem where it was otherwise not intended to end up) motivated me in a way I had not yet experienced over the entirety of my career.

Groundbreaking technology

Why is this technology so special? Let's break it down.

Plastics are made from oil, more specifically, from petrochemicals derived from oil. According to the European Association of Plastics Recycling, those plastics are produced at a worldwide rate of 810 billion pounds every year. The oil majors' claim that the plastics industry will maintain the rate of growth it has shown since 2010, which is around 4 percent per year. The question becomes, does it have to? Can the recycling industry reduce the overall amount of oil needed to produce the virgin plastics that people need in their daily lives, and at the same time keep it out of landfills and waterways? In other words, can the recycling industry help plastics production become sustainable?

Of the 810 billion pounds of plastic produced globally every year, only about 9% on average is recycled, according to Organization for Economic Cooperation and Development. The chart (Figure 1) shows approximately what is produced and recycled annually; the type of plastic is usually imprinted somewhere on the item inside a triangle. (Source: "The world of plastics, in numbers," The Conversation.)

Considering only polypropylene, of the 159.5 B Lbs. produced annually worldwide,

PLASTIC TYPE		ANNUAL GLOBAL PRODUCTION
1 PETE	Polyethylene Terephthalate (PETE or PET)	68 B lbs.
2 HDPE	High-Density Polyethylene (HDPE)	104.5 B lbs.
3 V	Polyvinyl Chloride (PVC or Vinyl)	78 B lbs.
4 LDPE	Low-Density Polyethylene (LDPE)	141 B lbs.
5 PP	Polypropylene (PP)	159.5 B lbs.
6 PS	Polystyrene (PS)	49.5 B lbs.
7 OTHER	Miscellaneous/Other	210 B lbs.

Figure 1. Of the 810 billion pounds of plastic produced globally every year, only about 9% on average is recycled, according to Organization for Economic Cooperation and Development.

Of the 159.5 B lbs. of polypropylene produced annually worldwide, only about 5.6% is recycled, and almost all of that is *mechanically* recycled.

Figure 2. Mechanically recycled plastic is cleaned and re-compounded into a grey or black plastic (right), which has a limited number of use cases that don't require a specific color or residual-odor specification.

only about 5.6% is recycled (according to "Solvent-Based Recycling of Waste Plastics," PEP Report 199H, IHS Markit / S&P Global, October 2021). And almost all of that is *mechanically* recycled, meaning it's cleaned, and then re-compounded into a grey or black plastic (Figure 2) . This recycled plastic has a very limited number of use cases like deck boards, paint cans, trash cans, and other applications that don't really rely on a specific color or residual-odor specification.

But what if that same plastic could be recycled in such a way that it could be purified—or taken to a "virgin-like" state—making it reusable in all its original use cases?

Enter PureCycle. PureCycle takes post-consumer and post-industrial polypropylene waste and purifies it. The innovative process essentially cleans the plastic at the molecular level. Feed prep works to remove biological impurities from the plastic waste. The purification process is designed to remove color and other additives by scrubbing the molecule, resulting in an ultra-pure, virgin-like polypropylene that can be used in all its original use cases.

What impact can this technology have on overall plastic production? It has been suggested that plastic imposes an annual cost on society almost equal to its total market value each year. Costs to remove it from waterways, and the original carbon footprint to produce it (and to recycle it) make up most of this external cost.

If this is true—and it seems plausible—why wouldn't we want to exploit the one recycling technology that had the power to reduce oil production and reduce plastic pollution? If a technology exists that can clean plastic that has already been produced, then why would we need to produce it again? That would be like throwing away your reusable plates and buying new ones every day, instead of just washing them!

There are those who reject the idea that plastics recycling will ever be sustainable. They continue to make blanket statements like, "recycling will never work". Their solution is often reduced to a proposal to eliminate plastics, which is not realistic and fails to prescribe an alternative that provides some of the same benefits of plastics.

Life without plastics

Let's look back over the last 70 years on what our lives would be like and how we would suffer without plastics.

Plastics helped win WWII for the Allies. Because polyethylene was found to have very low-loss properties at very high frequency radio waves, Great Britain suspended the commercial distribution of polyethylene at the outbreak of World War II and a new process was secretly developed to produce insulation for UHF and SHF coaxial cables of radar sets. Development of radar greatly expanded in September of 1936, and the design and installation of aircraft detection and tracking stations along the East and South coasts of England was realized just in time for the outbreak of World War II in 1939. Without this technology, the Royal Air Force would not have had the vital advance information to know where to deploy their aircraft; they didn't have the vast numbers needed to patrol the skies without it. If it weren't for plastic, Great Britain might have lost the Battle of Britain.

Plastics save lives. Of course, metals, glass, and paper are all used in the healthcare industry, but nothing has had the impact that plastics have had in hospitals over the past 70 years. The list is nearly endless: gloves, masks, IV bags, tubes, syringes, catheters, pill bottles, pill packaging are all made better by the use of plastic. Plastic possesses the properties that are necessary for the biomedical industry. It is easy to sterilize. It's lightweight, low-cost, and easy-to-produce, making it abundantly available when needed, such as during the COVID-19 pandemic.

One example is incubators, which today are made almost entirely out of plastic. An incubator is a bed that helps provide warmth to an infant, and it is an essential tool for reducing infant mortality the world over, especially in third-world countries. It is estimated that about 42% of all neonatal deaths worldwide occur in Sub-Saharan Africa, with neonatal hypothermia as a strong contributing factor. In this context, does the availability of incubators made from plastic to drastically reduce their overall cost represent a *moral case* for plastics production?

The problem is that about 90% of the plastic used in the healthcare industry isn't recycled, and either heads to landfills or undergoes incineration.

Automobiles without plastics. Automobile pollution is real, of course, because burning gasoline and diesel fuel creates harmful byproducts like nitrogen dioxide, carbon monoxide, hydrocarbons, benzene, and formaldehyde. In addition, vehicles emit carbon dioxide, the most common greenhouse gas. But plastics have played a vital role in *reducing* that pollution. Here's how: Fifty percent of the average car is made of plastic, and that 50% accounts for about 10–15% of its overall mass. (Polypropylene makes up about 32% of that plastic, on average.) Reducing the mass of the car makes it lighter and therefore more fuel-efficient, thus reducing emissions.

What about automobile safety? Bumpers are critical to absorbing impact during accidents. Plastic bumpers weigh 50% less and at the same time absorb four to five times more energy during impact. Seat belts and airbags are made of plastic, and child restraint seats are made almost entirely of plastic.

Windshields made of laminated glass are shatter-resistant thanks to a thin layer of plastic sandwiched between two layers of glass, which is lighter and stronger than tempered glass. Since 1938, this addition alone has helped save lives by reducing ejection during accidents, which increases the likelihood of death by a factor of 10. In addition, modern laminations can filter out up to 99 percent of harmful UV rays. This also reduces in-car temperature and consequently the use of air conditioning, which further increases gas mileage, further reducing emissions.

These are just a few examples of how plastics benefit the planet. The fact is, plastics are somewhat vital to helping preserve the environment and human life, so why wouldn't we want to propagate a technology that could enable plastics and the earth to coexist?

The circular recycling process

Another significant concern about plastics is the single-use applications for food service items and healthcare industry materials, which have the highest likelihood of polluting the environment. A management system is needed to ensure that single-use items are disposed of in such a way as to increase the likelihood that they head to a recycling center instead of a landfill. To assist in the solution, the industry needs to step up and create the demand for items with "multiple lives" and eliminate single-use in favor of multiple-use.

PureCycle Technologies is working on all fronts to keep polypropylene plastic out of landfills and in the circular recycling process for re-use where it belongs (Figure 3). Here are a few ways PureCycle is doing this:

- We're partnering with sports venues to adopt our PureZero™ program where single-use plastics are collected at the source.
- We're implementing Pre-Processing (PreP) facilities where bulk plastics are sorted and pre-agglomerated as feedstocks to our commercial purification facilities.

Figure 3. PureCycle Technologies is working on all fronts to keep polypropylene plastic out of landfills and in the circular recycling process for re-use where it belongs.

- We're partnering with civics groups to collect PP waste. For example, most political yard signs are made out of polypropylene so, after an election, these should head to the recycling center not the landfill. PureCycle is working to offer this option.

Our short-term goal is to grow to a level where we can recycle 1 billion pounds of polypropylene each year by the year 2025. Our long-term goal is to grow our polypropylene recycling technology so that ultimately not much virgin PP has to be manufactured yearly. In other words, let's make it once and recycle it over and over.

PureCycle has the technology designed to do this now, and with our "Born Digital mind-set," we can do it efficiently, and with a low carbon footprint. Despite what the naysayers say, true advanced plastics recycling has arrived. ■

All photos courtesy of PureCycle

ABOUT THE AUTHOR

James Haw has been a career leader of the International Society of Automation having served at the local, regional, and national levels and is member of ChemPID. He is also a Certified Maintenance and Reliability Professional (CMRP), as well as a Certified Project Management Professional (PMP). Professionally, James is vice president of Program Management & Digital Strategy for PureCycle Technologies, Inc, responsible for all worldwide project/program execution, as well as PCT's Born Digital program. He has over 33 years of experience in the industrial manufacturing sector, holds a Bachelor of Science degree in Electrical Engineering (BSEE) from the University of Arkansas at Fayetteville, and is a registered Professional Engineer (PE) in the state of Texas.

Building the Hydrogen Hub Backbone

By Nishadi Davis

The clean hydrogen ecosystem needs control systems integration and network planning.

After decades of speculation and false starts, it is likely that hydrogen's time has finally come. Federal investment and funding opportunities have created unprecedented opportunity for private entities to partner with federal agencies to jumpstart the hydrogen economy. The DOE's Bipartisan Infrastructure Law includes $9.5 billion in clean hydrogen incentives with the intention of establishing several regional clean hydrogen hubs.

Hydrogen is a versatile energy carrier, and its applications today range across a number of industries. This allows us to leverage existing assets to scale up the hydrogen economy by combining these assets with a range of new technologies to quickly establish the basis for regional hydrogen hubs.

While the most recent focus in establishing these hubs has rightly been in developing solutions for the individual assets within a hub, the backbone of hydrogen hubs will be the control systems that link the individual entities together. This means that system integration will play a key role in the success of these projects.

Hydrogen hub anatomy

The anatomy of the hydrogen hub can be divided into four main segments: hydrogen generation, hydrogen storage, hydrogen transportation, and electrical power generation (Figure 1).

Each of these major segments can then be divided further. Hydrogen generation, for example, will occur through a variety of different processes from many different producers. Production methods will range from existing fossil fuel facilities that will likely be modernized by adding carbon capture units, to new electrolyzer and biomass facilities that have yet to be built. Hydrogen that is produced across these entities will then need to be transported to either storage facilities or electrical power generation units. All these different pieces will need to be monitored effectively and controlled efficiently to ensure a robust hydrogen network.

Because hub establishment will require multiple partners across the energy industry, the controls systems within each hub will have a drastic range of systems from different vendors, as well as a wide range of functionalities and communication protocols. It will therefore be necessary to establish some form of a supervisory control system to integrate all the individual controls into one centralized system to get an accurate view of what is happening across the entire hub at any given time.

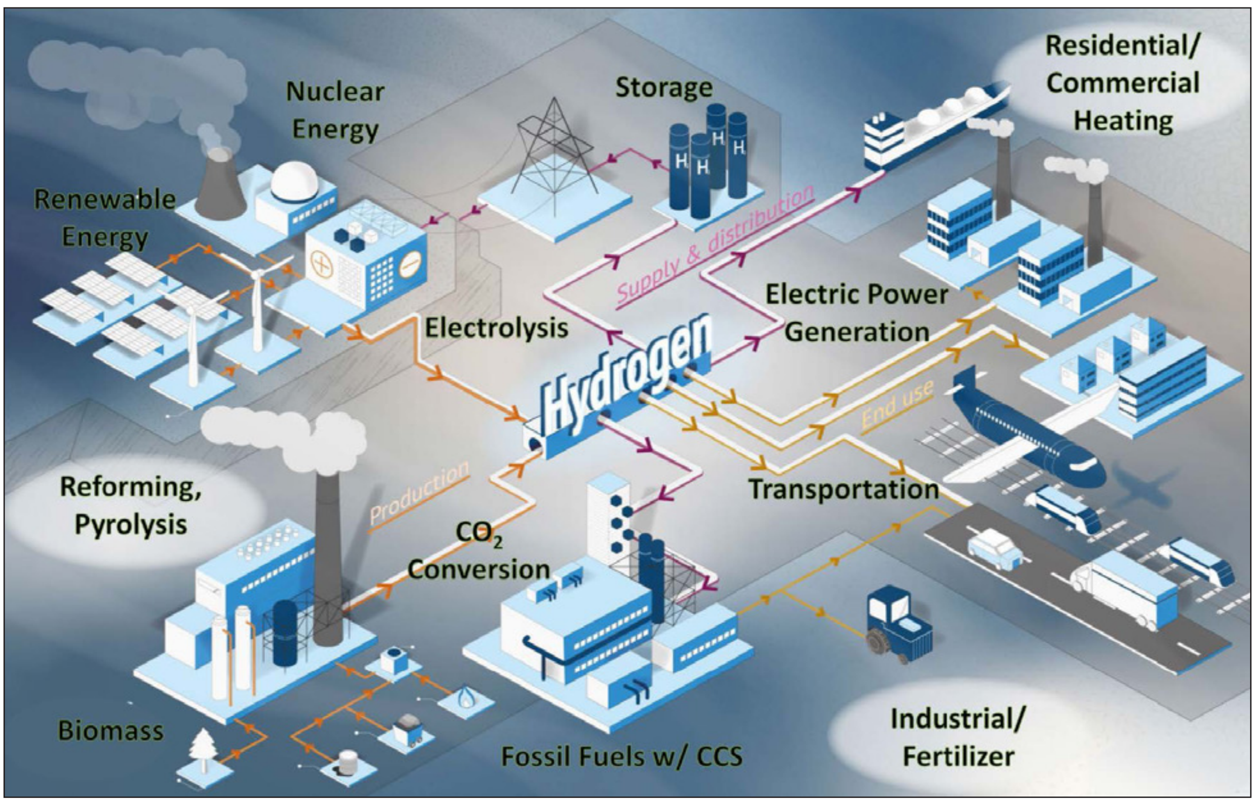


Figure 1. The anatomy of the hydrogen hub can be divided into four main segments: hydrogen generation, hydrogen storage, hydrogen transportation and electrical power generation.

Courtesy: www.hydrogen.energy.gov

Hydrogen hub considerations

When considering the controls systems piece of hydrogen hub establishment, the following should be considered across the entire hub:

- Centralized controls
- Safety systems
- Centralized human-machine interface (HMI)
- Alarm rationalization
- Information technology (IT)/operational technology (OT) infrastructure
- Cybersecurity

To design a seamless operating system, a control systems integration plan should be developed in early hub planning stages and not as an afterthought. The systems integrator must take existing network architecture into consideration as well as plan adequately for future expansion because hub development will roll out in stages and continue to expand.

A control plan must be developed to outline which information is necessary to be relayed to the central control system. The central control room, at a minimum, should supervise electrolyzers and other hydrogen generation units, monitor pipeline activity, control electro-chemical fuel cell interface with the power grid, and interface with the safety instrumented system (SIS). This means data from programmable logic controllers (PLCs), distributed control systems (DCS), and SIS will converge to a central location with the help of remote/supervisory control and data acquisition (SCADA) systems. Advanced applications will need to be evaluated for integration between hydrogen hubs and the electric grid to manage grid balance.

Because hub establishment will require multiple partners across the energy industry, the controls systems within each hub will have a drastic range of systems from different vendors, as well as a wide range of functionalities and communication protocols.

Begin with safety

Safety system implementation is an integral piece of hub integration, as hydrogen is both volatile and explosive. Because hydrogen use is well-established across industries, regulations, guidelines, and codes and standards already exist to facilitate safety guidelines around the industrial use of hydrogen.

In addition to existing regulations, systems have already been put in place to establish codes and standards that facilitate hydrogen and fuel cell commercialization. Layer of protection analysis (IEC 61511/ISA84) will continue to govern safety integrity level (SIL) implementation for SIS. The hydrogen hub centralized control room will be required to interface with safety systems to facilitate remote shutdowns as well as take necessary control action during abnormal events.

HMI development also should be planned carefully for the central control room. The goal of the HMI should be to provide control room operators with as much visibility into the entire hydrogen hub without loading unnecessary data onto graphics. The HMI should be structured so that operators are quickly alerted to abnormal conditions and can take immediate action to rectify any issues.

High-performance graphics, following the ISA101 *HMI* standard, should be developed so that operators are presented with useful information rather than being overloaded with data points. Display hierarchy is critical to the development of a hydrogen hub HMI because of the vast network of assets that are integrated to a central system. Analysis should be done in advance to determine how to structure this hierarchy, as well as how to best integrate future assets as they become connected to the hub.

A robust alarm system will be an important part of the hydrogen hub's central control system.

Alarm rationalization should be performed following ANSI/ISA84, *Management of Alarm Systems for the Process Industries* standard. Alarm rationalization will minimize the number of alarm activations and nuisance alarms. Following rationalization, the alarm system generally results in rapid response from control room operators who learn that the alarm system can be trusted to only report on necessary events. This also reduces complacency. A robust alarm system will be an important part of the hydrogen hub's central control system because operators will need to be quickly alerted to abnormal conditions across the entirety of the hydrogen hub.

IT/OT network infrastructure

Another piece of the control systems integration effort is the IT/OT network infrastructure planning. Industry practice for industrial control systems (ICS) is based on IEC/ISA 62443. Technology advances in recent years have led to a push for the convergence of IT and OT systems, but it is important to understand the purpose of each system. OT systems prioritize maintaining reliable and safe production operations while IT systems prioritize securing business data. When it comes to hub planning in this regard because many different private entities will form a single hub, networks will have to be carefully planned so businesses can share vital production data with the entire hub, while securing their own business networks. The hydrogen hub in turn will likely require its own independent IT network infrastructure. Early planning of this network architecture allows communication to be streamlined across networks.

Integral to IT/OT infrastructure planning, is cybersecurity. Traditional IT risk assessments do not fully capture process risks at the OT level. This is where new cyber risk assessments as part of CHAZOP (Control Systems HAZOP methodology specified in

NIST SP 800-82 and IEC/SA 62443) is useful. Performing CHAZOP allows us to systematically identify key risks at the OT level that have health, safety, and environmental implications. Performing a CHAZOP will help stakeholders and decision makers identify true risks across the hydrogen hub and take appropriate mitigation measures.

Looking ahead

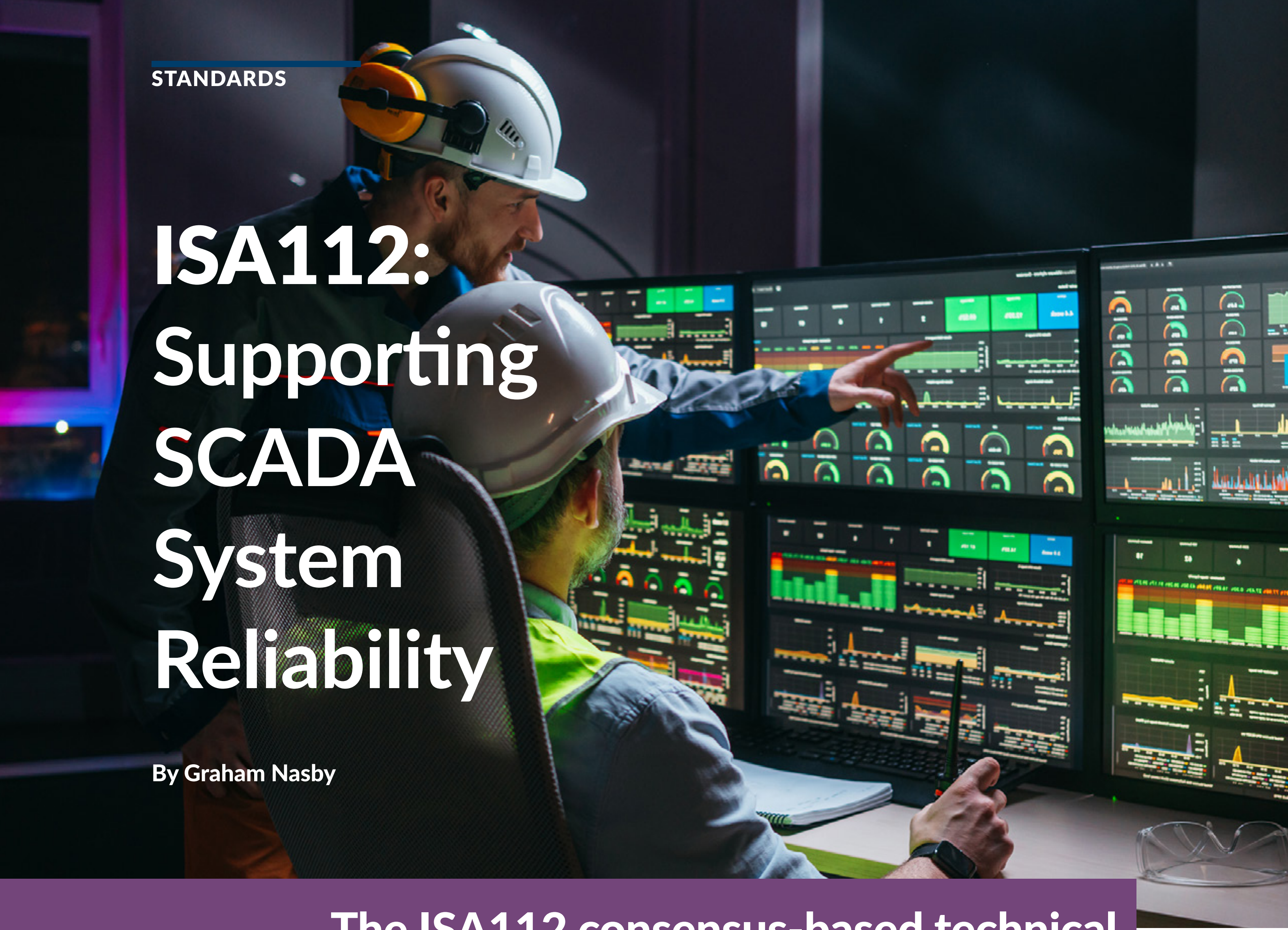
Control systems integration is a key component in establishing hydrogen hubs. Individual pieces of the hydrogen ecosystem can only function together if they are able to communicate effectively with one another other. Control systems and network planning should be started early in the hub development phase to ensure that communication is streamlined across entities.

Defining communication protocols at the hardware purchasing stage is ideal. Identifying all necessary hardware interfaces up front will also be beneficial to the planning process. Alternatively, trying to piece together communication links in the late stages of hub development is more expensive and time consuming. Control systems planning in hub development should be systematically planned to design a robust control network. ■

ABOUT THE AUTHOR

Nishadi Davis, PE, is a member of the ChemPID and an experienced automation engineer with a demonstrated history of working in the oil & energy industry with a new focus on hydrogen and renewable fuels. Strong engineering professional with a Bachelor of Science (B.S.) degree in Chemical Engineering from Texas A&M University. Currently she is a business development manager with Wood, a global consulting and engineering company operating in energy and materials markets

STANDARDS



ISA112: Supporting SCADA System Reliability

By Graham Nasby

The ISA112 consensus-based technical standard identifies and promotes best practices.

When it comes to supervisory control and data acquisition (SCADA) systems, oil and gas industry users and vendors have a need for common terminology, minimum hardware/software specifications, standardized control modes, and other references. The ISA112 standards and reference models provide a common framework that can be used for specifying, designing, pricing, building, and maintaining SCADA systems. This framework helps define how all the disparate parts of a control system can be linked together to form a single system able to communicate machine-to-machine as well as machine-to-human.

The ISA112 standards committee is actively developing a series of SCADA system standards and technical reports to help users in all industries integrate those controls and follow best practices. Established in 2016, the committee now has more than 300 SCADA experts from around the world representing a broad cross-section of roles, industries, and geographies. These members include software and hardware vendors, end users, system integrators, consultants, distributors, and government.

Work on the first ISA112 SCADA systems standard is not fully completed yet, but it is already having a major impact on how SCADA systems are designed, used, and implemented in multiple industry sectors. For example, the majority of the largest water utilities in Ontario, Canada are already using the ISA112 framework for managing large automation projects and SCADA master-planning activities. Many other water utilities, sewerage districts, oil and gas companies, and other organizations are now starting to look at the ISA112 SCADA framework for managing their automation assets. There is a need for this sort of guidance, and ISA112 is actively working to provide it.

The ISA112 committee's role is to develop a series of ISA standards and technical reports that provide guidance for the system design, implementation, operation, and maintenance of SCADA systems. The ISA112 standard is being developed as a "horizontal standard" so that it can be applied to a wide range of industries, including pipelines, water and wastewater, power, oil and gas, and other industries. By having a broad membership from multiple sectors, the committee has an overall goal to provide a set of SCADA best practices to support the overall integrity and reliability of these systems.

Through the committee's leadership, the ISA112 committee has made a conscious choice to encourage active participation of experts from a diverse cross-section of industries from around the world. Of the committee's over 300 members, 75 are active co-authors and the rest are reviewers. As an open committee, the committee welcomes expert members from around the globe. Further information can be found on the committee webpage at www.isa.org/isa112/.

ISA112 committee work to date

Since it was formed, the ISA112 committee has been able to accomplish the following milestones.

- Developing a consistent and inclusive consensus-based definition for what a SCADA system is, which can be used by a wide variety of industries and geographic locales
- Developing a SCADA system management lifecycle diagram, which contains workflows for building, long-term management, operation and continuous improvement of SCADA systems that can be easily applied to small, medium and large sized SCADA installations

Oil and gas companies and others are starting to look at the ISA112 SCADA framework for managing their automation assets.

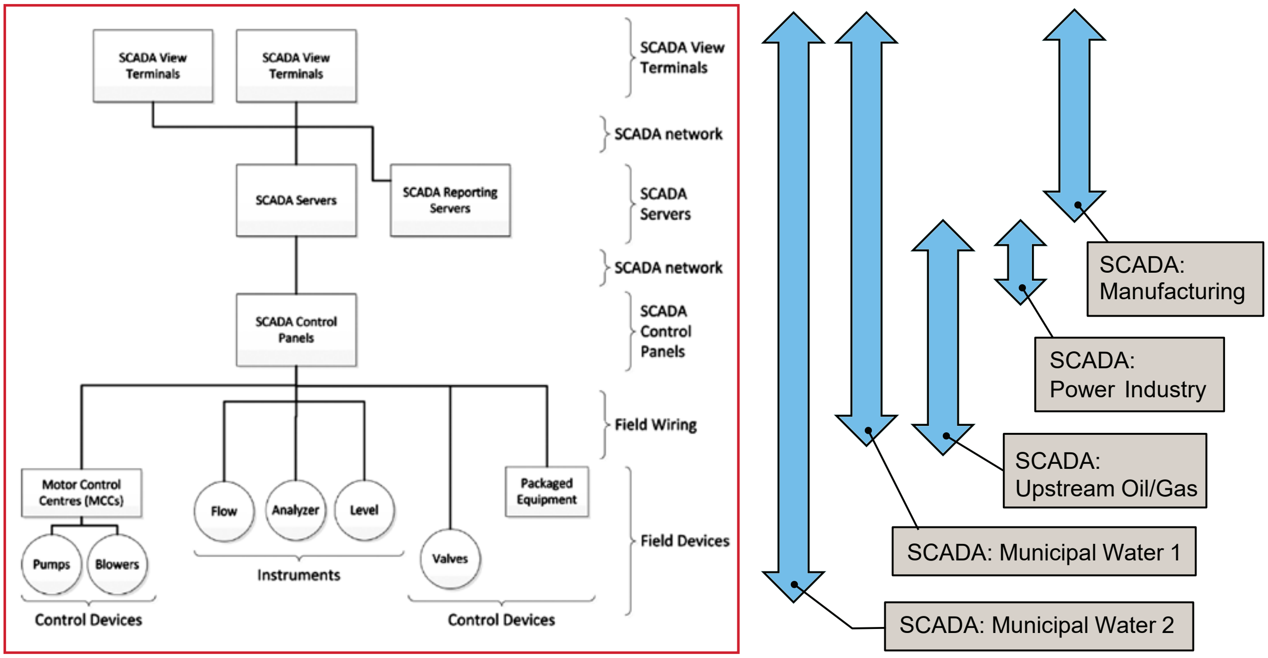


Figure 1. Between different industries, companies, and regions, the definition of what SCADA is can vary widely. Each is correct in its own context, so the ISA112 standard had to take this into account.

- Developing a SCADA Model Architecture diagram that can be applied to a wide range of SCADA technologies, including PLC, RTU, DCS and IIoT based solutions
- Developing more than 800 pages of technical content that is now being assembled into a 3-part published standard and associated technical reports
- The committee is now starting on the formal commenting cycles for Part 1 of the ISA112 standard, which is expected to be published in early 2024. Parts 2 and 3 will follow soon after.

Like all ISA standards committees, the ISA112 committee uses an open, consensus-based process for writing and developing vendor-neutral standards.

SCADA definition: The committee's first significant accomplishment was to reach consensus with an open and inclusive definition of the term "SCADA." Because of the considerable variation in terms of how SCADA systems are designed in various regions, industries, and backgrounds, nailing down consensus on the definition was more of a challenge than originally anticipated. After discussion, the committee adopted the following definition at at a face-to-face meeting on May 5, 2017 in Raleigh, NC USA.

"Supervisory control and data acquisition, or SCADA, is a system that is a combination of hardware and software used to send commands and acquire data for the purpose of monitoring and controlling."

Different industries use the term "SCADA" to mean many different things that are specific to that individual industry. Each of these industries is correct in how it uses the term SCADA within its own context (Figure 1). Taking this into account, the ISA112 committee has defined the term SCADA in such a way that can be applied to a wide variety of industries, each with their unique needs.

Some consider SCADA to be the upper layers of software. Others consider it to be end-to-end, from the field devices to the view terminals. Many others consider it to be somewhere in between. For example, in the municipal water sector the term SCADA is used by regulators to refer to the entire automation system, whereas for many oil/gas applications SCADA is often used to refer to just the software and telemetry systems.

SCADA system architecture: After much debate and consideration, the committee reached a consensus for a common logical architecture that could be used for any SCADA system, regardless of its technology or size (Figure 2). The committee described SCADA in layers. It uses letters for the layers instead of numbers to avoid any potential confusion with the Purdue reference model levels (shown at the right in Figure 2).

The committee's first significant accomplishment was to reach consensus on a definition of the term "SCADA" which could be used by multiple industries.

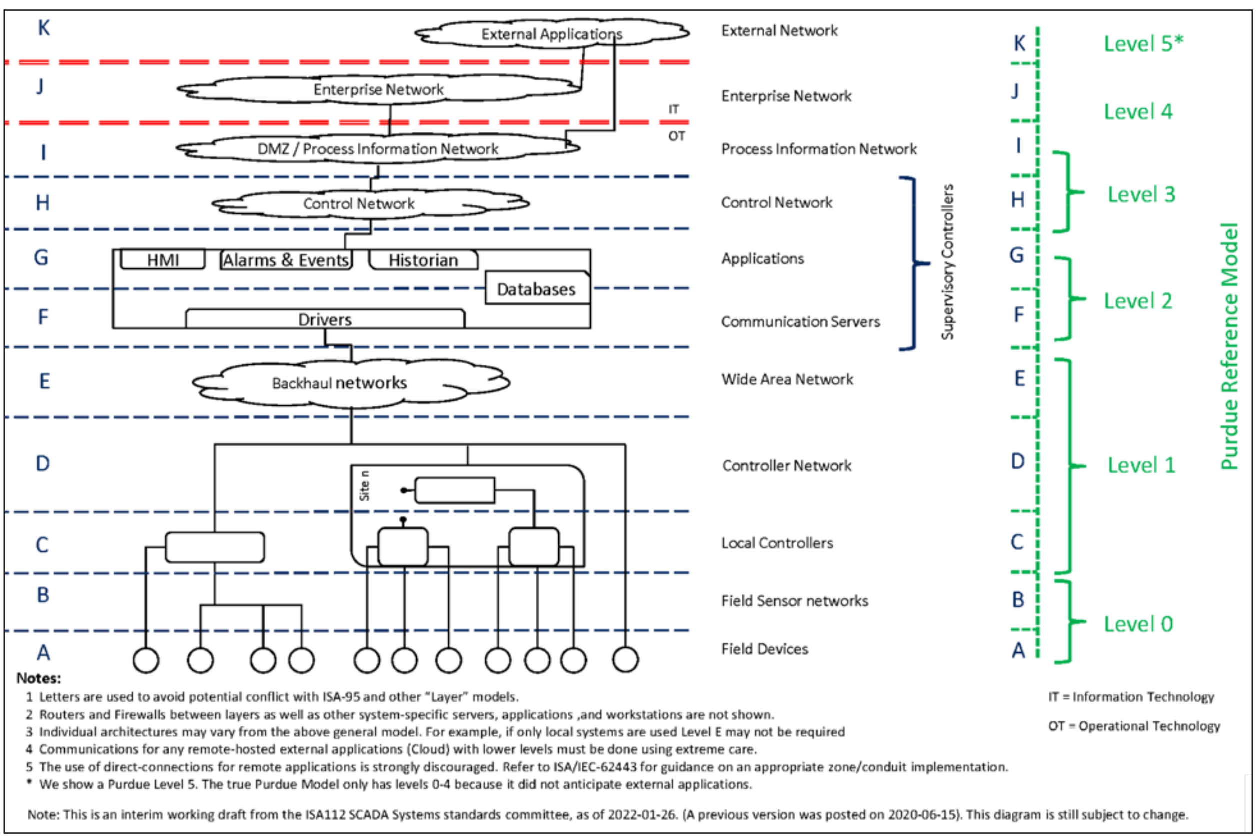


Figure 2. The ISA112 SCADA model architecture diagram is a functional diagram outlining how most SCADA systems are structured, and how this relates to other architectural models.

Looking ahead

The ISA112 committee uses a combination of monthly conference calls, semi-annual face-to-face meetings, and offline work to carry out its endeavors. However, much of the collaboration and face-to-face meetings have only recently resumed after what had been a 3 year hiatus due to the COVID 19 pandemic. Most recently the committee met face-to-face in Galveston Texas in Nov 2022 as part of the ISA's Annual Leadership Conference.

The committee is currently hard at work putting Part 1: SCADA Systems Lifecycle, Diagrams and Terminology through formal commenting rounds, with an aim to go to final ballot in 2023. Part 1 is expected to be published in early 2024. In parallel, the next two parts of the standard - Part 2: SCADA Lifecycle Work Processes, and Part 3: SCADA System Architecture—are on track to be published in 2025 and 2026 respectively. ■

ABOUT THE AUTHOR

Graham Nasby, P.Eng is co-chair of the ISA112 committee and an industry-recognized leader in the OT (operational technology), SCADA, and industrial automation sectors for his efforts in cybersecurity best practices, standards development, alarm management, and operational efficiency. He led development of ISA112 SCADA Management Lifecycle workflow, now used by water/wastewater, electric power, and pipeline utilities across North America. Through his work with ISA, CSA, ANSI and IEC, he has co-authored international standards on systems design, cybersecurity, industrial automation, alarm management, and HMI systems. He is currently Senior Manager—OT Security Architecture for CN Rail.

The Four Pillars of Operator Performance

Elements of operator performance are complicated, so look to standards and best practices to guide improvements.

By David Lee

Operator Performance (OP) is a large topic and can be a very difficult subject to navigate. It is also a subject that is forever evolving. Keeping track of latest best practices and standards can be time-consuming and difficult. This article looks at the various elements of OP and some of the latest initiatives and focus areas relevant to automation professionals.

When I look at OP, I take a holistic view and break it out into four subtopics. I refer to these as pillars, as each, in my opinion, is an important foundation upon which a successful approach to OP is based. The four pillars can simply be stated as:

- Having the right number of people to perform the required tasks
- Ensuring those people are competent to perform those tasks
- Ensuring those people have appropriate tools to perform the tasks
- Having a conducive environment in which to perform the tasks

1. Number of People

The first pillar requires task analysis and workload calculations. Having the correct number of people continues to be perhaps the most challenging aspect of operator performance metrics as there are no standards on how to effectively calculate workload—although there are some recognized proprietary methodologies that are used to do so. However, getting this wrong can have a significant impact on, for example, the number of operator consoles, the size of the control room, and even the control center.

Another part of workload calculations is perhaps better understood: It is the managing of fatigue through hours of service and overtime limits. Fatigue can have an impact on shift schedules and number of shifts and that, in turn, could impact the size and structure of the operations' team. Excellent guidance on fatigue risk management is provided in ANSI/API RP-755.

2. Operator Competency

The pillar relating to competency is one that has been paid a lot of attention to over the last few years. Competency, most often managed through training and development programs, starts all the way back at new-hire selection, when key competencies are defined for each position and then used as an input to the hiring process.

Once operators are hired, these competencies—along with technical skill and knowledge requirements—should be used as the basis of formal, individualized training and development plans. Qualification based certification and periodic requalification are used to maintain competence over time.

The use of a competency-based qualification process also facilitates job progression not solely based on seniority. Using seniority alone is a poor practice that often leads to people working in roles for which they are not suited.

Technology to increase competency and support training of console operators especially, has developed at a pace. There has been a significant Increase in the use of simulation and digital twins, especially as the cost of ownership and maintenance of those technologies has significantly decreased. The use of cloud-based hosting and software-as-a-service licensing structures have helped in this reduction in total cost of ownership.

Key Points to Remember

- Automation team members have important roles supporting operator performance.
- Operator performance requirements affect the design of the control system and control room.
- Automation professionals should be aware of industry best practices related to operator performance.
- Operations and other stakeholder requirements must be considered in control system design.

3. Appropriate Tools

Perhaps the most obvious aid to improved operator performance is the toolset that the operator has. Increased use of more traditional advanced process control (APC) techniques can obviously help keep the process stable, freeing the operator from having to monitor and control complex loops. In some industries, batch control based on the ISA88 standard is prevalent, but increasingly, procedural automation including state-based control is becoming common. A standardized approach to implementation of these systems will soon benefit from the new ISA106 standard. ISA106, *Procedure Automation for Continuous Process Operations*, supports automatically detecting and reacting to process state changes, which is a way to remove workload from the operator while ensuring predictable response to abnormal situations.

As for the operator interface, its alarm management system is still in many cases an ineffective tool when it comes to providing an operator with prioritized, meaningful, and actionable queues to head off abnormal situations. The generally accepted best practices of ANSI/ISA-18.02, *Instrument Signals and Alarms*, provide a sound approach to developing an alarm management strategy. However, many people still stop at reducing normal alarm rates to meet the recommended KPIs and pay little attention to the problem of alarm floods potentially overwhelming the operator. The use of state-based dynamic alarming, to reduce the magnitude of alarm floods, as well as stale alarms, is not a new concept but it is still not common.

Along with the alarm management system, the human machine interface (HMI) is meant to provide the operator with situational awareness. The ANSI/ISA-101.01 standard, along with its technical reports, provides guidance for the implementation of a best practice HMI. The adoption of this standard has been very slow, however, and many companies live with poor design until they need to upgrade their process control system.

Arguably, the biggest impact of ANSI/ISA-101 on the operator is the adoption of its suggested four-level display hierarchy. By providing an effective Level 1 display, typically on a large screen, the operator gets a continuous view of critical operating parameters such that changes—especially those changing towards abnormal—can be easily identified and acted upon.

The use of properly designed Level 2 displays allows the operator to act and see the response to the action in one place, allowing the number of monitors to be reduced to meet good ergonomic practice.

As we look at the design of these levels, and indeed the traditionally P&ID based Level 3 displays, we must get away from earlier lazy practices. We also must start thinking about how we present process information, moving away from simple data to contextual information, to ultimately, simple decision support representations. Radar plots and trends are not the only answer!

An often-overlooked tool is the application of communication technology. This could be as simple as a plant radio or telephone, but increasingly collaborative environments can provide real benefits. There also is a trend toward the use of mobile devices as operator interfaces. Use of these tools and their applications in certain industries where there are no real control rooms, or where the operator is by design mobile, can be game-changing.

4. Operating Environment

Finally, there is the operating environment, which, in many cases, is the control room. Over the last couple of decades, control rooms have been moved out of process areas to safe locations or they've been built to be blast-resistant and otherwise address most safety concerns. However, addressing operator performance in control rooms has not been a consistent consideration. Guidance, in the form of ISO-11064, and even the ISA-RP60 series, has been out there for some time, but still many control rooms are dark, cramped, noisy, and distracting environments. Consoles are often designed without attention to good ergonomic practices, and chairs are an afterthought. More could and should be done to improve this critical pillar.

In conclusion, operator performance is a complicated subject, there are many interacting components that can lead to ineffective solutions. If you are going to spend your hard-earned capital on improvements, plan carefully and look to the standards and best practices to guide you. ■

ABOUT THE AUTHOR

David Lee C.Eng, FIChemE is ChemPID Past Director and Chair of ISA's Standards and Practices Council. David spent 20+ years in industry in automation, project management and operations management. For the last 17 years he has been an automation and operator performance consultant. He is currently a Solution Consultant in Emerson's Industrial Software division.

State-Based Control Solutions for Complex Systems

By Robert Rice and Ziair DeLeon

One producer tamed a difficult level control task, improving test separator performance.

Anyone who has ever worked in the Canadian Athabasca oil sands production fields knows that the term "tar sands" is far more accurate. While oil is ultimately produced, it begins as bitumen, the heavy crude that is almost solid. Extracting it from wells demands steam-assisted gravity drainage (SAGD) techniques where each well is a combination of two drilled holes (Figure 1). One well injects steam to heat and soften the bitumen, separating it from the sand, and the other producer well pumps it out. What results is a mix of bitumen, natural gas, solids, and water. While this process is energy-intensive and expensive, numerous companies are using it and producing a total of about 1.3 million barrels per day across the region.

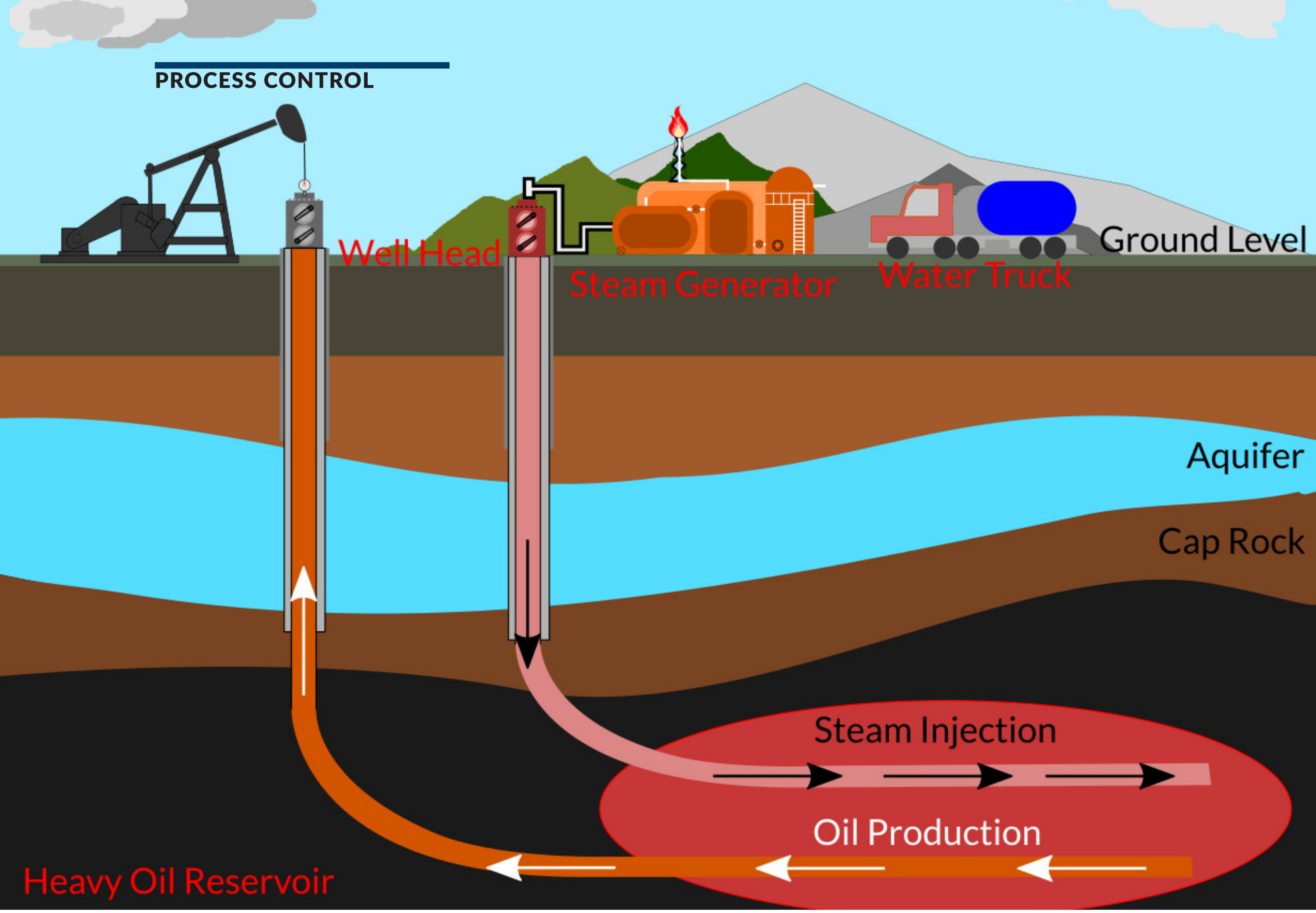


Figure 1: SAGD wells use steam injection to extract thick bitumen, which also contains natural gas, solids, and water.

Most companies engaged in this effort operate large production sites with multiple pads consisting of 10 to 20 well pairs sharing common infrastructure. Since the output of any well is a mix of products and contaminants, multiple steps are required to recover and concentrate the actual crude oil while removing lighter hydrocarbons and contaminants. The first stage of separation combines all the wells into a single stream and removes gaseous compounds so the liquids can be treated subsequently. Later, water and oil are separated. Recovered water is usually treated and reused.

This first separation stage provides the earliest opportunity to evaluate the output from a given well so operators can judge the actual production volume with its proportion

Real-world production facilities rarely present ideal scenarios. They are invariably driven by numerous conditions and interactions, providing impediments as well as opportunities.

of bitumen against water, entrained solids, and contaminants, including undesirable sulfur compounds.

Well output is anything but consistent since bitumen deposits are non-uniform even over short distances. Consequently, different wells, even at the same site or pad, can have much different output. Characteristics of a given well can also change over time as different portions of material liquify and are extracted.

To evaluate individual wells, a much smaller test separator is often used (Figure 2), in conjunction with piping and valve manifolds, so that any one of the wells can be directed by itself to the test separator rather than the collective unit. This allows operators to examine and characterize each individual well, determining the quality and quantity of its output. For a typical operation, the control system might configure each well to the test separator for 12 hours, stepping through each well in sequence.

Controlling level

The test separator is not a grab-sample system. For the 12 hours it is connected to a specific well, production must continue normally, so the flow is continuous. To do its job, a specified level must be maintained in the separator. When working properly, the test separator performs the same task as the main separator, but at a smaller scale and only for one well at a time.

Assuming an example production site with 12 wells, each well would get its time on the test separator every six days. The test separator drum is very small compared to the main

Figure 2: A test separator provides an opportunity to evaluate the output of each well pair individually.

separator, perhaps less than 100 gallons, and it is critical to maintain a consistent level in the drum for it to function properly. Due to difficulties instrumenting this type of flow stream, there is no flow meter on the separator inlet, so the task becomes a basic level loop. Conventional wisdom says creating an effective level loop is difficult under the best circumstances, but this situation introduces additional complications.

For example, when switching wells, there is no way to know what the incoming flow will be. The wells do not produce consistently when compared to each other, nor does any single well produce consistently all the time. When well No. 1 is tested on a given day the level loop may be stable, but the quantity and character of its output will likely be different when it is tested again almost a week later. So how can operators hope to maintain control of the test separator level loop in the face of such chaotic conditions?

Applying loop analysis tools

For the last 20 years or so, control loop performance monitoring (CLPM) tools have been available to help oil refiners, chemical plants, and other process manufacturers improve the interaction of hundreds and even thousands of related PID loops controlling a process. By analyzing operational data, these traditional CLPM solutions identify undesirable PID performance characteristics, facilitate the isolation of root-causes, and even recommend issue-specific corrective actions.

These tools have proven very effective at providing a generalized assessment of controller performance based on in-use data. Unfortunately, they are often limited to a single basic operating condition, generally when the plant is stable and running "normally," whatever that means for the plant or unit.

For the case of test separator level control, the picture is much different than a typical process unit. The biggest difference is the scope of the problem. Instead of hundreds of loops, the operators are concerned with a single isolated level loop for the test separator where tuning parameters need to change every 12 hours and be associated with a unique source. Conventional CLPM tools simply do not apply.

Adding state-based analytics

More sophisticated CLPM tools that have emerged in recent years now incorporate state-based analytics capable of distinguishing a process's many and unique operating states. They develop and apply multiple operating profiles, or operational states, that can be dynamically applied to a control loop's performance metrics. Depending on the operating situation, state-based analytics allows operations staff to gain a more accurate assessment of loop performance as processes shift between different phases of manufacturing, making users better informed and more capable of improving production performance.

States add context to the source data and are configurable based on any combination of operating phases, products, run-time conditions, or other production-related attributes. Even distinct batch sequences can be addressed in this manner.

For our example well site, a more advanced state-based version of CLPM proved ideal for analyzing a control loop with 12 entirely unique operating conditions.

State attributes are determined by the CLPM solution using process and condition data accessed from a plant's data historian, so that state-based analytics techniques can be applied for like-to-like conditions throughout an operation. This makes it possible—based on what state the system is in—to proactively detect negative performance trends and enable users to understand and address issues more precisely, such as variable tuning, operational constraints interfering with effective control, and loop interaction problems.

For the case of our example well site, this more advanced state-based version of CLPM proved ideal for analyzing a control loop with 12 entirely unique operating conditions.

Applying state-based analytics

In this case, because the control system is used to configure the valve manifold to connect a given well with the test separator, it is straightforward to designate 12 unique states. Of course, more states are possible if there are other uniquely detectable conditions. Figure 3 clarifies how this works. It shows a few days of data from the process, with 12-hour periods for several wells. The set point of the level loop during production would normally remain constant for effective separation, although this figure happens to depict setpoint changes that were initiated to characterize the system and generate models used to build the adaptive PID settings. Clearly, the amount of control effort necessary to maintain the set point changes drastically. This may be related to tuning, but also likely instability of well output across the test period.

Analytical results

Prior to Control Station's involvement at the site, there was little differentiation between the level control success of each individual well. When assessing overall performance,

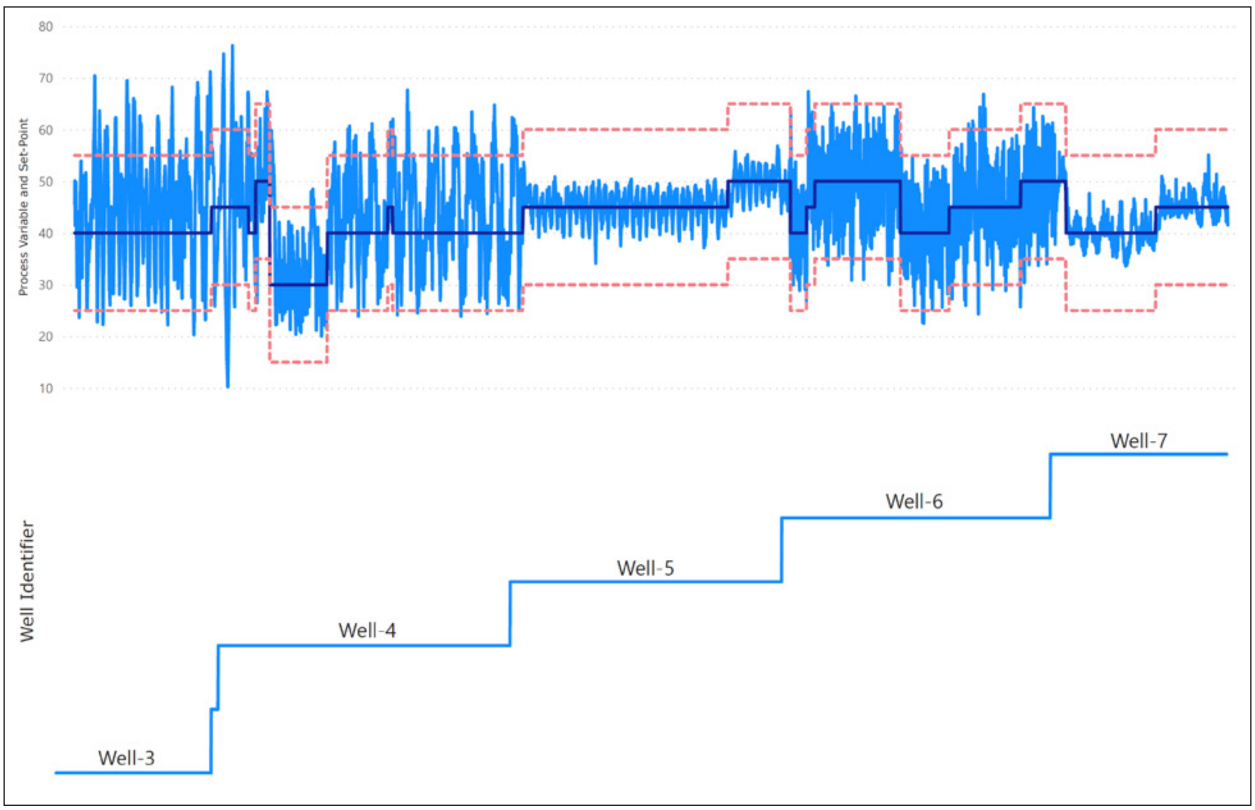


Figure 3: This process data from the level controller shows how it regulated separator output from several different input sources over a period of days, depicting the dramatic change in PID controller conditions and performance based on the state. The top trace shows the level and the PID's set point value. The bottom trace is the sequence ID, or state.

the traditional CLPM approach operated on the aggregated data from many varying states. The assessment included computations related to PID tuning, mechanical performance, and process interaction. But without the ability to distinguish the performance of individual well pairs, the result was a set of values not specifically helpful for any of the states.

The key performance indicator (KPI) in this case was an average absolute error (AAE) value. It is a common assessment of controller performance and quantifies the difference between the set point and measured process variable for a given PID loop. Naturally for a dynamic process such as this application, some degree of variability should be expected and tolerated. Still, any notable increase in AAE generally corresponds with a change that production staff should at least note if not investigate and address.

When data from the test separator process was examined using traditional CLPM capabilities, the AAE (as an overall average calculated across available well pairs) was 4.8. For this operator, the average value was not considered excessive, and seemed to suggest that the controller was performing reasonably well when having to regulate liquid level across so many different well pairs. However, a decent average can hide some truly bad actors.

Once data on individual wells was available using the state-based analysis, it was clear that there were excellent wells with values below 5.0, along with five underperformers well above that value (Figure 4). Determining why those bad actors were so far above the average and solving the underlying problems

State-Based Results (Bypass Test Separator)

BEFORE		AFTER	
WELL PAIR	**AVERAGE ABSOLUTE ERROR**	**WELL PAIR**	**AVERAGE ABSOLUTE ERROR**
WellPair-5	9.21	WellPair-5	4.03
WellPair-6	8.4	WellPair-8	3.45
WellPair-11	8.13	WellPair-11	2.83
WellPair-7	7.59	WellPair-6	2.3
WellPair-9	5.63	WellPair-10	1.93
WellPair-4	3.01	WellPair-9	1.17
WellPair-3	2.82	WellPair-1	0.842
WellPair-1	2.58	WellPair-3	0.749
WellPair-10	1.95	WellPair-4	0.497
WellPair-8	1.93	WellPair-7	0.489
WellPair-12	1.19	WellPair-12	0.312
Average	**4.8**	**Average**	**1.7**

Figure 4: Once it was possible to see an AAE value for each individual well pair, several stuck out as needing attention, and an improved PID control strategy enhanced performance under all conditions.

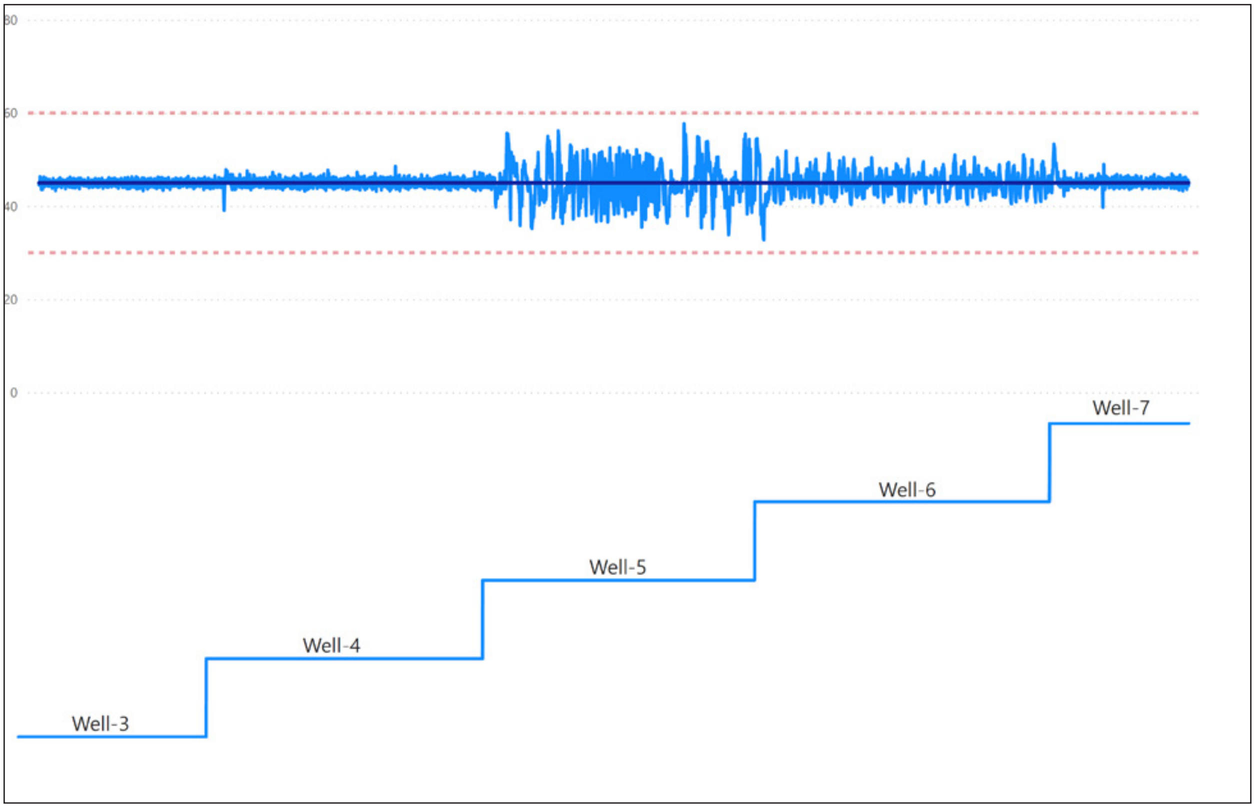


Figure 5: Once the site identified the poorly performing loops, it was possible to modify the tuning parameters for those wells to optimize overall performance of the test separator.

went a long way to optimizing the overall performance of the test separator, and the site as a whole.

Once each well could be treated as its own state, it was possible to implement a PID strategy with gain scheduling to bring the loop under tighter control (Figure 5) for all states, reducing all AAE values below 5.0 and resulting in a much better average value of 1.7. Analysis revealed that there was a reasonably strong correlation between the average flow rate and the recommended controller gain, allowing an improved control strategy to be developed. This stabilizes production during each well's time on the test separator and presents a clearer picture of the output. Analytical tools allow users to "expand" the data to recognize any one state, or they can "collapse" the data to consider averages of one or more states, depending on the need.

Prior to the tuning effort, the end user experienced issues where the separator

By analyzing operational data, traditional CLPM solutions identify undesirable PID performance characteristics, facilitate the isolation of root-causes, and even recommend issue-specific corrective actions.

would exceed alarm limits and cause a unit to trip, so operators ended up babysitting the units more than seemed reasonable. After analysis and subsequent tuning, the system runs more consistently in automatic so far less operator intervention is required, and there are fewer trips.

While traditional CLPM tools have proven helpful in assessing the performance of basic loop operations, state-based analytics is showing particular value within more complex systems. Real-world manufacturing and production facilities rarely present ideal scenarios. They are invariably driven by numerous conditions and interactions, providing impediments as well as opportunities. The combinations of these attributes can be enormous, and the effect of individual combinations on production can be lost within broader trends.

The addition of state-based analytics now makes it possible for CLPM users to delve deeper, facilitating the detection, analysis, and adjustment of operational conditions that had previously stood in the way of plant-wide process optimization. ■

Images courtesy of Control Station

ABOUT THE AUTHOR

Robert Rice, PhD is the vice president of engineering at Control Station. He is Control Station's thought leader, and he has published extensively on topics associated with automatic process control, including multi-variable process control and model predictive control. Dr. Rice has been the recipient of numerous awards for innovation, and for his contributions to the advancement of the process industry. He received his BS in Chemical Engineering from Virginia Polytechnic Institute and State University, and his MS and PhD from the University of Connecticut.

Ziair DeLeon is a field application engineer at Control Station. He is responsible for the deployment, use, and support of Control Station's award-winning portfolio of process diagnostic and optimization solutions. Prior to joining the company, Mr. DeLeon held positions in operations in the State of Connecticut's tobacco industry. He received his BS in Mechanical Engineering from the University of Hartford.

Fundamentals of ISA Standards

By David Lee

One of the questions I get asked most goes along the lines of "I know ISA has a lot of standards, but which ones should I be using?" It's a reasonable question, and perhaps, given the breadth and depth of the standards available, an understandable one. More than 140 ISA committees, subcomittees, working groups, and task forces are involved in ISA standards. Almost 200 standards documents are available from the International Society of Automation (ISA), and more are currently in development.

You will also see many standards referenced as ANSI (e.g., ANSI/ISA-18.2). These are documents that have been adopted by the American National Standards Institute as U.S. national standards. ISA also has some international standards that are developed with the International Electrotechnical Commission (IEC), such as ANSI/ISA-61511-1.

Document types explained

To start with, there are a few different types of documents:

- Standard
- Technical report (TR)
- Recommended practice (RP)

Standards are documents that have mandatory statements such as "shall" that need to be complied with to meet the standard. Technical reports are typically documents that provide guidance on how to use the parent standard. Recommended practices are standalone documents that provide best practices that are encouraged to be adopted. Neither technical reports nor recommended practices have mandatory statements.

Although the lines can be a little blurred, we break down the standards into the following broad categories:

- Process safety
- Instrumentation
- Control
- Networking and security
- Automation
- Business systems

Standards are documents that have mandatory statements such as "shall" that need to be complied with to meet the standard.

Standards categories

Process safety is of paramount importance and there are two significant standards: ANSI/ISA-18.2 and ISA-84.00.01, in this space. ANSI/ISA-18.2 deals with alarm management in the process industries. It also has several technical reports that provide guidance on the application of the standard, including areas such as Batch and Discrete Processing (TR-6) and Packaged Systems (TR-7). IEC 62682, *Management of alarm systems* *for the process industries*, is based on ISA-18.2. ISA84 adopted the IEC 61511 standard, Parts 1–3 , which replaced ISA-84.00.01, Parts 1–3. Similarly, this has technical reports that cover burner management systems (TR-5), fire and gas systems (TR-7), and even cybersecurity for safety systems (TR-9).

Instrumentation provides the foundation of any automation system, and there are several key standards in this category. Perhaps the most basic of these is ANSI/ISA-5.1 providing standards for instrumentation symbols and identification for P&IDs. There is also ISA-51.1 that provides guidance for instrumentation terminology. This standard is a little dated, last updated in 1993, but still contains a great deal of foundational information. Both of these should be in all automation professionals' libraries. Another extremely useful standard is ISA-20, providing standardized specification forms for instruments, primary elements, and control valves. There are also several documents that address hardware specifications, calibration, and testing, such as ISA-75 (valves), ISA-37 (transducers), and ISA-67 (nuclear).

Building on the instrumentation layer is the **control** system itself, and there are important standards that deal with this. The first of these are the other standards in the ISA5 series dealing predominantly with the documentation of control logic along with instrument loop diagrams (ISA-5.4—who knew there was a standard for this?) and graphic symbols for process displays (ISA-5.5). The latter is somewhat dated, although still relevant, but has been partially replaced by ANSI/ISA-101.01, and its technical reports, providing guidance for the human-machine interface (HMI) for process automation systems. This standard has also been provided as the basis for the future IEC63303. There is also a series of standards and technical reports under ISA77, which deals with fossil fuel plant controls and with documents relating to controls, simulation, testing, and HMI. There is also a set of recommended practices, ISA-RP60-x, that provides guidance on control center design. These documents are more than 30 years old, and we are looking to reform the committee to create a new control room standard.

In the **network and security** category there are three important standards. The first is ANSI/ISA-100 which deals with wireless systems. The second is the set of standards dealing with cybersecurity, previously ISA99 are now ANSI/ISA-62443-x. These are extremely important standards and are foundational to ISA's cybersecurity training and certification and ISASecure system certification. Lastly there is the set of ANSI/ISA-62453 standards dealing with field device interface specifications.

The next category deals with **automation**, and there are two very important standards in this space. The first is the ISA88 set of documents that provides a framework and guidance for batch control systems. The second is the ISA106 set that similarly provides guidance for procedural automation for continuous process operations, for example state-based control. The parent ISA-106 standard is due to be released very shortly. A third standard that we are eagerly awaiting the publication of is ISA-112. This standard will provide much needed guidance for the implementation of supervisory control and data acquisition (SCADA) systems.

The final category concentrates on the **business systems**, especially the integration of enterprise level and control system level. There is only one set of standards in this space, ANSI/ISA-95, but it consists of nine separate documents. As we look at recent trends in digital transformation and integration of business and control systems, this set of documents provides guidance for informational transactions between the various software components.

Final thoughts

Hopefully this article has helped identify some standards that you can use in your jobs. These are all for sale on the ISA website, but one of the great member benefits is that you can view all ISA documents, with the exception of some IEC documents, online. Another service that ISA provides relating to standards is to help users with expert interpretation of standards. If, as you try to apply an ISA standard, you are struggling with how to interpret a requirement or recommendation, we have experts who can provide an official interpretation.

Lastly, standards are developed by volunteers; we are always looking for volunteers to participate in these activities, the S&P board or specific committee chairs would love to hear from you. ■

ABOUT THE AUTHOR

David Lee C.Eng, FIChemE is ChemPID Past Director and Chair of ISA's Standards and Practices Council. David spent 20+ years in industry in automation, project management and operations management. For the last 17 years he has been an automation and operator performance consultant. He is currently a Solution Consultant in Emerson's Industrial Software division.

ISA Announces 2023 Global Event Schedule

ISA has set the dates for its 2023 global events, each with virtual access to select sessions. Attendees will benefit from experiences with renowned experts and presenters, hear firsthand about the latest technologies and trends, and gain access to high-value, peer-reviewed technical content.

Online registration opens soon for all conferences.

OT Cybersecurity Summit—Scotland

May 31–June 1, 2023

Cheri Caddy, deputy assistant national cyber director at ONCD/the White House and Megan Samford, VP, chief product security officer at Schneider Electric will be keynote speakers for this brand new event. The OT Cybersecurity Summit will focus on the leading international standards and conformance systems that are being used to keep operational technology (OT) safe and secure in industries such as energy, manufacturing, building automation and more. New developments within the ISA/IEC 62443 standards series will be highlighted and technical training and certification programs designed to help you implement the standards into your business operations and workforce will be reviewed. Professionals involved in the security process should attend this event to learn more about workforce development strategies, hardware and software protection practices, and ways to improve infrastructure and data security measures.

Digital Transformation Conference—Brazil

September 2023

This second annual event will take a deeper dive by going beyond the need for effective cybersecurity to keep up with the increasing pace of digital transformation within the industrial automation field. It will explore the development of a smart manufacturing center of excellence that targets the digital landscape as it continues to evolve. This event will provide a platform for sharing ideas and solutions to address the unfolding issues resulting from rapid technological growth across multiple industries in critical infrastructures such as oil/gas, chemical, water and power generation.

ISA Automation & Leadership Conference—USA

October 4–6, 2023

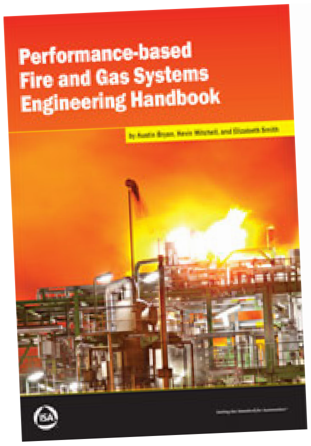
The ISA Automation & Leadership Conference (ALC) is the automation event of the year—combining ISA's leadership conference with the best technical presentations from ISA's automation conference series into an unparalleled event experience. This multi-day technical and leadership conference and exhibition will bring together a global audience of automation managers, engineers and technicians who want to stay abreast of trending industry topics focused on digital transformation, cybersecurity, IIoT, smart manufacturing and process automation. It will provide attendees with access to an array of subject matter experts from the US, Middle East, Brazil, Malaysia, and India—and will offer the best-of-the-best content and ultimate networking opportunities in a fun, interactive format.

Digital Transformation Conference—Asia Pacific

November 2023

This third-annual event will bring together subject matter experts to share end-user case studies and firsthand experiences on how to optimize core assets in acceleration towards energy transition and industrial sustainability through digital transformation. An in-depth program will explore how oil producer companies leverage machine learning, data analytics and IIoT technologies to streamline operations, improve life-of-field production, and increase HSSE across the region. ■

Design of Fire and Gas Detection Systems for Process Industries



With the release of the ISA-TR84.00.07 technical report on performance-based design of fire and gas detection systems for process industries, risk-based techniques for detector placement have become prevalent in fire and gas system (FGS) design. While the technical report addresses designing the FGS based on the user's risk profile and performance requirements, it does not provide any guidance on implementing the FGS lifecycle.

The *Performance-based Fire and Gas Systems Engineering Handbook* by Austin Bryan, Elizabeth Smith, and Kevin Mitchell provides a thorough overview of the FGS design lifecycle presented in the technical report. It examines each phase of the lifecycle and describes practical activities required to develop an FGS design. In addition to discussing the design process, this handbook also provides appendices that contain data for FGS system risk analysis, FGS risk grading procedures, and a discussion of the FGS mapping techniques used to verify the achievement of the newly defined coverage targets.

Find out more about the book from one of the authors. The book is available for purchase on the ISA website. ■

ISASecure Announces Site Assessment Program for OT Cybersecurity

This month, the International Society of Automation (ISA), along with the ISA Security Compliance Institute (ISCI), has announced its intention to create an all-new conformity assessment scheme for automation systems deployed at operating sites—a critical and long overdue addition to the landscape of operational technology (OT) cybersecurity solutions.

Based on the world's only consensus-based automation and control systems cybersecurity standards—ISA/IEC 62443—the OT cybersecurity site assessment scheme will apply to all types of automation and control systems in industries ranging from traditional process industries to critical infrastructure such as oil and gas, chemicals and water/wastewater.

Suppliers have broadly adopted the leading international standard for OT cybersecurity, ISA/IEC 62443, as well as its certification scheme, ISASecure, for commercial off-the-shelf (COTS) automation and control system products and supplier's security development practices. ISASecure recently released an IIOT component and gateway certification program (ICSA) to remain current with new technology advances. However, asset owners and plant managers have yet to coalesce around a single cybersecurity assessment scheme for OT deployed at operating sites, relying instead upon a patchwork of third-party specifications that may not promote industrial control system (ICS) security best practices, leaving operating sites vulnerable.

"The proposed site assessment scheme will have a critical role in the OT cybersecurity landscape—the automation systems at the operating site itself," said Brandon Price, ExxonMobil senior principal engineer for ICS Cybersecurity and current ISCI Board Chairman. "This standards-based program is unique, and we anticipate it will become the global standard used by operating sites, certification bodies, internal auditors and public policy makers."

The program will encourage the broad industry adoption of the ISA/IEC 62443 operating site cybersecurity standards and best practices. ISA and ISCI plans include building and overseeing a related training and credentialing program for site assessors. ISA and other training organizations already offer training for the ISA/IEC 62443 operating site standards.

"We are inviting companies who are interested in supporting and promoting this program to participate; particularly end-users whose support is critical to this program's success. Supporters may participate in specification development, provide funding, or simply provide public support," said Andre Ristaino, managing director of ISA Consortia and Conformity Assessment Programs.

"We anticipate a development schedule of 12-14 months and expect to formally launch the program in Q4 2023 or early 2024," said Ristaino.

An informational webinar was held on 28 February. Visit the website for more information. ■

ISA Wins Two Awards for its Conference

The 2022 ISA Automation & Leadership Conference has won first place in two categories at the annual vFairs Eventeer Awards: Best in Class Hybrid Event and Best Use of Mobile App. The event was also a runner up in the Best Use of Gamification category.

The Eventeer Awards showcase the best events hosted on the vFairs platform throughout 2022—a total pool of more than 2,000 events with over 10 million attendees worldwide. Nominations for these awards were open to public voting, and winners were determined based on the highest number of votes received.

"We are honored to be recognized for the ISA Automation & Leadership Conference—our Society's flagship annual event," said Claire Fallon, ISA executive director. "From its high-caliber speakers and technical content to the excellent networking opportunities for automation leaders and sponsors, our 2022 conference marked a triumphant return to in-person events. Making that experience just as strong for our virtual attendees the world over was a huge priority for our events team, and we are honored to be recognized for the high quality of ISA events. ■

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Interview with ISA Fellow Nick Sands

By Jack Smith

Nick Sands was elevated to ISA Fellow in 2012 for his work in alarm management and safety systems. He has worked for DuPont for more than 32 years, all in automation roles, and is currently a Senior Technology Fellow as well as the company subject expert for safety instrumented systems (SIS) and alarm management. He was the co-chair of the ISA18 committee from 2003 until 2022.

InTech asked Sands to elaborate on his automation career, experience with ISA, thoughts on becoming a Fellow, and automation challenges.

"My advice is to be ready to say yes when the opportunity comes and to put in the work to make it successful. And then repeat."
—Nick Sands, ISA Fellow and member of ChemPID

InTech: How did you get involved in automation?

Nick Sands: It started when I worked as a co-op at Tennessee Eastman. The company had a great program, with many different types of assignments. My first was in the manufacturing information systems group and I learned that computers ran the chemical plant. That was it. Since there was no automation engineering program at Virginia Tech, I took all the courses I could that were related to automation in the chemical engineering, chemistry, and electrical engineering departments. I was going to be an automation engineer.

InTech: How did you get involved with ISA?

Sands: I joined the local ISA section in Victoria, Texas when I started working after graduating from Virginia Tech. The senior engineers encouraged me to join ISA and the meetings were fun, educational, and social. A few years later, I wrote a paper and submitted it to the Chemical and Petroleum Industries Division (ChemPID) for the conference with the ISA Expo. That was an amazing experience and opened my eyes to how important ISA was (and is) to the automation industry. I was hooked. The people from ChemPID were welcoming and I've been a member of the division ever since.

InTech: What advice do you have for ISA members seeking to become ISA Fellows?

Sands: It's important to highlight that ISA Fellow is a membership grade awarded for impact on automation and not for service to ISA. ISA does provide many opportunities to develop expertise and to make an impact. Participation in divisions and especially standards committees let you interact with experts and become an expert. ISA conferences and InTech let you share knowledge and experience to help others on their journey, creating an impact.

The ISA18 standard committee's effort on the first global alarm management standard, ISA-18.2-2009, was that type of experience for me. I had no idea going in how that one effort would change my career, from the many friends to the papers and presentations, to the implementation in my company. So many new opportunities opened over time.

My advice is to be ready to say yes when the opportunity comes and to put in the work to make it successful. And then repeat.

InTech: What do you see as the greatest challenge in automation today?

Sands: One of the biggest challenges is that of developing and maintaining automation competency in manufacturing, in my view from working in manufacturing. Automation competency is a wide scope. It includes instrumentation, programming, safety systems, alarms, human-machine interface (HMI), control theory, networking, integration, security, and performance of all the parts. The challenges include the range of technologies, with many that are obsolete, the reduced staffing at plants, the retirement of many knowledgeable resources, and the continued lack of an automation engineering program in many countries, like the U.S.

The solution probably has many parts and should be sustainable. Competency goes beyond training to practice and eventually to expertise. ISA and many future ISA Fellows have a role to play. ■

ABOUT THE AUTHOR

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

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