July/August 2019

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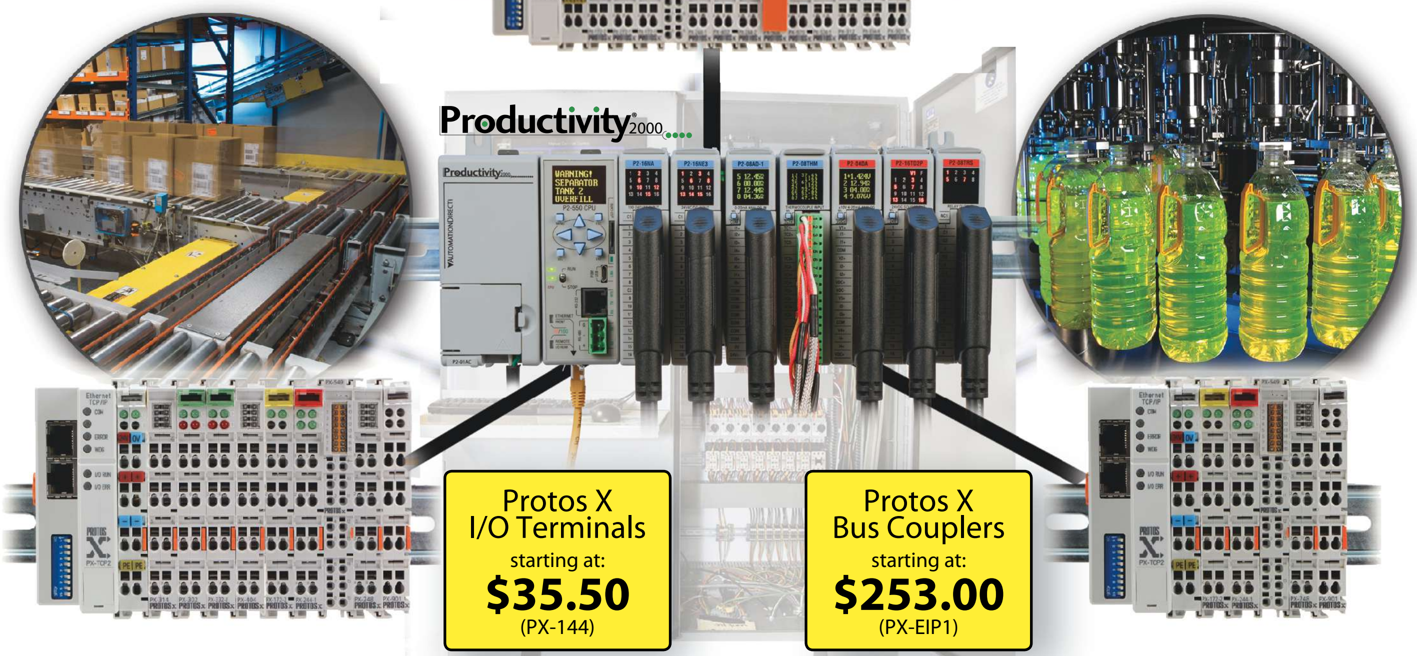

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InTech provides the most thought-provoking and authoritative coverage of automation technologies, applications, and strategies to enhance automation professionals' on-the-job success. Published by the industry's leading organization, ISA, *InTech*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

Professional preparation for technology-driven shifts

By Renee Bassett, *InTech* Chief Editor

No matter your industry, your age, or the particular type of industrial automation you immerse yourself in day-to-day, I have an important question to ask: How are you preparing your professional self for the technology-driven shifts happening all around you?

The need for lifelong learning is real, and "the pace of change is accelerating at the exact same time that people's work lives are elongating," says author, speaker, and work strategist Heather McGowan. Through her think tank called Work to Learn, McGowan talks about how, in the third industrial revolution, "we learned (once) in order to work, but now in the fourth industrial revolution, we will work in order to learn (continuously)."

How are you staying on top of technology-driven shifts and helping your professional self absorb the changes?

Now, "work tasks as we knew them in the past have become *atomized*, broken into job fragments that can be done anywhere around the world; *automated*, achievable or solvable by computerized technologies; and *augmented* [with] technologies that extend the human physically or cognitively," McGowan says. So, I ask you: How are you staying on top of technology-driven shifts and helping your professional self absorb the changes?

One way, of course, is with this magazine, the official publication of the International Society of Automation. I am happy to be the new chief editor of this almost-70-year-old publication, as well as a new collaborator in the development of other professional tools that ISA provides. (Former chief editor Bill Lydon remains; his column is now The Final Say.) From leadership training courses to technical certifications to automation standards and best practices, ISA provides the greater automation community with ways to identify, evaluate, and apply important new technology.

An important new way ISA is doing that has just been announced: The ISA Global Cybersecurity Alliance brings together end-user companies, control system vendors, IT and OT infrastructure providers, system integrators, and others to participate in an open, collaborative forum designed to advance industrial control system (ICS) cybersecurity awareness, readiness, and knowledge sharing.

Industrial sectors covered by the alliance include manufacturing, commercial buildings, and critical infrastructure facilities.

In this issue of *InTech* magazine, you can learn more about other industrial automation technology. The cover story describes how artificial intelligence applications are using the data being gathered by IIoT devices to enable better decision making. Elsewhere, learn about how acoustic monitoring systems enable predictive maintenance improvements, or how chemical plants go beyond spreadsheets to analyze data in new ways.

As contributing editor Bill Lydon says, "There have been times in history when there were radical changes in technologies and methods that transformed industries, creating winners and losers. At each stage, those that adopted appropriate new technologies and methods became winners, and the others were losers. In this environment of change, automation professionals who can sort out fact from fiction and hype from reality are important."

Finding the right tools and resources to help with that sort is important too. I'm glad you found us. ■

ISA Global Cybersecurity Alliance debuts

ISA, which developed the ANSI/ISA 62443 series of automation and control systems cybersecurity standards adopted by the International Electrotechnical Commission and endorsed by the United Nations, has created an open, collaborative forum to advance cybersecurity awareness, readiness, and knowledge sharing.

Industrial sectors, including manufacturing, commercial buildings, and critical infrastructure facilities, need to explore new ways to better prevent, mitigate, and respond to catastrophic threats and attacks on their safety- and mission-critical assets, operations, and applications. The ISA Global Cybersecurity Alliance will bring together a global group of stakeholders from end-user companies, control system vendors, information technology (IT) and operational technology (OT) infrastructure providers, system integrators, and others affiliated with global industry.

"Several leading automation and other technology providers have engaged ISA to explore how they can work with us to proactively increase awareness and adoption of cybersecurity best practices, standards, and compliance in all relevant sectors," said ISA executive director Mary Ramsey. "As an independent nonprofit organization dedicated to improving operational excellence, ISA is uniquely able to fulfill the need for open, collaborative discussions and knowledge sharing."

Among its defined objectives, the Global Cybersecurity Alliance will work to proliferate adoption of and compliance with global standards. The acceleration and expansion of standards will help address technology-related gaps and set best practices for managing processes within an open architecture, said Ramsey. The Alliance will also develop certification and education programs for industry professionals, drive advocacy and thought leadership, and facilitate new levels of knowledge sharing among its members. Member companies will identify and prioritize initiatives, ensuring that the alliance's approach is multifaceted.

"The ICS cybersecurity threat landscape is becoming more complex, with more direct attacks on control system, IT, and OT infrastructure," said Larry O'Brien, vice president of research for ARC Advisory Group. "Frequently backed by hostile nation-states, malevolent actors are becoming more sophisticated at targeting specific aspects of industrial control systems that have the potential to wreak havoc in the physical world, such as process safety systems. Standards and frameworks are valuable, but end users also need the resources to take the guidance provided by standards and put it into practice in real-world plant and OT environments. ARC applauds this effort to increase the security of industrial facilities."

ISA plans to announce the initial members of the Global Cybersecurity Alliance in late July, and end users, companies, and industry organizations are invited to join. For more information, visit https://isaautomation.isa.org/cybersecurity-alliance. ■

In memoriam

Louis Grover Good, former ISA president and lifetime member of The Instrument Society of America (now The International Society of Automation), and The American Society of Mechanical Engineers, died on 7 July 2019. He was 97 years old.

Born 7 August 1922 in Glen Alum, Mingo County, W.Va., Good served as ISA regional vice president, vice president, and treasurer, before becoming president in 1981. He also was elected a Fellow in The British Institute of Measurement and Control. After President Nixon opened the door to China, Good led a delegation of engineers to meet with The Chinese Instrument Society with a goal of technology exchange.

Good served in the U.S. Army during WWII in England, France, and Belgium and was honorably discharged in 1946 with the rank of first sergeant. During his tour of duty, he invented a multistage orifice flowmeter used for fuel flow measurements by the U.S. Army's Armored Tank Division to ready tank performance for desert and artic conditions.

Good graduated from Virginia Tech in 1948 with a degree in mechanical engineering. He also attended West Virginia University, the University of Kentucky, and did graduate work at Northwestern University.

Good was formerly employed by the North Carolina Pulp Co. in Plymouth, N.C. as an instrument engineer, and later became vice president of Panellit Service Corp. in Skokie, Ill. He founded Systems Service Corp. and Control Industries of Charlotte, N.C. in 1961. He also founded Good Equipment Company in Marion, N.C., and Hickory, N.C. He retired in 1989. His hobbies were playing bluegrass music, hunting, and fishing.

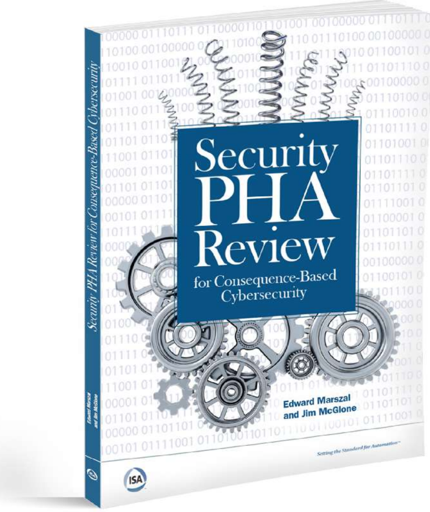
Good, preceded in death by his wife of 69 years, Helen Mae Bailey Good, is survived by a son, daughter-in-law, daughter, son-in-law, and numerous grandchildren and great grandchildren. Donations in his memory can be made to Tragedy Assistance Program for Survivors, Inc. (TAPS). ■

New ISA book identifies 'hackable scenarios' to protect against industrial cyberattack

Today's industrial automation and control systems deliver much-improved performance and features compared to their analog counterparts, but also come with more vulnerability to cyberattack. *Security PHA Review for Consequence-Based Cybersecurity* is a new book published by ISA that provides an easy-to-follow, cost-effective methodology for safeguarding critical infrastructure and process industry facilities from cyberwarfare and other forms of cyberrisks.

The book illustrates how a security process hazards analysis (PHA) review identifies hackable scenarios, ranks them appropriately, and pinpoints nonhackable safeguards, such as relief valves and current overload relays, that are not vulnerable to cybersecurity threats. It was written by Edward Marszal, PE, and James McGlone, two globally recognized experts in process safety, industrial cybersecurity, and the ISA/IEC 62443 series of industrial automation and control systems security standards.

McGlone says he and his co-author were prompted to write the book because "industry and cybersecurity practitioners



are still unsure of what to do and why. The prevailing approach in industrial cybersecurity focuses on network devices such as computers, Level 3 switches, and firewalls instead of on the processes and machines that could be damaged or cause damage if control is lost," he says.

By analyzing the cause of and safeguards for cybersecurity weaknesses, it is possible to determine consequences, says McGlone. "Any consequence that is not protected by existing safeguards or that can be caused by a cybersecurity attack is assigned an ISA/IEC 62443-based security level target to be implemented, or it is assigned an alternative safeguard or redesign to eliminate all or some of the cybersecurity risk," he explains.

Focusing on hazard and operability study designated scenarios, it is possible to identify hackable scenarios, rank them appropriately, and design nonhackable safeguards, such as relief valves and current overload relays that are not vulnerable to the cybersecurity threat vector. "Where inherently secure safeguard design is not feasible, the appropriate cybersecurity countermeasures must be deployed," says McGlone.

The modifications or redesign may involve choosing a different type of technology to remove the cyberattack vulnerability. In many cases, the fix involves "a device with a spring or gear instead of a microprocessor," he adds. For more information or to order the book, visit www.isa.org/securitypha. ■

Process Industry Conference focuses on oil, gas, chemical company challenges

The best and brightest minds in the process industries will return to Houston this fall to present solutions to the most pressing challenges in energy processing and process manufacturing. ISA's 2019 Process Industry Conference will be held 4–6 November at The Westin Houston Memorial City. It is designed for engineers, automation professionals, business owners, and others in the midstream and downstream sectors of the oil, gas, and chemical industries.

This year's event has been expanded to deliver more comprehensive technical content and best-practice advances, particularly in the areas of instrumentation/control; cybersecurity and safety systems; open architecture and infrastructure; and operational improvement.

ISA is proud to have representatives from the following organizations participating as part of this year's event. Each entity will be providing sessions and subject-matter experts unique to their missions:

- The Society for Underwater Technology (www.sut.org)
- The Open Process Automation Forum (www.opengroup.org)
- The Center for Operator Performance (www.operatorperformance.org)

Early bird registration discounts and special hotel rates are available. To register or find out more information, visit the conference website, https://isaautomation.isa.org/pic2019/#about. ■

IoT and industrial AI:

Mining intelligence from industrial things

By Renee Bassett

FAST FORWARD

- If you are deploying IoT, deploy AI with it. Each has value alone, but they offer greater power when combined.
- Industrial AI applications fall into three categories: AI for assets, AI for processes, or AI for operational excellence and/or business agility.
- When starting a pilot project, aim for fairly soft outcomes and focus on worker augmentation, not worker replacement.

Here's how to understand what industrial AI can do, how IoT feeds it, and how to start a pilot project of your own

By Renee Bassett

There is nothing "artificial" about the intelligence that can be gleaned from the detailed monitoring of machines, processes, and the people who interact with them. Ever since the time and motion studies of the efficiency experts of the early 1900s, industrial engineers have been turning real-time data into information and decisions that could improve productivity, efficiency, and profits. With the fourth industrial revolution upon us now, artificial intelligence (AI) technology is ready to go to work in ways that are not always obvious.

According to a Gartner Group forecast, *The Business Value of Artificial Intelligence Worldwide, 2017–2025,* AI and Internet of Things (IoT) "already work together in our daily lives without us even noticing. Think Google Maps, Netflix, Siri, and Alexa, for example. Organizations across industries are waking up to the potential. By 2022, more than 80 percent of enterprise IoT projects will have an AI component—up from less than 10 percent today" (2018).

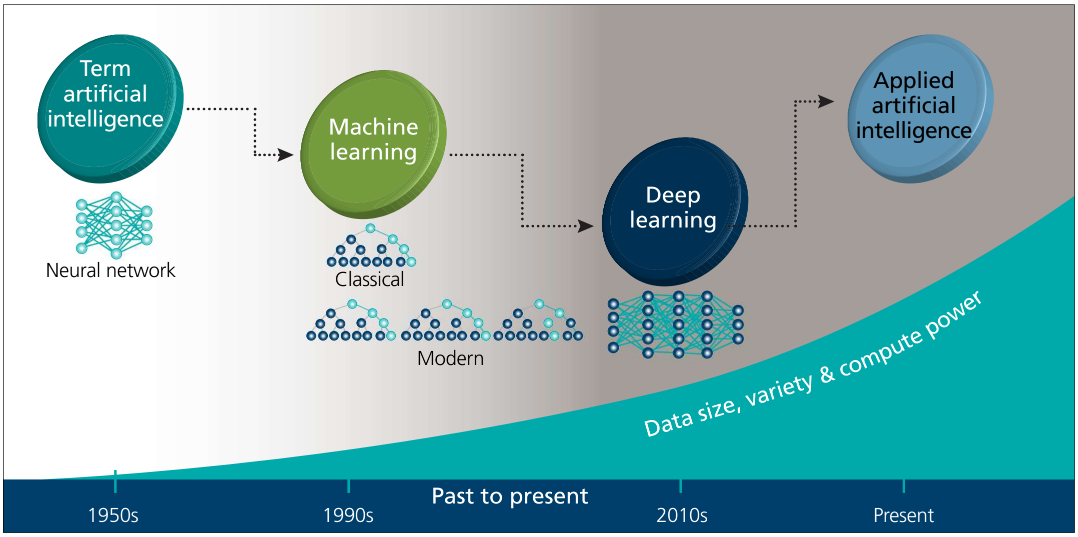
The takeaway is clear, says data analytics software provider SAS: "If you're deploying IoT, deploy AI with it. If you're developing AI, think about the gains you can make by combining it with IoT. Either one has value alone, but they offer their greatest power when combined. IoT provides the massive amount of data that AI needs for learning. AI transforms that data into meaningful, real-time insight on which IoT devices can act."

AI and machine learning

Artificial intelligence uses a variety of statistical and computational techniques and encompasses a number of terms. Machine learning (ML), a subset of AI, identifies patterns and anomalies in data from smart sensors and devices without being explicitly programmed where to look. Over time, ML algorithms "learn" how to deliver more accurate results.

Because of this learning, "ML outperforms traditional business intelligence tools and

AI evolution timeline



AI, around since the 1950s, is becoming a mainstream application as a result of the explosion in IoT data volume, high-speed connectivity, and high-performance computing.
Source: SAS

makes operational predictions many times faster and more accurately than systems based on rules, thresholds, or schedules," according to SAS. "AI separates signal from noise, giving rise to advanced IoT devices that can learn from their interactions with users, service providers, and other devices in the ecosystem."

"The challenge is that people have not developed the level of trust in artificial intelligence and machine learning that they have in other technologies that automate tasks," says Oliver Schabenberger, COO and CTO of SAS. "People sometimes confuse automation with autonomy, he adds. But have no fear: "AI does not eliminate the need for humans, it just enables them to do their work more effectively," he says.

Defining AI applications

Industrial AI can range from low-intelligence applications like automation to higher-end intelligence capable of decision making. It can also be controlled centrally or distributed across multiple machines. According to Gartner vice president and analyst Jorge Lopez, AI applications can be broken down into five levels of sophistication:

> "The speed of advancement in the industrial AI/ML space over the last three years affords a unique advantage to newcomers."

- **Reactors** follow simple rules but can respond to changing circumstances within limits (such as basic drones).
- **Categorizers** recognize types of things and can take simple actions to deal with them within a controlled environment (warehouse robots).
- **Responders** serve the needs of others by figuring out questions and situations (driverless cars, personal assistants).
- **Learners** gather information from multiple sources to solve complex problems (IBM Watson, wholly automated military drones).
- **Creators** initiate a paradigm shift, such as inventing a new business model. They are not merely tools that people use; they have the potential to engineer actions harmful to humans. They will change humans' relationship to technology as well as people's roles within society and the economy, says Gartner. Therefore, "AI creator applications require profound thought before development."

These five artificial intelligence models have three types of organization, says Gartner: standalone, federation, or swarm. A standalone AI system is an individual entity that acts by itself to solve problems. The enterprise exercises centralized control over it by overseeing the entity as it performs.

In a federation structure, says Gartner, multiple versions of an entity work in the same way but on different problems (e.g., robo-advisors, personal assistants). The enterprise can exercise central control or give more autonomy to the entities. In a swarm structure, multiple entities work together on the same problem (e.g., Intel light show drones, Perdix drones). Control over execution is left to the machines entirely or requires only light human management.

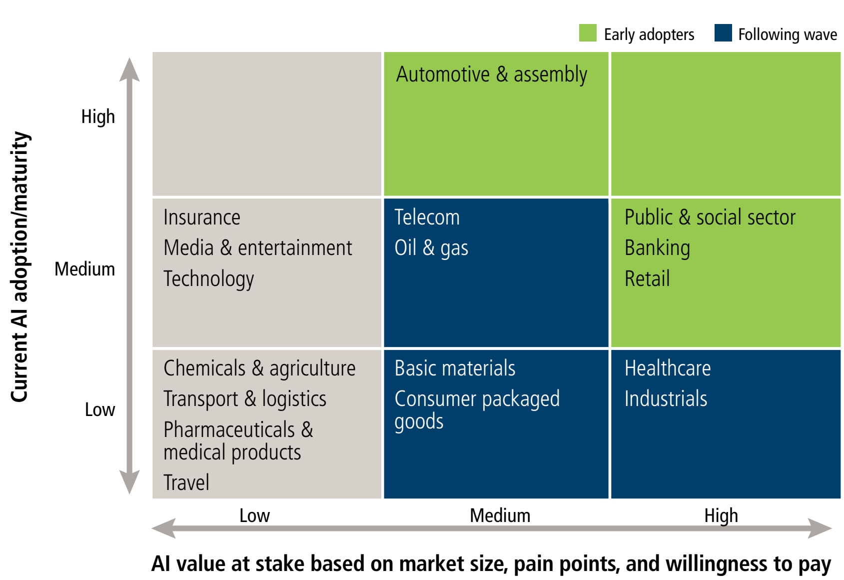
More than automation

The most common place to start with AI is with automation, but experts say it is a mistake to stop there. The more powerful use of AI is to aid human decision making and interactions. Because AI can classify information and make predictions faster and at higher volumes than humans can accomplish on their own, those terabytes of data being produced by industrial IoT devices are being transformed into powerful tools today.

In a recent blog post for industrial AI startup Petuum, author Atif Aziz says, "Some industry leaders are zooming past the basics: digitization, cloud infrastructure, monitoring and dashboards. They are putting newly acquired data to good use through AI-driven advanced analytics (e.g., uncovering patterns through system of systems) and automating complex processes. Some early adopters are implementing as many as 100 digital transformation initiatives simultaneously or using AI to automate their core production processes across 30 or more plants," Aziz says.

On the other end of the spectrum, "some folks still need to understand how AI can provide real value and balance the ROI with their limited

AI adoption maturity, by industry



Early AI adopters like retail and banking firms have reaped the benefits of AI, but it is not too late for fast followers, according to Petuum. AI has caught the attention of industrial innovators and naysayers alike.
Source: McKinsey & Company

resources," says Aziz. "The breakneck speed of advancement in the Industrial AI/ML space over the last three years affords a unique advantage for these newcomers. They can skip many of the expensive intermediate steps (e.g., significant investments in data aggregation infrastructure, dashboards, and monitoring centers) and gain the same AI benefits as the savvier early adopters."

Aziz says most industrial AI initiatives fall into three categories. AI for assets includes equipment automation, equipment stabilization, and equipment health. AI for processes includes yield maximization through efficiency gains, automation and stabilization across multiple assets or spanning multiple flows, and quality improvement. AI for operational excellence and/or business agility includes energy cost optimization, predictive maintenance, logistics and scheduling, research and development, and more.

AI for assets

IBM Watson IoT helps organizations make smarter decisions about asset management by combining IoT data with cognitive insights driven by AI. IBM's Maximo enterprise asset management (EAM) system uses Watson IoT technology to make better decisions about critical physical assets in industrial plants—whether they are discrete machines, complex functional asset systems, or human assets.

One Maximo user, Ivan de Lorenzo, is outage planning manager for Cheniere Energy, a Houston-based liquefied natural gas producer. He says that, with the software, "we have better information on assets and maintenance activity, and more sophisticated tools and mechanisms for managing it all. The result is greater operational control and accountability, especially when it comes to planning and scheduling."

AI-based asset life-cycle and maintenance management solutions like Maximo use real-time data collection, diagnostic, and analysis tools to extend an asset's usable life cycle. Use of the software also improves overall maintenance best practices; meets increasingly complex health, safety, and environmental requirements; and controls operational risk by embedding risk management into everyday business processes.

IBM says EAM also helps "control the brain drain among employees facing retirement by [putting] into place proven workflows and enforced best practices that capture the knowledge and critical skills of long-time employees." Such a system also helps a reduced workforce to work more efficiently and cost effectively "by using the captured intellectual experience of skilled workers in a format easily dispersed in a wide range of languages."

By 2022, more than 80 percent of enterprise IoT projects will have an AI component—up from less than 10 percent today.
—Gartner

AI for processes

AI systems are being used to improve whole processes as well as industrial assets. In an *MIT Technology Review Insights* publication produced in conjunction with IBM, Raytheon senior principal systems engineer Chris Finlay describes the benefits of replacing document-based information exchange with an AI-compatible digital platform to support engineering and design. "Once you start to capture things digitally, you can start to exploit machine learning or AI algorithms," he says. "You can start to reduce development costs because you can automate tasks that you were doing by hand."

Joe Schmid, director of worldwide sales for IBM Watson Internet of Things, says, "In the engineering process, you define what you want to do, design it, build it, test it, and prove that you've done it. The key is integrating those steps. But integrating is hard."

Customers that Schmid has worked with are often good at one part of the process, such as design, but they do not integrate design into the life cycle. "When they need to change goals or specs, it's all in people's heads," he says. "That doesn't work anymore with the complex systems we have today. One engineer can't have an entire system in their head. That's when errors pop up."

The goal of AI for engineering processes is to create an integrated "system of systems," a closed loop that runs from the requirements phase of product development to real-time monitoring of how consumers are using the product, and then deploy AI systems to analyze the data and leverage that knowledge to improve the product, says Dibbe Edwards, vice president of IBM Watson IoT connected products offerings.

In another example, global building materials company Cemex is on an industry 4.0 journey toward enhanced standardized operations using AI. The ultimate goals are increased efficiencies, reduced fuel and energy consumption, better quality, reduced costs, and improved decision making. The company announced in March

AI project success criteria

Petuum's Atif Aziz says, "Typical AI-driven improvements provide savings or value-added improvements ranging from 2 percent to 7 percent to many multiples after that." In his experience, such extremely high gains require the following criteria:

- strong sponsorship from the C suite
- effective change management
- leveraging an ecosystem; not trying to do everything in-house
- significant collaboration between subject-matter experts and AI/data science teams. ■

Examples of industrial AI/IoT applications

Industrial AI applications fall into three categories: AI for assets, AI for processes, and AI for operational excellence and/or business agility. The following specific examples have been implemented by users of SAS Artificial Intelligence Solutions.

- **Turbine engines.** Model drivers of unscheduled downtime; identify optimal maintenance scheduling.
- **Wind turbines.** Identify turbines performing below average; model drivers of capital component failures; improve planned maintenance.
- **Gas treatment.** Identify predictors of foaming/flooding events; identify optimal operational parameters; optimize reagent utilization.
- **Aircraft parts maintenance**. Generate removal advice for specific parts; forecast part removal and alert dispatching for optimized part delivery and availability. ■

that it had installed "AI-based autopilots" for its rotary kiln and clinker cooler systems that will "autosteer" its cement plants and enable autonomous, operator-supervised plant operations.

Cemex used OSIsoft PI systems to power Petuum Industrial AI Autopilot products. The two work with plant control systems to provide precise real-time forecasts for significant process variables, prescriptions for critical control variables, and a supervised autosteer function aligned with business objectives while staying within applicable static and dynamic constraints. The PI systems fuel real-time predictive and prescriptive recommendations.

Rodrigo Quintero, operations digital technologies manager for Cemex, says, "Petuum Industrial AI Autopilot helped us achieve something we didn't think was possible at this time: yield improvements and energy savings up to 7 percent, which is game changing for our industry. Additionally, this is a giant step in digital transformation toward safe, highly standardized operations, that will help us strengthen our high-quality products portfolio while also ensuring we meet our operational and sustainability goals, and minimize costs."

The Autopilot products can ingest data from a variety of sources, including unstructured, images, structured, time series, customer relationship management (CRM) data, enterprise resource planning (ERP) data, and others. The Petuum platform provides sophisticated data processing, data cleansing, and machine/deep learning pipelines to implement advanced AI that is sensitive to linear, temporal, long range, and nonlinear data patterns in a range of industrial use cases.

AI for operational excellence

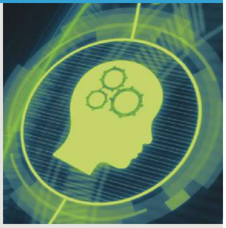
Staying ahead of maintenance and production challenges to keep precision metals rolling out of its plants on time is a high priority for Ulbrich Stainless Steel & Specialty Metals. That is why the global company chose SAS Analytics for IoT to gain access to the latest suite of AI, machine learning, and streaming analytics available to analyze the data from plant sensors.

Jay Cei, COO at Ulbrich, says, "Collecting machine and sensor data from our factories and integrating that with ERP system data will help us understand the intricate relationships between equipment, people, suppliers, and customers.

Learning what their IoT data means is critical for understanding how the company can become more productive and efficient in the future, Cei says. DJ Penix, president of SAS implementation partner Pinnacle Solutions, says, "Streaming analytics will not only help Ulbrich understand what is happening now with their machines. It will also enable them to predict future events, such as when a machine needs maintenance before it breaks down."

The software provides a simplified way for any user to prepare stationary and streaming IoT data for analysis without specialized skills, says Penex. Whether a data scientist, business manager, or someone in between, they can use SAS Analytics for IoT to

Honda R&D: AI planning requires special skills



Kyoka Nakagawa is chief engineer, Value Creation Department, Digital Transformation Division, Digital Solution Center at Honda R&D Co., Ltd., Japan. She is also one of 40 women driving the adoption of artificial intelligence in business and industry profiled in *IBM's List of Women Leaders in AI*.

Kyoka is leading Honda research and development's efforts to train its automotive engineers to use advanced IBM analytics tools, helping them to better understand driver behavior, to increase the reliability of cars, and to design a more personalized driving experience.

What was the challenge you sought to address with AI?

The challenge was to raise our engineers' interest in wanting to use other people's data that could enhance their analysis. I offered an open proof of concept for people who have different engineering expertise for data they had never used, which helped engineers imagine how they can enlarge their analysis capability with other sources of data.

What benefits are you realizing?

Teaching AI helps people to organize their own thinking and their processes and helps focus their core of knowledge. It was a surprise to me that when AI functions well at work, business people seem to create more ideas to do better work. It may be because AI helps unburden some of their workload.

What do you wish you knew when you first started with your work with AI that you know now?

AI planning requires special skills, and not every project ends in success. ■

quickly select, launch, transform, and operationalize IoT data, he says.

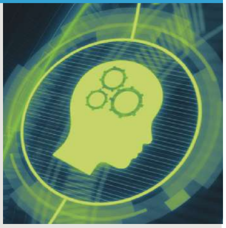
Jason Mann, vice president of IoT at SAS, says companies can no longer afford to ignore the hidden signals in their IoT data. "To thrive, organizations need a solution that addresses data complexity and automates timely and accurate decision making," he adds.

Tips for AI pilot projects

According to a recent Gartner survey, 37 percent of organizations are still looking to define their AI strategies, while 35 percent are struggling to identify suitable use cases. Once you have developed a solid understanding of AI and its potential applications, it is time to make a case for a pilot. Here are some tips from Gartner for making the pilot project a success.

1. **Be realistic about a timeline.** Once you have approval from executives, it can be tempting to think a pilot project will follow quickly. In fact, according to results from Gartner's 2017 Annual Enterprise Survey, 58 percent of respondents in companies currently piloting AI projects say it took two or more years to reach the piloting phase, and only 28 percent of respondents reported getting past the planning stage in the first year.
2. **Aim for fairly soft outcomes**, such as improvements to processes, customer satisfaction, products, or financial benchmarking. Gartner Research Circle respondents urged others not to fall into the trap of seeking only immediate monetary gains. Aim initially for less-quantifiable benefits from which financial gains would eventually arise.
3. **Focus on worker augmentation, not worker replacement**. AI's potential to reduce staff head count attracts the attention of senior business executives as a potential cost-saving initiative. A more informed expectation, however, is for applications that help and improve human endeavors, as AI promises benefits far beyond automation. Organizations that embrace this perspective are more likely to find workers eager to embrace AI.
4. **Plan for the transfer of knowledge** from external service providers and vendors to enterprise information technology and business workers. External service providers can play a key role in planning and delivering AI-powered software, and knowledge transfer is crucial. AI requires new skills and a new way of thinking about problems. These include technical knowledge in specific AI technologies, data science, maintaining quality data, problem domain expertise, and skills to monitor, maintain, and govern the environment.
5. **Choose AI solutions that offer tracking** and revealing AI decisions, ideally using action audit trails and features that visualize or explain results. To that end, Gartner predicts that by 2022, enterprise AI projects with built-in transparency will be twice as likely to receive funding from CIOs.
6. **Start small**; do not worry about immediate return on investment. Digital transformation should begin with small experiments that are purely for learning, says Gartner. Use the time to pilot projects that employ a variety of technologies to assess which make the most sense for the business. ■

ExxonMobil: Get your feet wet in AI



Xiaojun Huang, PhD, is senior advisor for Upstream Digital Transformation for ExxonMobil. She is also one of 40 women driving the adoption of artificial intelligence in business and industry profiled in IBM's List of Women Leaders in AI.

Xiaojun and her team are using AI to create a CT-like scan of the inner earth. This will help ExxonMobil target drilling investments on the most promising opportunities, adding speed and precision, and minimizing human biases. The current project focuses on deep-water drilling off the coast of Guyana.

What do you want to achieve with AI?

We are at the early stages of transforming our work processes. Our goal is to allow our domain experts to focus on what they are good at, augmented with AI. The project allows for much more efficient and collaborative planning for Guyana deep water development wells. Ultimately, that will lead to an ever-safer operation and steep improvements in efficiency and profitability.

What are some key things that you have learned?

We need to change the way we approach our business processes and partnership. Transformation is not about moving every piece of data to the cloud. It is rather about reimagining work processes inside out through the lenses of the art of possibility with all digital technologies, with a focus on business objectives. Digital transformation requires agility and speed. We established our collaboration agreement with IBM, put together the team in a month, and delivered the minimum viable product to the Guyana team in 10 months.

What do you wish you knew when you first started with your work with AI?

We need to have empowered digital champions to help transform a large organization. Understanding both the business and AI, these champions can connect business with solutions, advocate principles and value for change, and act as a conduit between the organization and external innovations. I strongly advise key business champions to get their feet wet on AI. ■

ABOUT THE AUTHOR

Renee Bassett (rbassett@isa.org) is chief editor for *InTech* magazine and Automation.com, and publications contributing editor for ISA. Bassett is an experienced writer, editor, and consultant for industrial automation, engineering, information technology, and infrastructure topics. She has a bachelor's degree in journalism and English from Indiana University, Bloomington, and is based in Nashville.

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Analytics next: *Beyond spreadsheets*

New approaches handle more data volume and perform predictive analytics

By Michael Risse

Merriam-Webster's online dictionary says the first known use of "analytics" was in 1590 when it was defined as "the method of logical analysis"; whereas "analysis" was first used in 1581 and was defined as "the separation of a whole into its component parts." Fast forward 430 years, and analytics is now defined in many ways, including data visualization, machine learning, business intelligence, dashboards, and key performance indicators (KPIs). The pressure to gain insight from data is so pervasive that analytics has become a throwaway term in marketing materials for all types of software.

But whatever analytics is called or supposed to mean, process manufacturers have too much data and not enough insights. Most process industry companies have collected years of time-series historical data but are unable to quickly surface and share critical insights leading to improvements in efficiency and innovation. Additionally, it is difficult to determine value or affect in-process batches or processes, because it takes so long to find the insights.

Further, this "data rich, information poor" (DRIP) (figure 1) situation is only getting worse with the exponential increase in data as the Industrial Internet of Things (IIoT) takes hold. IIoT forecasts correlate to the amount of data expected, and market intelligence firm IDC is expecting worldwide spending on IoT to reach $745 billion in 2019, led by the manufacturing sectors. That represents a massive amount of sensor data, and it will go to waste absent robust analytics and a flexible, cost-effective way to store and process it.

If business and production insights are going to be faster, better, and easier to achieve—then something will need to change by bridging computer science innovation with the expertise and

FAST FORWARD

- Data analytics has a long and checkered history of overpromising and underdelivering.
- The main problem has been inadequate tools for data analytics, particularly the spreadsheet, to keep up with increasing data volumes and demands.
- Self-service advanced analytics applications have been created to address this and other issues, and their use is rapidly growing across the process industries.

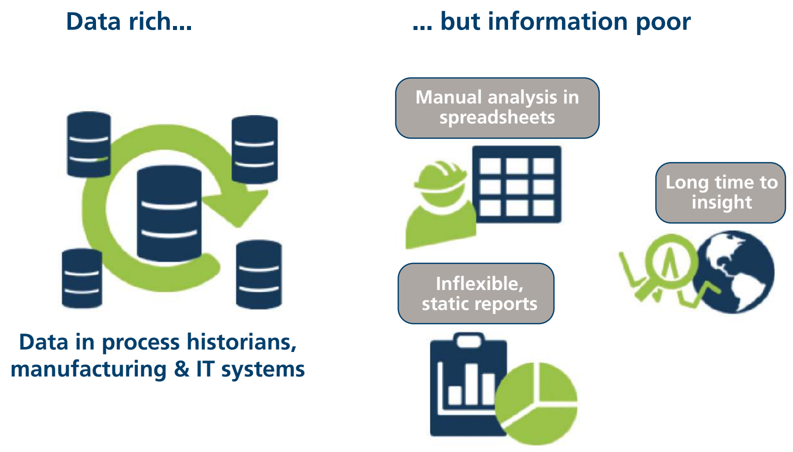

Figure 1. Many process manufacturing companies are drowning in data but thirsting for information.

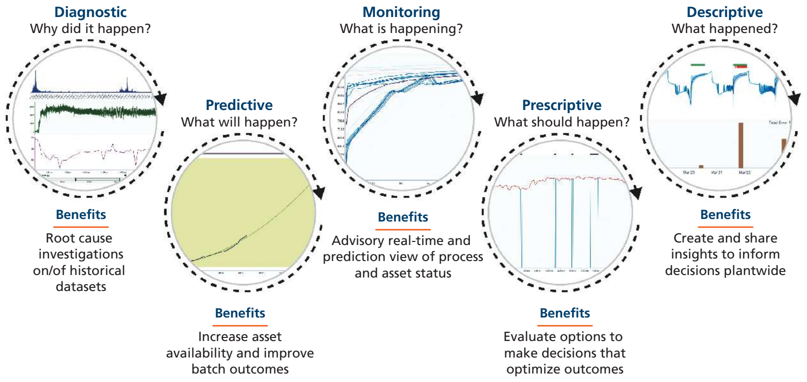

Figure 2. This taxonomy describes five different types of analytics in process manufacturing and their benefits.

experience of plant employees. The spreadsheet, the backbone of the past 30 years of analytics efforts in manufacturing, will simply not suffice for the next 30 years. There is too much data, too few engineering professionals, and too many demands for insight from improvements in analytics for spreadsheets to be the primary solution.

Analytics defined

The increased attention on analytics in process manufacturing has led to a taxonomy for different types of analytics. It is important to identify how they may be applied in process manufacturing (figure 2).

- **Descriptive** analytics are by definition backward-looking, because they describe what happened in reports, charts, and KPIs based on collected data. This is the most widely used type of analytics across all industries, and the insights are broadly useful and may be shared in near real time.
- **Monitoring** analytics track asset, batch, or operations performance and seek to answer the question "what is happening now?" Typically, monitoring solutions answer the question of current status in dashboards or process graphics updated in near real time, but

they are strictly advisory and are thus not suited for inclusion in closed-loop control systems.

- **Diagnostic** analytics seek to identify *why* something happened based on analysis of historical data, often called root-cause analysis. As descriptive analytics are to reports, diagnostic analytics are to spreadsheets as engineers combine, contextualize, and perform calculations on data to uncover cause and effect in processes and units.
- **Predictive** analytics help engineers identify what *will likely* happen based on real-time and historical data, enabling corrective action to be taken before an undesirable outcome. Benefits include avoiding unplanned downtime, optimizing maintenance schedules, and improving quality or yields.
- **Prescriptive** analytics aim to optimize outcomes by informing plant employees of their best actions based on existing conditions. In a closed-loop system, prescriptive analytics can automate asset or process adjustments based on a predefined set of conditions. In an open-loop system, prescriptive analytics inform engineers of desired actions.

The future of analytics: Three developments

Against the backdrop of DRIP, with ever more data coming soon and elevated pressure to gain faster insights of all types for improved production, there are three important trends that will define the future of analytics as experienced in process manufacturing environments.

1. **Recognition of employee empowerment through self-service analytics**. The reason spreadsheets have enjoyed their run of success as the primary tool for analytics is that they are accessible to the employees who know the questions to ask. The approach of information technology (IT) personnel without industrial knowledge generating or automating analytics or insights is proving short lived, and deservedly so. It simply does not work in complex and rapidly changing environments with extensive interaction among variables.

   An example of the importance of a self-service approach can be found in a recent McKinsey & Company report. “Value emerges as a combination of the tool and the people who operate it. Yet we have seen too many cases where that simple truth has been forgotten in the wave enthusiasm for a new approach. Advanced solutions often fail not because they produce erroneous results, but because the workforce does not understand, or trust, those results.” Technology investments are necessary, but not sufficient to achieve productivity improvements, the authors write. To succeed, it is essential for manufacturers to invest in their people.

   In process industries, such as oil and gas, chemical, refining, pharmaceutical, and food and beverage, engineers are the most important group of analytics users. They have the required experience, expertise, and history with the plant and processes. Self-service analytics let engineers work at an application level with productivity, empowerment, interaction, and ease-of-use benefits (figure 3). In the future, the universe of analytics users will expand beyond engineers to operators, executives, and accountants—all of whom will also benefit.

Figure 3. Self-service analytics enable engineers to work at the application level and gain productivity, empowerment, interaction, and ease-of-use benefits using Seeq R21 software.

2. **The emergence of advanced analytics.** This new class of analytics speaks to the inclusion of cognitive computing technologies into the visualization and calculation offerings that have been used for years to accelerate insights for end users. McKinsey defines advanced analytics solutions this way:

Figure 4. Advanced analytics applications can access data from multiple sources.

   “[Advanced analytics solutions] . . . provide easier access to data from multiple data sources, along with advanced modeling algorithms and easy-to-use visualization approaches and could finally give manufacturers new ways to control and optimize all processes throughout their entire operations.” Figure 4 depicts data from multiple sources accessed from a single advanced analytics application.

   The introduction of machine learning and other analytic techniques accelerate an engineer’s efforts when seeking correlations, clustering, or any other needle-within-the- haystack analysis of process data (figure 5). With these features built on multidimensional models and enabled by assembling data from different sources, engineers gain an order-of-magnitude improvement in analytic capabilities, akin to moving from pen and paper to the spreadsheet 30 years ago.

   These innovations in advanced analytics are not a black box replacement for the expertise of the engineers but are instead a complement and accelerator to their skills, with transparency to the underlying algorithms supporting a first principles approach to investigations.

3. **Analytics moving to the cloud.** Companies of all types, including process manufacturers, are moving their IT infrastructure and data to public and hybrid clouds to increase agility, speed responsiveness, and reduce complexity. Driving this growth are the burgeoning data volumes and increased demand from compute-intensive workloads.

   Analytics workloads are particularly suited for migration, because most use cases require the scalability, agility, time to market, and reduced costs provided

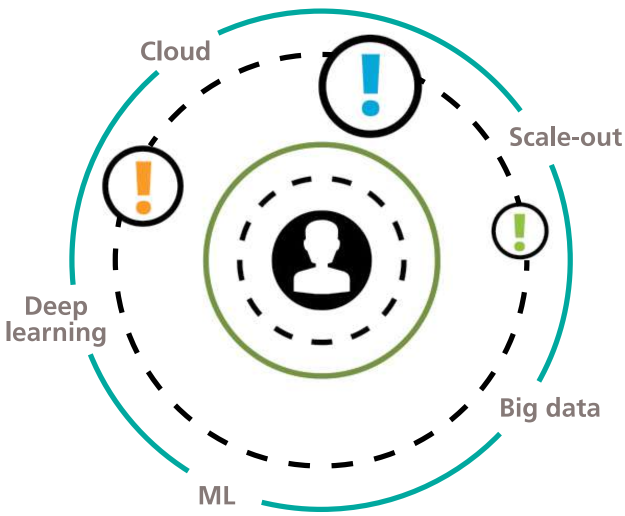

Figure 5. Software takes advantage of advances in a range of technologies, including machine learning, empowering engineers to create insights.

by the cloud. Large process manufacturers will likely utilize a mix of public and private cloud offerings, as well as on-premise components, for analytics.

The trend is in its infancy, though some industries are ahead. Chemical manufacturers, for example, are beginning to embrace the cloud, for analytics as well as other use cases. As a result, Microsoft, Amazon, and Google have specifically focused on the oil and gas sector as a starting point for their efforts. This is clearly a sign of market interest, and it is also a sign of the maturity of the cloud offerings: Amazon brought out AWS in 2002, and then introduced S3 (storage) and EC2 (virtual machines) in 2006. Cloud computing competition then increased with Microsoft's and Google's cloud platform introductions in 2008.

Storing large volumes of data in the cloud is increasing, and it is already a "when" and not an "if" question for most companies. Consequently, the big public cloud platforms are paying more attention to the largest sources of data, with manufacturing leading all sectors of the economy. What this means for process manufacturing customers is faster time to deployment and a lower price for analytics access.

Dominant for decades as the analytics tool of choice, spreadsheets are not up to the task of performing advanced analytics on ever-larger datasets, yet their accessibility to engineers is a requirement for any future analytics offering. Insights that take too long to discover languish because they cannot easily be published and shared with others. Advanced analytics applications connect with data from a wide array of sources and surface insights much more quickly in a format that is easy to share, enabling actions to improve business results and profitability.

Here is an example showing advanced analytics in action.

Cloud-based analytics

A chemical company took advantage of a browser-based advanced analytics application running in the cloud to connect back to its on-premise data via a secure HTTPS connection and a remote connection agent. The solution was deployed and accessible in a matter of hours, and the data stayed where it was, enabling insight in days rather than months.

Another option is to make the cloud the destination for datasets collected from remote or IIoT end points. This is a more natural and easier option than trying to reroute data from carriers and wireless systems back into IT systems and then to the cloud, because data "born on the cloud" is a popular option for many monitoring applications. In this case, end users can then access the data by either running analytics on the cloud or by running the analytics solution on premise with a remote connection to the cloud-based data.

In either scenario, the monitoring data may be complemented or contextualized by connecting the analytics solutions to other data sources—historians, manufacturing execution systems, etc.—to get a complete view of all data. For chemical companies, this scenario can be used for new insights into supply chain and operations by complementing existing data with data from wireless or cellular networks.

A third scenario is accessing multiple sites from a cloud deployment of analytics software. Although moving or copying the data to the cloud also could facilitate cross-plant comparisons for yields, quality, etc., a simple remote connection for occasional queries and comparisons may suffice, depending on the frequency and requirements of the end user.

Measurable value

Analytics is not new, and neither are the unrealized promises that have surrounded the field. But technical advancements, cloud computing and machine learning for instance, along with the massive explosion in data from sensors and other sources, have come together to create new opportunities. There is now reason to believe analytics will finally generate measurable value for process manufacturers by rapidly bringing shareable insights to light. ■

ABOUT THE AUTHOR

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Why bother with a

"What if" analytics run on actual plant data is key to more effective decision making

By Joseph Ting and Duncan Micklem

Decision cycles across industrial environments are becoming increasingly disrupted by proliferation of data, new data sources, and compute speeds within an increasingly volatile business environment. The digital twin is the key to effective decision making in this new world.

Making better decisions, faster, that can be executed perfectly every time is vital for delivering superior results, sustained. However, this is easier said than done. Every individual perspective is underpinned by a series of unique cognitive biases that drive swift action in adversity but make accurately weighing evidence, assessing probabilities, and deciding logically a challenge. Look no further than the constant discrepancy between strategic planning/ambition and results realization (figure 1).

A single view of the truth and analytics is therefore key to situational awareness and effective organizational decision making. But many players in the industry are stuck on determining what type of analytics they need. The solution to this question should be driven by the problem, not by how much analytics can be thrown at data in the hope it will both find the problem and solve it. The desired outcome should influence the type of analytics being sought and the available analytics technology that is fit for purpose (figure 2).

Basic analytics technology can move data around and display key performance indicators (KPIs) to the right people at the right time to enable decision making. They work well for understanding what happened in hindsight. However, increasing plant complexity requires more sophisticated ways of approaching KPIs and targets. In some cases, a rudimentary approach to KPI setting and monitoring can even become ineffective and counterproductive. In this case, deeper analytics technology, using digital twins, is nec-

FCC yield management

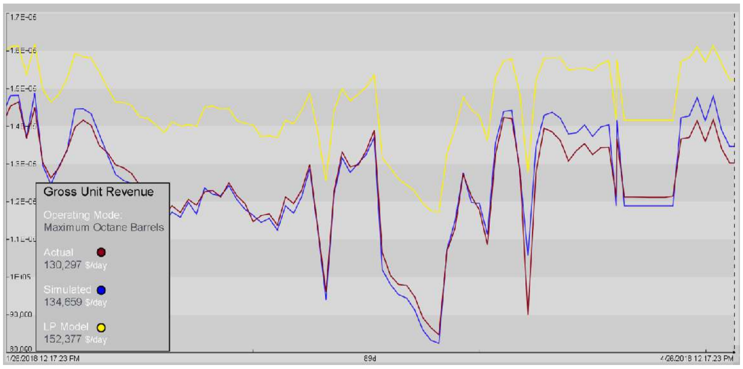

Figure 1. Sample of profit gaps in refinery operations.

FAST FORWARD

- The energy and chemical industries need digital twins for effective decision making.
- An integrated production management system digital twin operates across the entire process manufacturing supply chain and asset life cycle.
- Where possible, the cloud should be exploited to host the digital twin.

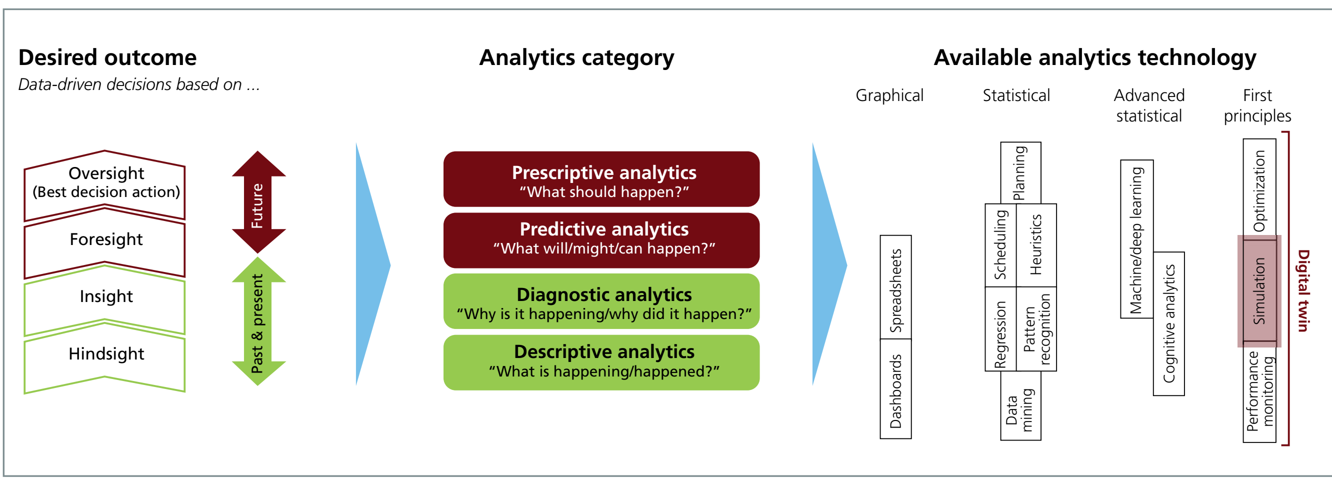

Figure 2. Digital twinning is a type of analytics technology.

essary to account for the multidimensional factors and nonlinear trade-offs that make effective decision making a challenge.

The digital twin allows "What if?" and "What's best?" scenarios to be run automatically on actual plant data to determine available strategies that maximize profitability. Experts can then review the recommended strategies to assess the effect of each approach without disrupting the live process.

A digital twin works in the present, mirroring the actual device, system, or process in simulated mode, but with full knowledge of its historical performance and an accurate understanding of its future potential. Therefore, the digital twin can exist at any level within the traditional ISA-95 architecture and can be defined as a decision support tool that enables improved safety, reliability, and profitability in design or operations. It is a virtual/digital copy of a device, system, or process that accurately mimics actual performance, in real time, that is executable and can be manipulated, allowing a better future to be developed.

A digital twin is useful for the entire life cycle of an asset. It is ideally created during the initial study to evaluate the feasibility and process model of the asset. It is then used and further developed during the design, construction, and commissioning of the asset, thereby facilitating the optimal design of the asset and the training of the staff who will operate it. During the bulk of a plant's life cycle, operation, and maintenance, the digital twin can be employed for optimization and predictive maintenance.

The digital twin enables everyone to see inside assets and processes and perceive things that are not being directly measured. They are wired so that insights are instantly available without end users having to wrangle data and models, and they run in a consistent way that everyone can understand and agree on. In this way the digital twin drives agility and convergence in understanding and action across the whole business, for example from engineering to operations, operations to supply chain, reservoir to facilities, and shop floor to board room.

The digital twin aims to be an accurate representation of a device, system, or process over its full range of operation and its full life cycle. Ideally, the digital twin should be able to transition from design to operations with ease.

To achieve the desired levels of accuracy, source data must be gathered in real time and be validated and reconciled to ensure that all physical and chemical laws are respected. Electronic noise and dynamic effects must be eliminated through filtering. Only through this approach can data quality issues be identified and mitigated, and the digital twin be trusted to reflect reality and relied on for the quality and accuracy of its predictions.

Although individual point solution digital twins exist today, a future digital nirvana has one multipurpose digital twin (figure 3). Getting to the future state in one step is unrealistic, and it is likely to be achieved by connecting valuable high-performing individual elements. Therefore, the mantra has to be one of agility—think big, start small, scale fast, and drive adoption.

Some examples of what digital twins are mirroring today include:

- instrument/device
- control system
- 3D design and engineering
- worker
- process/optimization
- energy/utilities
- supply chain.

Considering the above, some can understandably believe that "digital twin" is a marketing term used to repackage certain technologies that have been available in the market for a long time. To some extent that might be true, but not all digital twins are made equal. Their perceived use value varies, for example, a 3D computer-aided design model of a plant may be of less value to a process engineer than a digital copy of the plant's operating conditions and the way in which molecules behave and transform. If anything, the term has been a catalyst for driving clarity and understanding of the value that it represents.

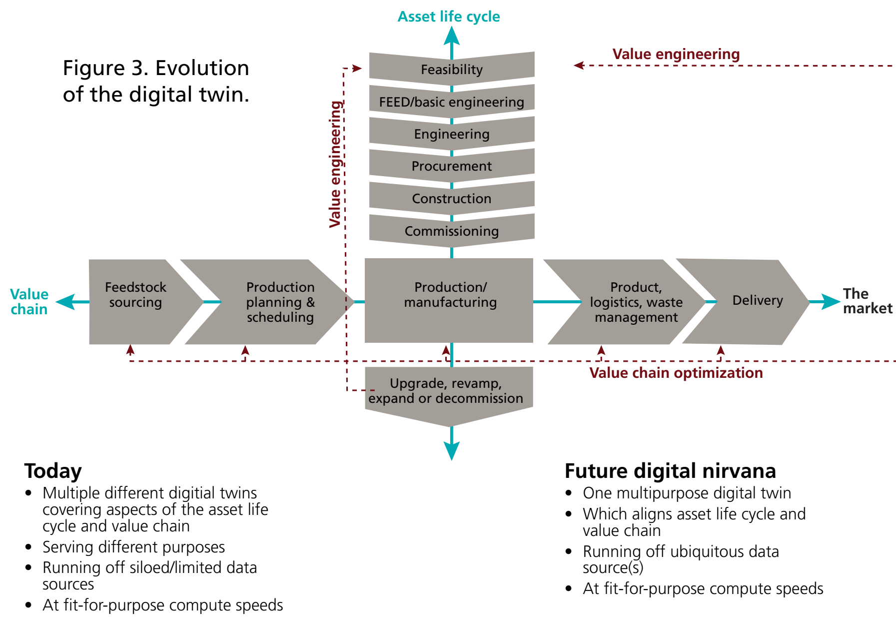

Figure 3. Evolution of the digital twin.

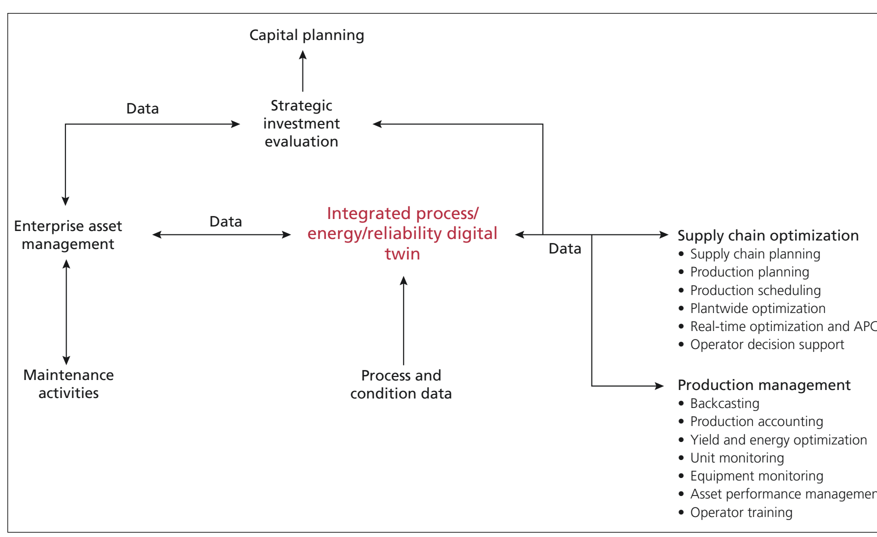

Figure 4. Alignment of production management, supply chain optimization, and strategic asset investment planning.

Comprehensive digital twin solutions have been developed for an integrated production management system. These operate across the entirety of the process manufacturing supply chain and asset life cycle to align production management and reliability, energy and supply chain optimization, and strategic asset investment planning (figure 4).

From an enterprise technology stack perspective, digital twin technology can benefit multiple levels of the organization:

- Digital board room. This could comprise a series of business and financial KPIs that are updated in real time as part of an enterprise-wide balanced scorecard. The underlying KPI calculation aims to combine a simple dashboard of measured parameters with integrated logic linked to the process, energy, supply chain, and asset digital twins.
- Simulation and optimization. This

could comprise a series of digital twins based on physiochemistry, such as an integrated process/energy/reliability digital twin, operator training simulation twins, and dynamic real-time optimization twins (for process/utility systems).

- Integrated control and safety. This could constitute a digital copy of the live plant and its automation algorithms through the "twin" function of an integrated control and safety system, thereby allowing engineers to conduct fundamental process control tests at an engineering workstation, as well as any proposed adjustments, before they are applied on the live plant.
- Instruments and devices. This could constitute highly intelligent devices, such as pumps, flowmeters, and transmitters, or chemical analyzers that provide total insight into their ongoing performance as well as an ability to adapt to changing duty requirements throughout the measurement device life cycle.
- Operator processes. This could comprise a copy of operator work processes to be executed, which could be tracked and manipulated in real time.

The digital twin promises to be a fantastic tool for strategy execution by ensuring field and line employees have the information they need to understand the bottom-line impact of their day-to-day choices. Strategy execution is also supported because a digital twin can facilitate information flows across organizational boundaries and minimize second-guessing of decisions.

A key challenge of the digital twin is that it needs to exist within a strong governance framework.

A key challenge of the digital twin is that it needs to exist within a strong governance framework. This includes well-defined business processes, along with clarity about the decision rights and actions for which people are responsible.

One area that needs to be considered is the necessary guidance from subject-matter experts and their associated analytical insights. These can be third parties, but often these experts are in-house yet remote from the operational location. Currently, these insights are obtained when there is a problem or when structured inputs are sent on a regular basis, such as in a weekly meeting or a quarterly service review.

As the energy and chemical industries move away from buying inputs to buying outcomes-as-a-service (XaaS) at both point and holistic solution levels, the digital twin will become increasingly important (figure 5). The digital twin serves as the single basis from which all outcomes are derived. The regularity of the inputs has been replaced with a digital twin predicting when service is optimal, considering current and future operation, and providing the time and best path for all stakeholders as decisions are made. This brings agility and convergence in understanding and action

WORRIED ABOUT A DCS MIGRATION?

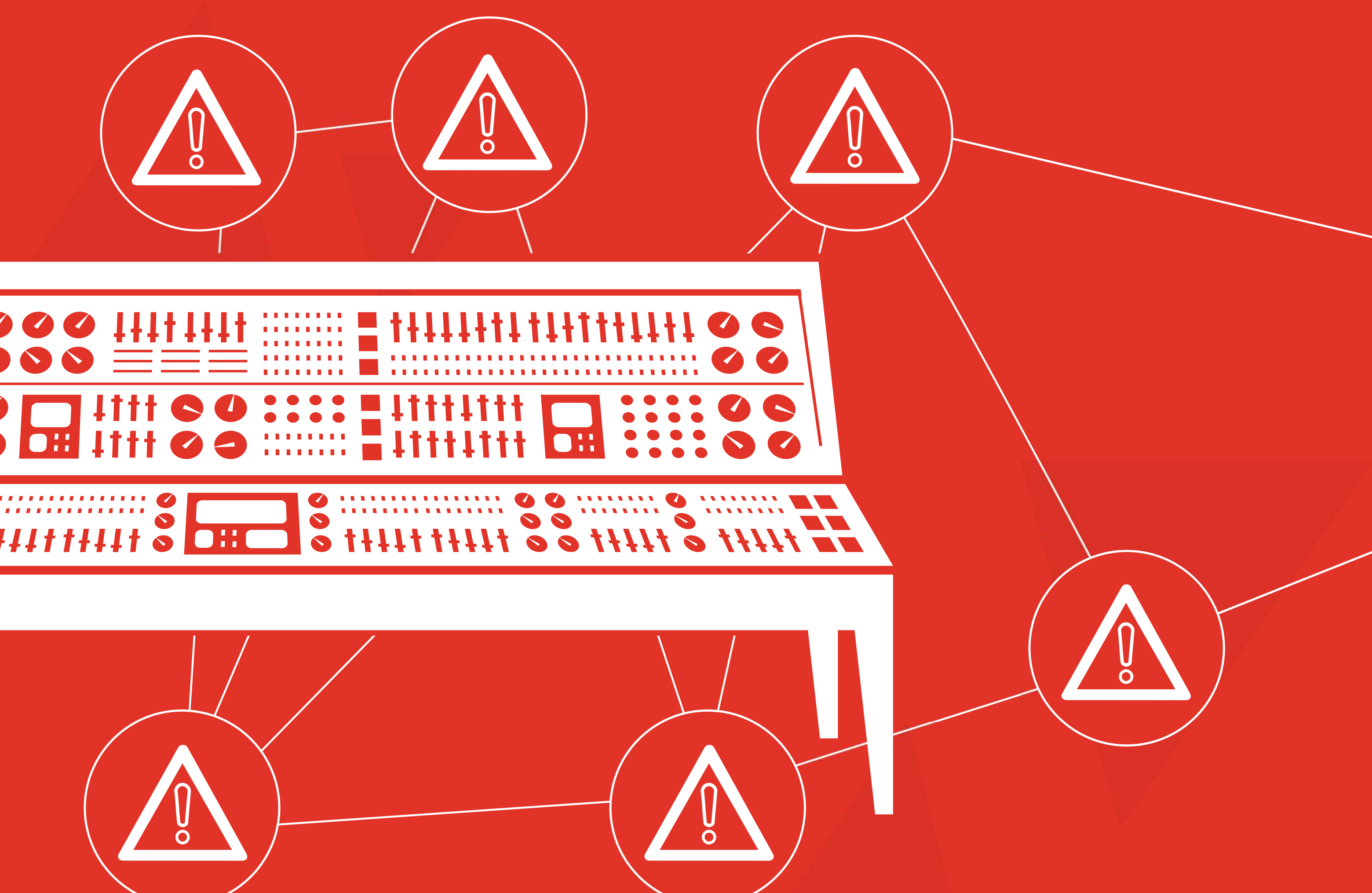

Figure 5. Outcomes-as-a-service (XaaS) uses the digital twin.

across the whole business.

How do we reach a future digital nirvana with the mantra of agile? Cloud is the answer in many industries, and we believe that it is a key enabler for the digital enterprise of the future. The cloud is already the infrastructure of choice for most business applications, but it remains unexploited for most operational applications. The reason is that most valuable operational applications rely on a continuous feed of plant data, which means they can never be isolated from the plant in a way that a human resources performance management system or capital budgeting system can.

This is partially addressed with "edge devices" living in the "fog" between the real world of the plant and the virtual world of the cloud to bridge the gap. But there is still a potential pathway for a "bad actor" to reach the plant even through an edge device. From an information technology point of view, the cloud offers some compelling savings versus an on-premise approach. But unless the operational risk associated with exposing the plant to the cloud is offset by the value created by the people and applications it serves, its use will remain marginal.

Where possible, the cloud should be exploited to host the digital twin for the following reasons:

- The cloud can engage people and technologies from outside corporate boundaries. Examples include augmentation with georeferenced 3D visualization models. In remote or resource-constrained environments, the cloud allows remote subject-matter experts to join in the day-to-day troubleshooting and profit improvement activities of the plant, using the digital twin, as if they were employees present on site.
- The cloud enables the digital twin to subscribe to external data feeds that can enrich its resolution.
- The cloud allows experts to offer analytical capabilities remotely.
- The cloud supports and nourishes agility with respect to the digital twin. Users can experiment and rapidly deploy new solutions. The cloud makes solution updates trivial and significantly reduces infrastructure costs. Similarly, the cloud reduces the cost of termination—if a solution does not work out as expected, a cloud solution can often be switched off with little-to-no ongoing cost.

Overall, connecting the plant to the wider knowledge pool, and thus completing the digital twin, provides a lot of value. Risks can be managed with governance, cybersecurity measures, and localized operational applications. A focus on the outcomes and an agile organization are key to making the balance right for the plant.

Digitalization is accelerating and disrupting the decision cycle. For the first time, a digital nirvana can be within reach for the energy, chemical, and process manufacturing industries. A digital twin initiative can rally your operations around this vision and create lasting, sustainable business value. ■

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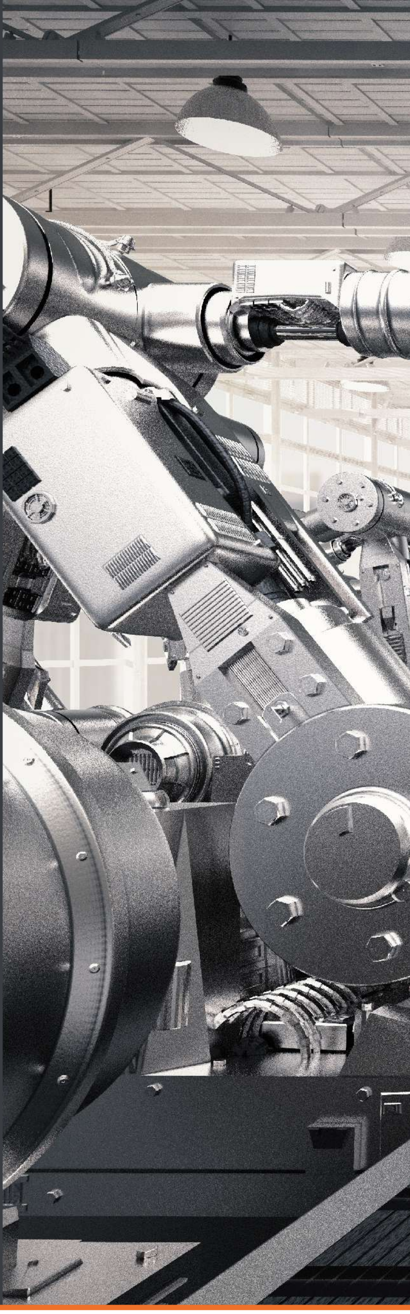
Device management made more efficient

Industrial devices—from robots to field devices, controller programs to drive systems—all have their own programming languages and data formats. Software version-control systems can make maintaining these assets easier



By Robert Glaser

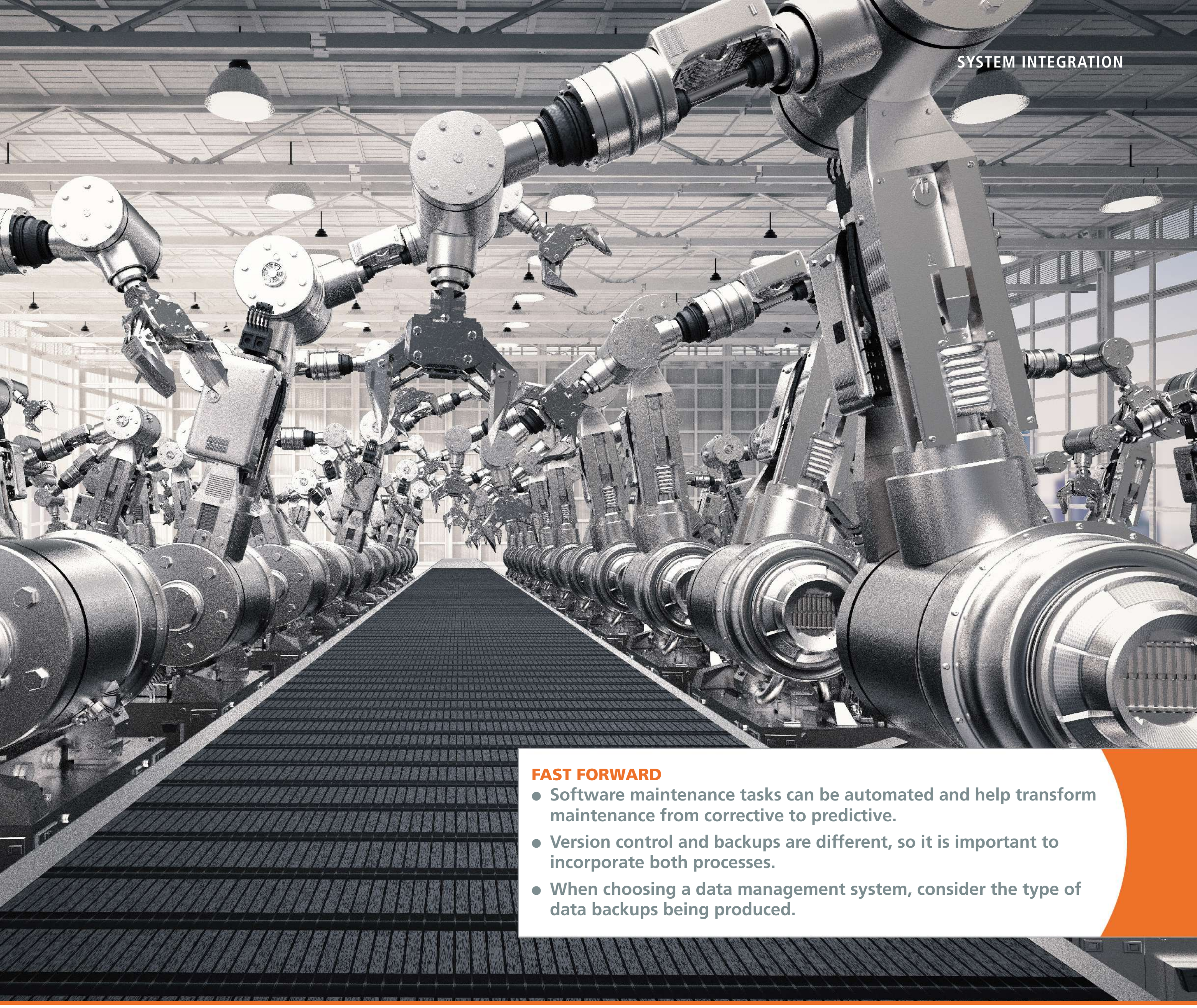
The Industrial Internet of Things (IIoT) is set to bring about radical changes to the work environments of today's industrial maintenance departments. IIoT smart devices come with their own software and intelligence that needs to be maintained. But how often have you—or should you—ask whether the software version running on a device is the same as the latest released version on the server? Only with the right kind of data management system—giving you more certainty, safety, and security—is it possible to answer this question.

One important aspect of data management is version control. Version control refers to a system in which the changes made to a file or to several files are logged over time. This helps to centrally manage upload, download, and compare processes.

The term "version control" originated from software engineering. Software developers use the term to meet their goals, to safeguard and optimize their work, and to make the process of developing software more flexible. Version control is slowly winning acceptance with industrial automation departments. This is partly due to increasing costs and the time constraints placed on maintenance departments. These departments have a critical mission to keep production environments running optimally—minimizing downtime and recovery time.

Maintenance departments are fully aware of the challenges they face. Changes made to devices can lead to errors, which in turn can lead to downtime or defective products. For this reason, it is necessary to monitor, track, safeguard, and compare changes made to projects and to device program logic. The need for these processes is further reinforced by the fact that the number of different processors, devices, data, and possible sources of error continue to grow.

The version control process enables an organiza-



FAST FORWARD

- Software maintenance tasks can be automated and help transform maintenance from corrective to predictive.
- Version control and backups are different, so it is important to incorporate both processes.
- When choosing a data management system, consider the type of data backups being produced.

tion to monitor who changed what, where, when, and why, helping to more accurately pinpoint the source of error when any problems arise. When required, version control can also help to quickly find and restore a previous, error-free version.

A detailed comparison of the online version (running on the device) and the offline version (running on the server) makes it possible to display the results of a comparison graphically, so that personnel are not forced to fly blind when it comes to operating a device.

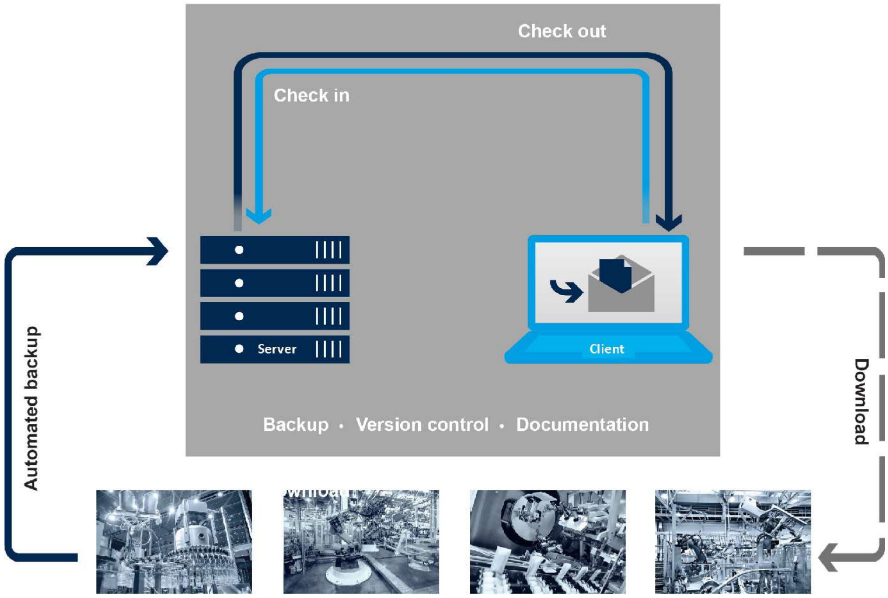
Version control versus backup

The terms "version control" and "backup" are not synonymous. They are two distinct tools that have the greatest benefit—with regard to organizing data with clarity and traceability—when both are used together.

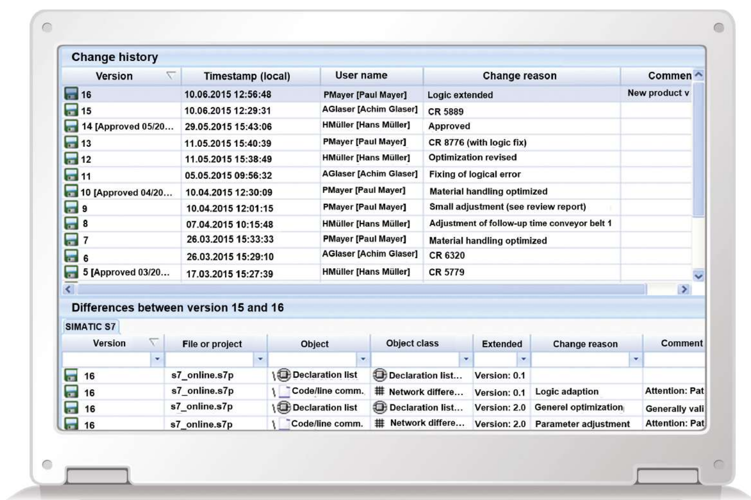
Users often mix up the backup of a device with the backup of project files. In this discussion, we define "backup" as "extracting the software running on devices." "Version" means "saving project data in centralized data storage with user management."

On their own, neither centralized data backups nor version control are enough to ensure 100 percent certainty, safety, and security. It is only possible to reliably determine if the latest released version on the server is the same as the online version if regular automatic backups have been carried out. With regular backups, it is possible to compare the software version running on a device with the last version checked into the server. This, in turn, allows changes to be detected and analyzed.

Conversely, it does not make sense to automate the process of creating versions using the data taken from a backup. This is because not all backups are the same. Depending on the device type, a subsequent use of the backup



Version-control software monitors changes made to a file or to several files over time and logs them, so they can be easily found and tracked.



To reduce plant downtime, it is necessary to monitor, track, safeguard, and compare changes made to project data as well as device program logic.

in the respective engineering system is not reasonable, as often no symbols and comments are included. Sometimes a subsequent use in the engineering system is not possible at all, because the backup consists only of compiled data.

It is therefore imperative when choosing a data management system to consider the type of data backups being produced. When it comes to maintaining high-quality data management and enabling the greatest possible production capacity, restorable backups always need to be available.

A manufacturer-independent approach

In recent years, the need for version control has also become apparent to device manufacturers. Nowadays many manufacturers offer version-control solutions. However, they are normally only compatible with their own devices. This means that they can only be effectively used in plants that do not have a wide variety of devices. However, in today's world, a production facility comprised of only homogenous devices is becoming more the exception than the norm.

As the automated sector continues to grow, so too do the number of different devices. This growth goes hand in hand with the increasing complexity of production facilities, which contain myriad different robots, field devices, controller programs, and drive systems, all of which have their own program language and data formats.

A future-proof version-control system is both manufacturer independent and transparent. It is capable of working with a full range of automation devices and systems commonly used today and is not tied to any single manufacturer. As newer products become more established, action needs to be taken to ensure that the necessary comparators are made available to users. (A test comparator helps to automate the comparison between the actual and the expected result produced by the software.)

Comparators are essential when it comes to version control, as it is only possible to detect and display differences between versions with their help. Version-control comparators allow organizations to make text-based, graphical, and tabular version comparisons that are easily accessible and readable, and backed up by technical implementation.

A location-independent approach

With the globalization of manufacturing plants, it is no longer rare for production to be spread across many locations and time zones. Therefore, it is highly important that version-control systems are location independent. A comprehensive server allows backup data taken from different devices and locations to be synchronized and centrally managed. It also allows differences between versions to be detected quickly and easily.

A version-control system also must account for external factors and third-party users. In times of lean production and lean maintenance, it is imperative that a version-control system be capable of detecting, monitoring, comparing, and analyzing changes to devices made by external system integrators and original equipment manufacturers. A version-control system capable of coordinating external personnel according to a variety of requirements has an added benefit: the documentation-of-change reasons allow for 100 percent clarity and traceability.

Because a good version-control system can monitor, detect, compare, and analyze changes to devices made by anyone anywhere, it can support a move to smart maintenance. Smart maintenance combines machine learning with predictive analytics. This allows maintenance work to be transformed from corrective to predictive.

To predict maintenance needs, a system must be able to recognize indications of malfunctions or defects taken from a large quantity of different types of data. And that data must be accurate. If data is corrupted or is missing, the source of error needs to be quickly detected, and normal operations need to be restored as quickly as possible. With version-control software, maintenance staff can rely on the accuracy of the data, and then produce well-defined and clear strategies to predict when maintenance action is required.

Steps to a successful implementation

With a central server and an unlimited number of installed clients, some version-control solutions allow users to work offline and check in new versions when necessary. Automatic synchronization helps to prevent unauthorized access and automatically documents who changed what, where, when, and why.

The industrial plant's information technology (IT) departments should be involved in any implementation of device version-control software to help ensure everything is properly prepared upfront. Depending on the level of integration during installation—such as integrating only a few typical device types or installing a plantwide solution—implementation of a system can take as little as one day or as long as several weeks.

When implementing across multiple facilities, including global implementations, it is recommended to roll out the system in phases to make sure all is running properly and in sync.

Nonhomogenous production facilities require many different project planning tools and editors that require multiple shifts. This results in large production and maintenance departments. Good version-control systems can integrate tried and tested editors and project structures while supporting users with a menu-driven tutorial and automated backups. This results in a high degree of usability by a wide range of staff and should require minimal training.

Implementing a system for device software backup and version control will logically result in adjustments to the IT infrastructure. However, it is a worthwhile investment—not only due to the reduced costs that it brings about, but also because of the way it helps to reduce risks to production facilities. A secure and safeguarded production facility means fewer errors, reduced downtime, reliable delivery times, and satisfied customers and partners. These benefits make the investment in a version control and backup system truly worth it.

The version control and data backup functions of a data management system are a valuable aid when automating simple but time-consuming tasks that would have been carried out manually. It thus helps to free up maintenance staff for other important tasks. Regularly carrying out comparisons allows authorized changes to be monitored. It also allows unauthorized changes to be quickly detected, which in turn allows users to quickly find and restore a previous error-free version. Thus, although the IIoT is set to bring about radical changes to the work environments of today's maintenance departments, the aim of those departments to maintain a well-secured and safeguarded production facility will not change. Production processes will simply become more efficient. ■

ABOUT THE AUTHOR

Robert Glaser is the CEO of AUVESY Inc. (www.auvesy.us). Before this role, he worked for AUVESY Germany for more than 10 years, since the company's founding in 2007. He was most recently director of research and development for the company. Glaser holds a master's degree in computer science.

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Acoustic monitoring systems

Deployed using a safe and secure cloud approach

By Rudolf Muench, Dipl.-Ing.

The monitoring systems used today in hydropower plants are based on a number of sensors that are directly mounted to the machines. The monitoring systems generate alarms if certain threshold values are exceeded. These thresholds are normally static limits based on technical standards or based on experience during the commissioning phase.

An acoustic monitoring system enables continuous monitoring of a large number of components and equipment simultaneously with only a few sensors. Applying cloud-based machine learning algorithms enables the detection of anomalies and clustering of typical machine behaviors.

The acoustic monitoring system emphasizes security and privacy regarding communication and prevents any interference with the safety and control system of the hydropower plant by design, as only one-way data transfer away from the hydropower plant is enabled. It further provides a cost-effective solution for monitoring existing hydropower plants, because it requires no physical modifications of the equipment itself.

Challenges of hydropower plants

One major challenge is the remote location of many hydropower plants. Some are very hard to reach, while others are not reachable in wintertime or during bad weather conditions like a monsoon.

Another challenge relates to the level of expertise and staff training in rural areas. Most big hydropower development projects therefore require extensive training of local labor for the safe operation of the plant.

Furthermore, the continuous reduction of maintenance personnel in recent years and decades affects plants even in well-structured areas. Many plants are unmanned and are only visited for inspection purposes in intervals of weeks or months. This raises the concern that something could happen the day after an inspection round has been finished, and then go unnoticed and cause severe damage over time.

Smart monitoring systems, such as the proposed acoustic monitoring system, will autonomously monitor the running equipment. A requirement of such systems is the data connectivity of these

FAST FORWARD

- A large amount of equipment can be simultaneously supervised with only a few sensors.
- Cloud-based machine learning algorithms can detect upcoming failures.
- An acoustic monitoring system prevents any interference with the safety and control system of the plant.

power plants, which is traditionally a point of concern. Connections routed through the Internet, in particular, are regulated by national standards and laws. However, as a customer pointed out, "solutions that address this concern are technically possible but still face a psychological hurdle."

Different monitoring approaches

Classical monitoring

Typical hydropower plant monitoring systems are fully integrated in the control system of the plant. Each monitoring sensor focuses on a singular quantity at a specific location. The sensors are physically mounted to the equipment. Therefore, a retrofit requires some physical modifications of the equipment.

During the design phase of the monitoring system, the engineer predefines static alarm limits, for example, in accordance with a norm like DIN ISO 7919-5, where maximum relative vibration displacement limits are defined. These limits are derived from statistical analysis of many hydropower plants. Although they gather the collective hydro experience, the limits are not necessarily suitable for a particular plant or even power unit. Adjustments to these static limits are usually done during the commissioning of the hydropower plant.

Advanced integral monitoring

Often, before equipment failure, early indicators like noise, heat, or odor are noticeable, even before a classical monitoring system observes an indication in a specific signal, because the static alarm limit is not yet reached. Equipment failure starts very early, progresses slowly, and is only noticeable to either personnel inspecting the plant or where slowly changing trends are monitored explicitly. This also requires that the actual failing component is equipped with a sensor. Often, this is not the case, because too many sensors would be required.

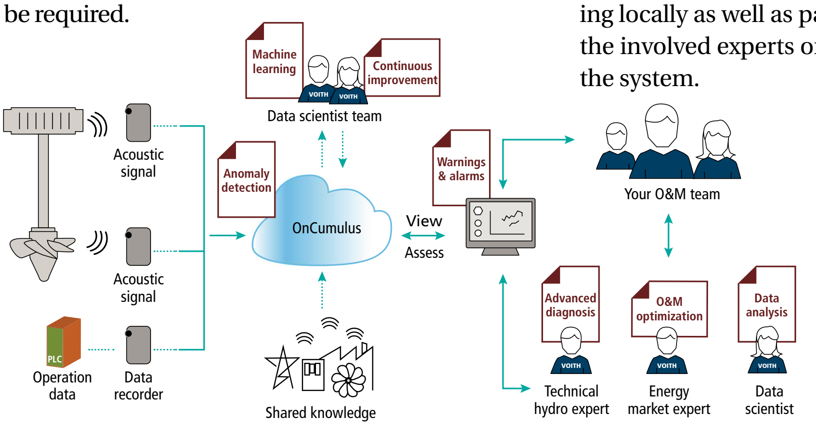


Figure 1. Integral monitoring system connected to a central, cloud-based platform for assessment and analysis of the collected information.

The new approach is based on microphones, which collect integral information from a larger space or a larger set of equipment, like inside the turbine pit. The system can detect anomalies or deviations from typical machine behavior and slowly moving trends and can diagnose specific signal patterns and relate them to past events. Figure 1 shows a sketch of the system where sensor data is combined with process information (e.g., current active power). Such an approach becomes feasible today, because the storage concepts and algorithms required to implement them are now available.

Some of the intelligence of this monitoring system is based on domain-specific preknowledge, like the knowledge of typical machine frequencies and their meaning. But, to achieve diagnostic or even predictive capabilities beyond such preknowledge, there are three major steps that have to be taken during the so-called learning phase.

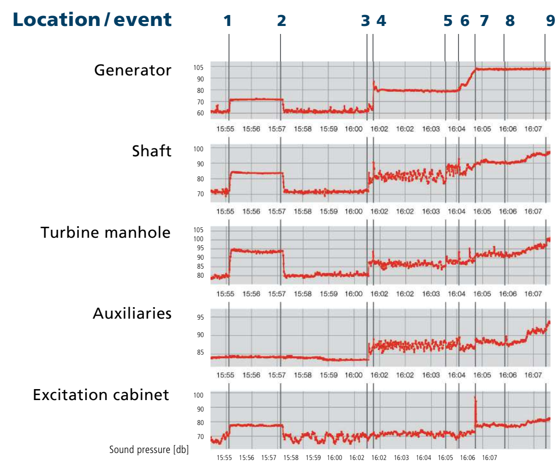
- First, collect a large number of training samples to get a fingerprint of the "normal" situation. This is the basis for detecting any abnormal situation or anomaly.
- Second, classify samples that show anomalies by the type. Later, if a reasonable number of such anomalies have been found, then the classification of similar types can be done automatically.
- Third, do further classification, where the technical background of a certain sound event is included. This puts the sample in a specific technical context. This technical classification includes the analysis of actual events happening locally as well as past experiences of either the involved experts or those already stored in the system.

Only now can the system be trained to diagnose specific events in addition to detecting anomalies. Prediction is still one step further. This requires that the classification explains whether the specific sound is an indication of an actual event to happen in the future.

First applications of advanced integral monitoring approach

Audible noise—An early indicator of failures

Audible noise is an early indicator of mechanical problems in equipment. A typical mechanical system starts rattling or making other noises before it breaks. Hence, microphones were selected as a first integral measurement quantity to develop the new type of monitoring system. Audio detection has been installed in pilot sites for a long-term test under real conditions.



Audible event

1 Air compressor on
2 Air compressor off
3 Oil pumps on
4 Oil supply to bearings on
5 Filling of spiral start
6 Wicket gates start opening
7 Excitation on
8 Synchronization
9 Maximal power reached

Figure 3. Audible patterns during a start-up sequence.

Start-up sequence analysis

To give an idea of what can be heard and diagnosed, the diagram shows a start-up sequence of a hydropower unit that was equipped with five measurement units in different locations across the hydropower unit (figure 3). Assuming the start-up sequence of the plant is fixed, the algorithm can now match any future start-up sequence and immediately issue a warning if it is not in accordance with the reference case. It is also noticeable that some of the events do not influence all signals in the same way. This is due to the spatial separation of the measurement locations.

Figure 2. Installed sound recorder.

Thus, the collected information only becomes meaningful and useful for diagnostics with the actual technical context of the installation. Interpretation of acoustic data relies not only on machine learning but also on a large amount of domain knowledge.

Potential failures to be captured

The table has examples of events that were indicated by audible noise upfront (figure 4). The collection is based on experience over the years and a selection of recent cases. Some of the cases actually led to an unplanned stop of the machine with major repair work required. It is interesting to note that the examples are not limited to a specific type or size of machine. In a number of cases, an early indication by acoustic monitoring would have prevented major damage and significantly saved maintenance costs.

Safety, security, and privacy for cloud-based approaches

Cloud-based software, network, and computing technologies bring opportunities to gain knowledge from vast amounts of data, but also bear certain risks. The safety of a hydropower plant must not be compromised. It is ensured by the following:

- The integral monitoring system performs only non-mission-critical operations.
- Only one-way data transfer away from the hydropower plant is enabled.
- The monitoring system uses communication channels that are separate from standard process control.

These measures make sure that the integral monitoring system does not interfere with any plant safety and protection, control, or supervisory control and data acquisition (SCADA) systems. Depending on the user's requirements and trust in information technology (IT), these principles can be implemented either as software or hardware. Still, communication across the Internet is needed to establish a dataflow between the cloud computing system and the monitoring system on site.

Connection of advanced monitoring systems to the cloud

One critical part of information security is the router, which separates the monitoring network from other networks in the direction to the Internet. The VPN router is set up so that it cannot be connected from "outside." It will simply refuse all connection requests. Separate, dedicated communication channels are strictly built up by the monitoring system and the router themselves. They contact the cloud actively and via tunnels, not the other way around. Being not actively reachable from "outside" is an important measure to increase security.

Each OnCare.Acoustic device on the user side, for example, is equipped with a private certificate. Thus, the cloud can identify the connecting devices, as it holds their public key. Additional security is provided by the fact that cloud components also have a private certificate, so devices can verify their intended connection counterpart.

Routers with integrated firewall and certificates are important cornerstones of security during data transport. However, they are supported more by measures, like encryption, which are standard in modern communication, such as AMQP, which was first used in the banking and finance sector.

Connecting advanced monitoring systems to the power plant

Another critical part is the connection between the OnCare.Acoustic system and the control system or SCADA system of the user. The system provides better diagnostics if it knows about the operating conditions of the power units. Thus, a data interface is required to retrieve process data from the SCADA or control system. Here, we have multiple possibilities. And this is also where the North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection (CIP) standards for cybersecurity have to be consulted.

The cybersecurity standards of NERC are aimed at protecting "critical infrastructure" by law. They are enforced in the U.S. for large power plants, for example. But their existence also increases the awareness of IT security topics in smaller plants and influences other industries.

Depending on the total network layout of the plant, measures can be used to permit data transfer only in one direction: from SCADA or the control system to OnCare.Acoustic. Such measures may include:

- Routers for network separation and with communication traffic control
- Protocol converters to connect to existing historians or other data layers on the customer side, instead of connecting directly to the SCADA or control system
- Data diodes, and especially physical data diodes. In this case, the connection is established through a single fiber optical channel. Thus, sending data toward the SCADA or control system is physically impossible.

Therefore, part of the scope of such new monitoring systems is a thorough site assessment to determine the best possibilities for IT security.

Promising results

The proposed solution shows promising results and offers opportunities to improve the availability of hydropower plants by reducing the risk of unplanned outages. It allows plants to recognize degrading equipment early and supports maintenance crews by guiding them to the proper area inside the hydropower plant. It thereby has the potential to also reduce operational risk and maintenance costs.

By combining the solution with remote expert services, it can also continuously guide local crews in gaining experience and expert knowledge faster. It is easy to retrofit for existing hydropower plants, even without existing monitoring systems. Unmanned power stations and hydropower plants in remote areas with only limited accessibility especially benefit from such an advanced and integral monitoring approach. It is a safe and secure solution due to the network separation from any existing SCADA or control system.

Building on the experience gathered from the first long-term installation of the system, similar, if not the same, algorithms can be applied to existing data from classical monitoring systems. This will have even greater potential to detect possible equipment failures. Overall, enriching the existing portfolio of monitoring solutions by cloud-based approaches brings new benefits to the operators of hydropower equipment and will lead to predictive maintenance strategies in the future. ■

ABOUT THE AUTHOR

Rudolf Muench, Dipl.-Ing. (Rudolf.Muench@voith.com), is development project manager and expert for data analytics at Voith Digital Ventures, Germany. Over more than 25 years, he has been working in advanced control systems, artificial intelligence, and data-driven applications for process supervision. Muench studied electrical engineering at the Technical University of Munich. He published multiple papers and holds several patents in the field of automation technology.

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RESOURCES

"Monitoring, Analysis and Diagnosis"
http://voith.com/ca-en/t_3385_e_HyCon_MD_screen.pdf

DIN ISO 7919-5
"Evaluation of machine vibration by measurements on rotating shafts, Part 5: Machine sets in hydraulic power generation and pumping plants"

"Python-based ecosystem of open-source software"
http://scikit-learn.org/stable

"MLlib is Spark's scalable machine learning library consisting of common learning algorithms and utilities"
https://spark.apache.org/docs/1.1.1/mllib-guide.html

Products and success stories
www.amqp.org/about/examples

NERC CIP Standards
https://www.nerc.com/pa/Stand/Pages/ReliabilityStandards.aspx

Power plant type	Rated power	Type of noise	Root cause	Damage
Kaplan	20 MW	Noise at blade passing and gate passing frequency	Larger blade tilt resulted in interaction with draft tube man door	High vibrations, potential leakage of man door
Kaplan	40 MW	Rattling of cast oil pressure line	Resonance in hydraulic system in certain operating states	Potential rupture of pipe
Kaplan	160 MW	Periodical noise at slip ring	Generator unbalance	Fire at slip ring
Francis	180 MW	Transformer noise	Audible strange noise was not reported to maintenance	Fire in transformer
Francis	440 MW	High-pitch audible noise	Runner blade crack	Potential bigger damage
Pump storage	50 MW	Generator ventilator caused noises around 100 Hz	Faulty mounting (insufficient stiffness)	Potential loss of equipment
Pump storage	240 MW	Potentially audible noise inside generator housing	Loose rotor fan blades	Stator required significant refurbishment

Figure 4. Examples of potential failures to be captured by sensing audible noise (collected from past experience).

Flowmeters are calibrated to meet applicable standards using a certified flow calibration rig like this one found at Endress+Hauser's ISO/IEC 17025 A2LA Accredited Calibration Laboratory in Greenwood, Ind.

Setting up an instrument calibration plan

A plan determines when instruments need to be calibrated, saving time and money by eliminating unnecessary work

By Kyle Shipps and Nathan Hedrick

Failure to calibrate instrumentation can negatively affect performance, while calibrating too frequently can result in excessive costs without providing any benefits. The question is, how do you determine if calibration is needed?

In many process plants, instruments are calibrated annually, or based on some other time-based criteria. New instruments and technologies, combined with careful planning and study, allow plants to calibrate instruments at an optimal frequency, for improved operations and cost savings.

In some cases, instrument calibration is determined by industry regulations. In the water and wastewater industry, for example, typical flowmeter requirements are:

- Flowmeters have to be verified at regular intervals.
- Verification has to be performed by a qualified third party and with an accepted inspection method that is based on quality regulations such as ISO 9001.
- A test report needs to be provided for documented proof of verification.

In the pharmaceutical industry, quality risk management has become a mandatory regulatory requirement for drug manufacturers. The Food and Drug Administration (FDA) and the European Medicines Agency (EMA) publish guidelines and requirements for process instrumentation. Guidelines such as "Process Validation: General Principles and Practices," by the FDA, and Annex 15 issued by the EMA offer input to help drug manufacturers manage instrumentation correctly.

The chemical industry has requirements for proof testing per IEC 61508 and IEC 61511, while the oil and gas industry must adhere to contractual agreements between buyer and seller, while also complying with government agency mandates. For example, a company producing oil from a well under an agreement with the Bureau of Land Management or other property owner may have to prove flowmeters at a determined frequency.

Traditional practice drawbacks

Because measurements are so critical to many processes, the traditional industry standard is to calibrate annually, even though it might not be necessary. For most companies, annual calibration is performed as a traditional ritual with no scientific basis, other than being the longest duration of time they are willing to risk.

In many instances, yearly calibrations are not necessary. For example, some flowmeters require calibration only once every three or four years depending on the process fluid, operation, and criticality. In other cases, instrumentation may require calibration much more frequently, possibly monthly, to maintain a safe, efficient, or regulatory-compliant operation. It is also important to realize that calibration intervals are not always fixed and may fluctuate based on usage and other factors.

The first step to addressing these and other issues is an assessment.

A plantwide assessment of all instrumentation to identify and make a list of all instruments is the first step in a calibration plan. This list should also include details such as description, location information, operating conditions, working range and history, and any other items that provide a better understanding of the instrument and system function.

Users should then identify which instruments are critical to the application, the environment, and operator safety. The quality, metrology, maintenance, and automation groups should pool their knowledge of the process environment, the condition of the installed instruments, the type of maintenance work carried out, and any limitations imposed by the plant in terms of servicing. The group should assess each instrument and ask: "Does this instrument have an impact on the quality of the product, on process functionality, or on operator safety?"

The next step is to create a calibration plan, taking all the above factors into account.

Assigning calibration criticality

All instruments should be assigned to one of four categories, ranging from critical to noncritical. The first category—instruments critical to the product—are those affecting product quality or regulatory compliance. These instruments have a direct link to company profits, whether regarding measurement of ingredients in food processing, mixing of chemicals, custody-transfer, or other critical applications.

The next category—instruments critical to the process—are those that can upset the overall plant or other processes, such as shutting down the entire process. The failure of an instrument in this category could cause inefficiencies and production losses but have no direct effect on product quality or safety.

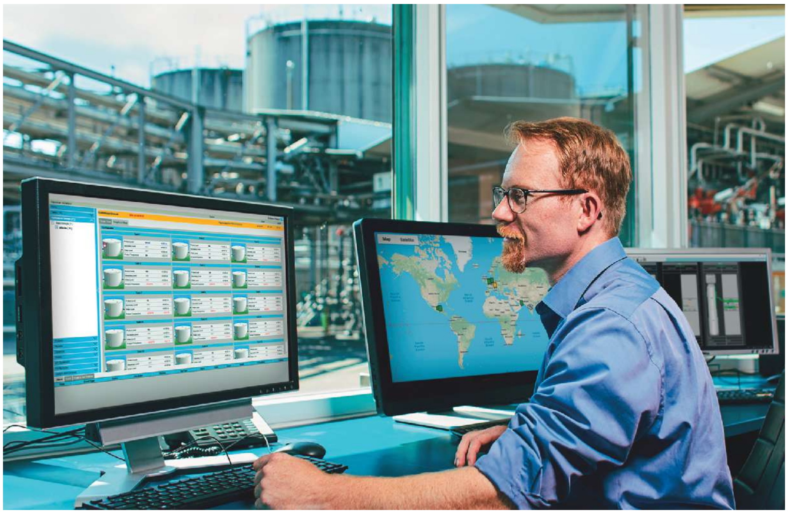
Instrumentation critical for safety has a direct impact on operator safety, equipment protection, and/or the environment. These instruments do not necessarily have to be extremely accurate, which lessens their criticality with respect to calibration, but they certainly have to work properly and reliably.

Finally, noncritical instruments have no impact on product quality, the overall process, safety, or the environment. These types of instruments are typically only used for local or remote monitoring, or when manual operations are performed.

After all instrumentation has been identified and classified into these four categories, a maximum permissible error (MPE) is assigned to each device. MPEs define the tolerance for each function being measured. A critical instrument will usually have a more stringent MPE than a noncritical one.

Over time, most instruments will experience slight accuracy degradation due to aging and simple wear and tear on mechanical components. This needs to be considered when establishing the MPE.

The first step in a calibration plan is to identify all the instruments in the plant and enter data about them into asset management software.



Modern instrumentation management software keeps track of all the information about each instrument, including when it needs to be calibrated.

Some asset management systems allow access to instrument information by mobile devices. This maintenance technician gets the data he needs to troubleshoot the level instrument on this tank.

If you can show an auditor or other responsible entity that a noncritical instrument has no effect on product quality, safety, or the environment, then you can claim there is little or no need for periodic calibration. Conversely, you may need to calibrate critical instruments more often than annually to maintain product quality, process operation, or safety.

The instrument manufacturer can help determine factors to keep in mind when defining MPEs, and it can help assess the plant's installed base. It can also help define ideal calibration intervals.

Managing instrument data

Data from the installed base analysis should be stored in an asset management, maintenance management, or instrumentation management software program. One of the major advances in recent years has been the development of instrumentation management software. These systems contain information such as spare parts lists, drawings specific to the instrument, original calibration data, and certificates.

All instrumentation is calibrated by each manufacturer before delivery to the customer, and this calibration data is easily entered into asset management software. Afterward, when a device is recalibrated, its calibration history can be updated and automatically loaded into the asset management system.

In many cases, modern instrumentation equipped with advanced diagnostics can determine if a problem exists, and condition monitoring or other software can inform the maintenance department via an alarm if a particular device is having problems. This diagnostic data also feeds into the instrument management software, where operators, engineers, and maintenance personnel can review it remotely.

For example, diagnostic data from a Coriolis flowmeter can include empty pipe detection, sensor drift, sensor error, electronics error, inhomogeneous mixture error, and ambient and process temperature errors. This data can be used to optimize calibration, diagnose problems, and detect minor issues before they grow into substantial problems.

In addition, many flowmeter technologies are incorporating built-in verification methodologies to qualitatively ensure and document instrument health. When these verification methodologies are traceable, they can be used to supplement the calibration plan.

Another recent advance gives access to the information in an asset management system via mobile devices. From the field, a technician can pull up the calibration history, diagnostic data, troubleshooting instructions, and other information needed to properly diagnose an instrument issue.

Deciding when to calibrate

Calibration frequency depends on the MPE, the nature of the product being measured, the need for clean-in-place (CIP) operations, the severity of process impacts, the type of instrument, and other factors. In some cases, it may only be possible to access an instrument during a complete process shutdown; in other cases, an instrument might be completely accessible for calibration.

Considering the cost of each calibration—which may involve shutting down a process to allow removal of the instrument, taking it to an accredited calibration facility, reinstalling it, and starting up the process—it is wise to combine the calibration plan with a plan for spare parts and replacement instruments.

Thanks to advances in diagnostics and instrument management software, setting up an instrument calibration plan based on best practices is much easier than in the past. Once set up, the calibration plan will improve operations and save money by making sure all instrumentation is calibrated only when necessary. ■

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Nathan Hedrick is national product marketing manager for flow at Endress+Hauser. He graduated from Rose-Hulman in 2009 with a BS in chemical engineering. He began his career with Endress+Hauser in 2009 as a technical support engineer.

Passionate problem-solver empowers future women of STEM

By Renee Bassett

A passion for continuous improvement and a desire to give back drives one chemical engineer, Six Sigma blackbelt, and mom to mentor girls in science, technology, engineering, and math (STEM) careers like her own. The result is rewards that keep coming, personally and professionally.

With a BS in chemical engineering, Amy AlSahsah has certified more than 300 candidates in Lean Six Sigma from white belt to black belt during her eight-year career with Greene Tweed. She helps the global manufacturer of high-performance thermoplastics, composites, seals, and engineered components improve factory performance, including safety, quality, delivery, and cost.

AlSahsah uses her expertise in Six Sigma's define, measure, analyze, improve, and control (DMAIC) methodologies and lean manufacturing/management techniques to meet problems head on at Green Tweed's Kulpsville, Pa., facility. And she often manages to solve them creatively using the combined talents of engineers and shop floor associates.

As a woman managing production on the floor, AlSahsah has found that she is typically perceived as being easily approachable. "People feel they can tell [me] things about finding problems and variations. There is perhaps an inherent trust that I am listening and might do something to correct the issue identified," she says.

Be an engineer first

AlSahsah tells girls that it is far easier to become an engineer or scientist first, and then use that background to accomplish anything else they want. She says in college she was initially a chemistry major, but quickly realized that she wanted to work in production, so she switched to chemical engineering in her second year and never looked back.

"Being a good problem solver is priceless—it will take your whole life in a positive path," says AlSahsah. "You can be anything if you are first an engineer—doctor, lawyer, nurse, accountant, artist, author, or marketing and sales professional. Going the other way is not always doable."

"Do it even though it is hard. That is what makes you grow!" AlSahsah adds.

AlSahsah regularly participates in a number of events, including speaking at her daughter's middle school STEM day and actively supporting Take Your Daughter to Work events. "I also will mentor anyone who comes along and asks for advice for their children or my daughter's friends!" she says.

She interacts with the local technical high school and participates in the Society of Women Engineers chapter at her alma mater, Lafayette College. The group supports numerous middle school activities, an engineering week, and a science fair, as well as providing scholarships and awards. She also gives advice to individual chapter members wondering whether they should pursue application versus process engineering and answers their questions about which courses to take.

"One of my prior roles as a process engineer for seven years at a small chemical plant has really paid dividends, because it enables me to mentor and coach other process engineers in ways they can make improvements," AlSahsah says.

Get to root causes

Her first engineering supervisor, also a chemical engineer, mentored her to problem solve by quickly getting to root causes. Her background helping in the family machine shop and insulation business propelled her initial interest in continuous improvement and taught her how it can enhance the bottom line. She worked on the family cars and did yardwork, while also learning traditionally female domestic duties such as cooking and crafts. AlSahsah has systems for everything, from loading the dishwasher to maintaining her cars.

"There are still people out there with preconceived notions about what an engineer looks like," says AlSahsah, and still a lack of awareness of what engineers actually do. Luckily, she has lots of examples to share with students and fellow engineers. These and other achievements resulted in AlSahsah being the first woman profiled in Greene Tweed's Women of STEM series.

"Being a good problem solver is priceless—it will take your whole life in a positive path."
—Amy AlSahsah, Green Tweed

AlSahsah's first black belt project saved $995,000 in one year and increased the product's profitability. The team she led eliminated a source of contamination that had caused a line stop issue and reconfigured the inspection process to mitigate similar issues moving forward.

More recently, she led a 20–30-person, cross-functional team looking for ways to reduce obsolete inventory. Diving deeply into past customer orders, they worked with the production, quality, planning, and methods groups, along with SAP programmers, to introduce better methods for systematic product scrap planning. By reducing scrap, that project saved her company $2.2 million in a year. ■

ABOUT THE AUTHOR

Renee Bassett (rbassett@isa.org) is chief editor for *InTech* magazine and Automation.com, as well as contributing editor for ISA Publications.

This column is adapted from Green Tweed's Women of STEM series found at www.gtweed.com.

ISA's Strategic Leader Meeting moves organization forward

BY PAUL GRUHN, 2019 ISA PRESIDENT

This past month, ISA leaders convened in North Carolina for the first of two in-person meetings. This was our Strategic Leader Meeting (SLM) and is intended to be a meeting of a relatively small group (around 50) of volunteer leaders to discuss strategic issues and operational details.

Our second in-person meeting, the Annual Leadership Conference, will be in October. This event has a larger and broader audience (around 150 volunteer leaders) and includes the Council of Society Delegates business meeting, professional development training, and the Society's annual Honors and Awards Gala. Many of our standards committees also meet before or after the annual conference.

I believe that all members have a voice in our future, and I am excited to share some of the work that happened during the Strategic Leader Meeting. I hope that you will get some sense of the excitement and optimism that I feel for where we are going based on the compelling conversations at this event.

Before I give more details, let's remember the journey we have been on as an organization. During the past year, we have revised our vision and mission statements. Our vision is *to create a better world through automation*. Our mission is *to advance technical competence by connecting the automation community to achieve operational excellence.* We have also developed five core values: *excellence; integrity; diversity and inclusion; collaboration; and professionalism*.

Leveraging these concepts, the Executive Board worked to develop strategic objectives that will move our mission forward over the next three to five years:

- Establish and advance ISA's relevance and credibility as the home of automation by anticipating industry needs, collaborating with stakeholders, and developing and delivering pertinent technical content.
- Enhance member value and expand engagement opportunities to nurture and grow a more diverse and global community to advance the automation profession.
- Become the recognized leader in automation and control education, providing training, certifications, and publications to prepare the workforce to address technology changes and industry challenges in the most flexible and relevant ways.
- Create opportunities for members to improve critical leadership skills, to build a network of industry professionals, and to develop the next generation of automation professionals.

With the long-term focus of the objectives established, your Board also discussed possible goals (9–18 months), tactics (up to 6 months), and key performance indicators.

The Board also knew it was important to tap into the collective wisdom of the Society, and that became the purpose of the Strategic Leader Meeting. After a brief dialogue about each objective, the leaders worked in small groups and brainstormed ideas. They summarized their suggestions for the group, which were captured in an online mind-mapping tool. With all the ideas captured, each leader identified the top two priorities under each objective. There were so many great ideas—you could feel the energy in the room, and we came out of the sessions with great input.

We are thrilled to report that 100 percent of attendee survey responses confirmed "the strategic discussions were valuable to me." Some comments on the overall meeting included:

"I really enjoyed the format, content, and people. Definitely a valuable experience."

"I found the people at the meeting intelligent, passionate, and willing to do what it takes to improve the society."

"I better appreciate the vision and challenges of ISA."

"ISA is in a much better place, financially and strategically."

I have personally been attending ISA leader meetings for close to 30 years. The positive vibe at this SLM was apparent to everyone. Many used the words "positive," "exciting," and "optimistic" in their feedback. There was more levity and laughter than any other leader meeting I can recall. One leader stated it was the most positive meeting he has been to in 15 years.

"I found the people at the meeting intelligent, passionate, and willing to do what it takes to improve the society." — Attendee

At the close of the meeting, leaders and staff were asked to pledge what they would do differently moving forward. Some of the responses were:

"Think collectively. Let others share ideas and listen carefully."

"Keep an open mind to new opportunities and ideas."

"Pitch in to help solve a problem that I have been waiting for others to solve." (There were several variations of "stop complaining.")

"I will encourage others to join and participate in leadership at my local section."

If you care about the future direction, success, and health of your society, I strongly encourage you to get involved. If you have ideas on what we can be doing better, we want to hear from you! You will be seeing tools and resources soon that will make getting involved much easier. Exciting times are ahead! Thank you for being part of the ISA community. ■

Congratulations to new CAPs and CCSTs

Qualifying for and passing one of ISA's certification exams is a noteworthy accomplishment. The exams are rigorous and require a solid command of various disciplines in automation and control. Below is a list of individuals who have recently passed either our Certified Automation Professional (CAP) or one of the three levels of our Certified Control System Technician (CCST) exam. Congratulations to our new certification holders! For more information about the ISA CAP and CCST certification programs, please visit www.isa.org/training-and-certifications/isa-certification.

Certified Control System Technicians

Level 1

Eddy Wang, Linde
Alexander Bryant
Ben Fabling
Shawn Blake
Jordan Foushee, The Dow Chemical Co.
Christopher Hickman, Seward County Community College
Dustin Robelia, Xcel Energy
Chris Snavely
Clinton Thompson
Shannon Vasseur, Williams Energy Services
Cody Webb
Matthew Jacko, Xellia Pharmaceuticals USA
Travis Donovan
Jeremy Krause
Robert Vanvalkenburg
Fortunato Alvarado Fernandez
Robert McNiel, Prime Controls
Jordan Crisler, Georgia Power
Jonathan Waker, Browns Hill Engineering
Ty Evans
Joshua Lee
Colton Moore, Prime Controls LP
Stephen Reich
Robert Shearer
Charles Jenkins
Stephen Blessing
Olson Dahl, Alyeska Pipeline Service Company
Nathan Eisenbarth, Williams
Kevin Fallon
Daniel Atha, Dominion Transmission Inc.
Scot Brain, Performed Line Products
Matthew Burton, Dominion Energy
Robert Grier
Gerald Gunsley
Michael Lewis, Dominion Energy Transmissions, Inc.
Gerard Mach
Joseph Pratt
Joseph Reese, Northeast Ohio Regional Sewer District
Daniel Dirzuweit
Ryan English, Regeneron Pharmaceuticals
Joseph Foland, Regeneron Pharmaceuticals
Carlos Morales Otero
Thomas Matt Boyer
Jose Castillo Villa, Utilities & Energy Services
Ryan Hawkins
Stephen Horgash
David Moore
Cordero Flores, Prism PSG
Adam Eishen, Prime Controls LP
Juan Anda
Arthur Imai
Jose Lozano, Metropolitan Water District of Southern California
Tad Milliken
Justin Nanney
Somphop Piapakdee, Instrument and Control Systems Technician
Ryan Tschimperle, Hollyfrontier
Isaac Baylis
Ronald Cavicchia
Dennis Gorlock, Mark West
Kevin Highley
Jason Martineau
Ronald Reed
Brice Bettinghausen, Orange County Sanitation District

Level 2

Jacob Enoch
Christian Djateu Pettang
Delroy Menzies
Ricardo Valencia
Matthew Abrell
Joshua Boyd
Terence Jokwa Mukete
John Pittman, Instrumentation Technical Services
Daniel Brewer, Jacobs
Joshua Smith
Charles Bethke, Tourgee & Associates Inc.
Robert Blanchard
Eric Gutierrez, Flint Hills Resources
Barry Phillips
Andrew Jones
Joseph Lawdanski, Custom Controls Unlimited
Matthew Tofte
Rafael Martin Anaya Figueroa
Paul Sexton
Juan Anda
Robert Cefalu
Eduardo Cervantes, Metropolitan Water District of Southern California
Heriberto De La Torre, Metropolitan Water District of Southern California
Darryl Gross
Arthur Imai
Charles Lane
Somphop Piapakdee, Instrument and Control Systems Technician
Enrique Young

Level 3

Eldon Thomas
James Robles
Peter Giannotti
Christopher Angie
Jeremy Kibler

Certified Automation Professionals

Chris Farajian
Taylor Russell
Manoj Rana
Sheikh Nauman Iqbal
Mack Seagro
Eric Swanberg, Excel Engineering
Fernando Enrique Pacheco
Ali Naveed Khan, NCB Capital
Nick Butterbaugh
Nithin Nasimudeen, Schem
Wilfredo Ramos
Daniel Porter
Kameran Tajdini, Solvay
Carlen Wallace
Khaja Afsar Hussain Khaja
Remya Sreenath
Benjamin Oser
Okon Solomon
Mustafa Alkhulaitit, Honeywell
Steven Martz, Crane Composites
Shams Ul Islam Haleem, Saudi Electricity Company
Stuart Britten
Nilesh Lal, Banks Integration Group
Elton Amirkhas
Ramesh Gurav, Thyssenkrupp Industrial Solutions (India) Private
Jelaine Angelica Ang, MHPS Technical Services Corporation
Rajesh Kharavalikar
Sandeep Sidhu
Ronald Rodriguez, AMEC
Luiz Rogério De Freitas Júnior
Adeel Ahmed

Global scan of AI and 5G wireless networks

By Erik R. Peterson

ABOUT THE AUTHOR

Erik R. Peterson is partner and managing director of the Global Business Policy Council of management consulting firm A.T. Kearney. This column is from a new report, "Competing in an Age of Digital Disorder." Find out more at www.atkearney.com.

Much attention is now focused on the technologies underpinning the fourth industrial revolution (4IR)—artificial intelligence (AI), 3D printing, advanced robotics, the Internet of Things (IoT), and augmented reality. These are reshaping production processes and redefining global value chains. While the global competitive landscape is intensifying across a variety of digital technologies, two areas in particular stand out in the short term: 5G wireless networks and AI.

Designers are creating 5G wireless networks to facilitate instant, reliable connections between billions of devices dramatically faster than is possible today. Greater bandwidth will allow it to support massive machine-to-machine communications, such as between cellphones, sensors, smart machinery and appliances, and other IoT devices. 5G will also enable a range of new and future applications in the other next-generation 4IR technologies, many of which will be the backbone of innovations in manufacturing and production processes.

The large-scale deployment of 5G wireless networks will therefore be one of the most intense—and consequential—technology races in the near term. National competitiveness will increasingly be determined by the level of 4IR technological adoption and innovation, which in turn will depend on the depth and breadth of national 5G wireless networks.

But 5G deployment is not without its challenges. As urban areas prepare to install 5G infrastructure, its uneven deployment is likely to become a limiting factor for the expansion of 5G-dependent technologies. More broadly, disparities in access to 5G could exacerbate regional inequities in digital connectivity.

One of the greatest challenges to a hyperconnected 5G future is lack of cybersecurity. According to a 2018 study conducted by Ericsson, 79 percent of business leaders across 10 industries regard data security and privacy as their top concern for 5G adoption. Such cybersecurity concerns are a matter of national security. As 5G enables the explosion of IoT, so too will it provide greater opportunities for potential exploitation of these devices by a range of malicious national and subnational actors.

South Korea, the U.S., and China appear to be the leaders in the race to 5G. The E.U. appears to be falling behind, which the chief executive of Ericsson recently attributed to regulations and high costs.

AI is the other area of technology driving intense national competition. From digital assistants and self-driving cars to job candidate selection and personalized medicine, AI-driven technologies are more available than ever before in the business, healthcare, retail, and entertainment sectors. Data security is one of the most common business use cases, with cybersecurity companies leveraging AI to detect malware and search for anomalies in how data is processed in the cloud.

These advances also come with concerns. As AI becomes more capable of performing both blue- and white-collar jobs, worker displacement seems inevitable. Regardless of the precise time frame and scope of job losses, AI will certainly have a transformative effect on the global workforce. Governments, companies, and educational institutions need to develop strategies to give workers the AI skills necessary to compete in the new environment.

AI also presents a new range of vexing ethical questions, such as concerns about bias and discrimination in AI algorithms. There are also worries that the growth of AI will cause even greater levels of income inequality as owners of AI-enabled companies reduce their human workforce. Despite these concerns, AI is generally acknowledged to be one of the major forces in the near term that will define national competitiveness in the coming decades.

The U.S. is the leader in three of the four main drivers of AI, according to the University of Oxford: hardware, research and algorithms, and the commercial AI sector. But on the final driver, data, China is far ahead of the pack. China's large population and data-sharing agreements between leading Chinese technology companies and the government have enabled significant real-world AI testing. But the race is by no means over.

Many governments, including all five of the world's largest economies, have released national—or in the case of the E.U., supranational—strategies in recent years to develop AI. Each is unique, but common themes include investment in R&D, efforts to upgrade skills and workforce training, greater private-sector innovation, and evaluation of AI's ethical implications. ■

Benefits of incorporating predictive analytics into manufacturing processes

By Jeff Ralyea

The rise of digital technology in manufacturing, known as Industry 4.0, is a transformation that makes it possible for manufacturers to gather and analyze data across numerous devices, machines, and systems. This enables faster, more flexible, and more efficient processes. According to a U.S. manufacturing industry survey commissioned by ECi Software Solutions, more and more manufacturers are embracing Industry 4.0 as well as the digital technology revolution. In fact, 89 percent of respondents said they have made increased technology investments over the past year to stay on top of this rise in innovation. However, as manufacturers continue to digitize their operations and adopt more technology, the amount of data they will access will inevitably increase. Manufacturers may struggle to know which data is actually useful.

The same survey found that 50 percent of manufacturers have begun turning to predictive analytics and tools that analyze both current and historical data to make predictions about future events. The more data available, the more accurate these predictions become. By incorporating predictive analytics tools in concert with an enterprise software solution, like enterprise resource planning (ERP), manufacturers create opportunities to make more informed, strategic data-based decisions.

Here are some examples of how predictive analytics helps manufacturers make the most of their data:

- **Forecasts market demand.** Market demand is rarely stable, making it harder for manufacturers to have a clear, comprehensive view of the future. By taking a closer look at the trends and events that reoccur in the market, manufacturers will have an easier time determining what they need to prioritize within their business to address market needs. Predictive analytics does exactly that by combining demand forecasting with risk-based inputs, helping manufacturers produce more outputs when they are needed, which ultimately saves them time and money.
- **Improves equipment management.** Machines break down over time, parts wear away, and the cost of replacing broken down equipment can add up. By implementing predictive analytics, manufacturers can reduce machine loss by determining when machines may need to be brought online or shut off. This tool can also help with preventive maintenance by triggering alerts or calls for assistance from machines based on the data captured. This reduces the issues found in devices and can also be used to identify manufacturer equipment defects in machines.
- **Applies forward-thinking business decisions.** Predictive analytics looks at all the manufacturer's historical data and determines what has worked and what has not worked in the past, allowing manufacturers to ask themselves important business questions like "how efficient are my workers and machines? How many jobs can I get through? Will my business benefit from investing in a new, expensive machine?"

  By answering these questions before making an investment, manufacturers can spend more time looking into the additional data they do not already collect and determining how they want to collect it and what to do with it in the future.

Manufacturers who are looking for business success need to incorporate predictive analytics into their tech stack, because it will help them better forecast inefficiencies in their processes, give them insight into what they should do to grow their business, and much more.

Unfortunately, some manufacturers think these analytics are too advanced; according to the survey, 34 percent of manufacturers fear they do not have the internal expertise required to implement these technological tools. Luckily, manufacturers who have management systems in place, like ERP, are already moving in the right direction toward an analytical approach toward their data. Many ERP systems are frequently updated through the cloud, so they stay up to date on the latest analytics tools and insights.

With simple accessibility to these tools comes a potential increase in competition amongst manufacturers. Manufacturers must realize that the most effective way to enhance their processes and grow their business is to embrace innovation and react swiftly and strategically to the ever-changing market. ■

ABOUT THE AUTHOR

Jeff Ralyea (eci@v2comms.com) is the president of ECi's manufacturing division and has more than 20 years of experience in the enterprise software industry. In his current role, Ralyea drives innovation across the company's manufacturing software solutions and identifies new opportunities to maximize value for the company's user base.

Predictive analytics integrated into manufacturing systems increases productivity and efficiency, providing insights into operations across the organization.
Source: M1 Manufacturing ERP Software

New ISA101 HMI technical report focuses on usability and performance

The purpose of having an automated process is to enhance process operations based on safety, performance, process improvements, availability, repeatability, and other relevant factors. Human-machine interfaces (HMIs), the primary means by which users interact with a process, provide the potential and opportunity both to greatly facilitate and enhance operations or to otherwise confuse users and degrade operations.

ISA's first human-machine interface (HMI) standard, ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems*, covers the philosophy, design, implementation, operation, and maintenance of HMIs for process automation systems, including multiple work processes throughout the HMI life cycle. It defines the terminology and models to develop an HMI and the work processes recommended to effectively maintain the HMI throughout the HMI life cycle, including all general concepts until its decommissioning, applying a practical and management approach. The target audiences include end users, designers, developers, and implementers of HMI systems.

In addressing HMIs for equipment and automated processes, the ISA-101 standard provides information, guidelines and a methodology to enable users to be more effective in yielding improved safety, quality, production, and reliability. The practices in the standard are applicable to continuous, batch, and discrete processes, and indeed to any process using an HMI for interfacing to a controlled system. There may be differences in implementation to meet the specific needs based on process type.

The ISA101 standards committee has now published the first in a series of technical reports to provide further guidance in key areas of HMI. ISA-TR101.02-2019, *HMI Usability and Performance*, addresses the specification, design, implementation details, and management of an HMI focused on usability and performance. It explains how the ISA-101 standard applies in determining the optimal solution to achieve the process goals using examples that have been shown to be effective.

HMI enhancements for improved usability and performance are often associated with additional specifications, custom design, implementation, and management considerations, in addition to vendor-provided functionality and features. The new technical report includes examples of these considerations within the HMI life cycle, including the continuous work processes of audit, validation, and management of change. The technical report was written with due consideration to other guidance documents that have been developed throughout industry.

Future technical reports will focus on HMI implementation, mobile devices, and on-machine applications.

The ISA101 committee is currently working on additional technical reports in three areas. The first area is directed at describing the guiding principles and conceptual foundations as a basis for implementation of the HMI, including but not limited to HMI philosophy and an HMI style guide. This technical report will describe general example applications of the philosophy and style guide and will be both target-platform and implementation independent.

The second area is focused on mobile devices, such as tablets and smartphones. This technical report will describe the potential applicability of the ISA-101 standard to mobile applications and devices as process automation HMI, including but not limited to:

- life-cycle process differences versus what is included in the current ISA-101 standard
- HMI design considerations for process control
- user interaction and collaboration considerations
- functional safety and availability of the mobile HMI
- mobile device selection appropriate for the operating environment.

HMI graphical requirements for on-machine applications are very different from those for process industries and control room use. While the ISA-101 standard is effective in guiding developers and end users on how to optimize graphics in an HMI application for process-based industries, it does not reflect the needs of original equipment manufacturers and machine builders.

Accordingly, a third area of work within ISA101 is directed at developing a technical report that will have recommended practices and examples for the application of the ISA-101 standard to on-machine applications, focused on developing HMI graphics that effectively convey contextual information for operating and maintaining a machine.

For example, "set up" is a prime activity in which an effective HMI application can decrease the time needed to set up a machine between different products by guiding an operator through the process; and proximity and line-of-sight security are just two ways an HMI can more effectively guide an operator or provide the relevant information an operator needs for the operator's particular position in regards to a machine and its current state.

ISA101 is co-chaired by Maurice Wilkins of Yokogawa and Greg Lehmann of AECOM. For information about participating in the ISA101 committee, contact Charley Robinson, ISA Standards, crobinson@isa.org, +1-919-990-9213.

For information about viewing or obtaining ISA standards and technical reports, visit www.isa.org/findstandards. ■

Focus on field devices, sensors, and I/O

Capacitive proximity sensors

The line of capacitive proximity sensors with potentiometer adjustment for sensitivity allows sensing of metal and nonmetal objects through insulating materials, such as wood or plastic. They are often used to sense fill levels of liquids or powders. New lower-priced 18-mm and 30-mm capacitive proximity sensors have a simple potentiometer sensitivity adjustment. Operating voltages are 10 to 30 VDC; shielded and unshielded versions and NO or NC units are available.

Existing capacitive sensors have a pushbutton teach function. CK2 series 18-mm capacitive sensors with IP65/IP67/IP69K ratings provide an unshielded sensing distance of up to 15 mm. 30-mm DC-powered CT2 series capacitive sensors have metal (IP65 rated) or plastic (up to IP69K rated) housings with sensing distances up to 25 mm. The sensors are cULus and CE approved and have a lifetime warranty.

Automation Direct, www.automationdirect.com

Analog-to-IO-Link interface modules

Four new second-generation, single-channel, analog-to-IO-Link interface modules can convert a variety of analog input data, such as current, voltage, and RTD/thermocouple measurement to digital equivalent values. Having IO-Link onboard enhances the diagnostic information available. The new modules and their functions are:

- BNI00C9 – Analog input conversion of input data like current, voltage, and RTDs
- BNI00C7 – Analog input for temperature measurement sensors, Type J, Type K, or RTDs
- BNI00C8 – Analog output module with voltage or current output configurations
- BNI00C6 – Universal analog module, configure as either an analog input or analog output.

These modules simplify installations by eliminating analog in-chassis interface boards and reducing additional analog network blocks. IO-Link lets users replace lengthy shielded cable runs with basic unshielded cables.

Balluff, www.balluff.com

Ultrasonic sensor for situational awareness

The TS3, 3D ultrasonic sensor combines hardware components with signal processing algorithms. It is suited for indoor navigation and object avoidance for robots of all types. The TS3 sensor enables them to map an environment and to localize themselves in predefined maps to execute complex path-planning algorithms. The operation mimics the echolocation techniques used by bats and dolphins for navigation and orientation in the wild. TS3 sensors perform independently of ambient light conditions and are even capable of detecting mirroring and transparent surfaces. For reliability, the generated 3D point cloud can be fused with data from other system-relevant sensors. The core technology is the company's SoundVision1 chip. Technical specifications include a detection range of up to 5 meters and a scan rate of approximately 28 Hz.

Toposens, https://toposens.com/ts3

Family of tension load cells

The UXT family of tension load cells, with OIML and NTEP approval, is certified for trade weighing applications. Capacities start at 50 kg to 7,500 kg, ensuring the UXT is suitable for a range of industrial and medical applications, particularly process weighing systems using suspended vessels or tanks. Other common uses include lifting applications, such as crane scales, and medical applications, such as a patient hoist. The load cells are OIML C3 3000d certified and have NTEP approval to Class III and Class IIII, IP67 environmental protection, bidirectional tension and compression loading, and metric and imperial threads available. With its nickel-plated, alloy steel construction, the UXT is an alternative to the company's stainless steel ULB tension load cell, while maintaining an environmental protection rating of IP67.

Flintec, www.flintec.com

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datafile

Datafiles list useful literature on products and services that are available from manufacturers in the instrumentation and process-control industry. To receive free copies of this literature, please contact each manufacturer via their provided contact information.

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The **HM-USB-ISO** USB HART modem meets industry standards for USB and HART connectivity. The small size, light weight, and durability of the HM-USB-ISO make it ideal for portable use. Operating power is derived from the USB connection. An easily installed Virtual Serial Port driver allows use in any Windows-based application.

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Sample of Jobs Available at Jobs.isa.org

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

Senior automation engineer

Perrigo Nutritionals: The senior automation engineer in Burlington, Vt., supports all aspects of the company's automation and control systems. He or she will support and maintain manufacturing automation and control systems to minimize downtime, identify and implement continuous improvement, modify systems to meet changing process requirements, and support capital projects. Work must be conducted to meet all FDA/GMP requirements. The position requires a BS in engineering and at least six years of automation engineering and project design/management experience in the food and pharmaceutical industry, preferably with evaporator/dryer manufacturing and automated packaging experience. The position also requires high proficiency with SQL databases and SQL Reporting. A professional engineer license is preferred . . . see more at Jobs.isa.org.

Maintenance automation technician

Ingersoll Rand: This position has a technical factory automation support role within the Lexington, Ky., maintenance department. The technician provides after-hours support if required and has some scheduled weekend work. The technician will perform electrical and mechanical troubleshooting and repair for all plant automation equipment and will work with the maintenance supervisor to procure parts and plan repairs. The position requires a two-year technical degree; experience with Salvagnini MV, S4, and P4 automated systems; and a minimum of seven years industrial or automation experience . . . see more at Jobs.isa.org.

Supplier quality engineer

John Deere: This engineer in Ottumwa, Iowa, will lead and participate in continuous process improvement and product delivery process teams as the quality representative, ensuring that quality activities and plans are formulated and followed. He or she will also lead supplier quality plan formulation; identify, communicate, and facilitate root-cause analysis for supplier quality problems; and conduct audits of new and existing suppliers to determine manufacturing capability and adherence to accepted quality practices. The position requires experience with drawing and schematic interpretation, product models, and geometric dimensioning; experience with standard quality tools; and knowledge of manufacturing processes . . . see more at Jobs.isa.org.

Senior electrical engineer

Arthrex California Inc.: The engineer, located in Santa Barbara, Calif., will be a leader in the development and optimization of test methods for electronic equipment manufacturing and will set up and conduct tests of complete systems and components under operational conditions to investigate system performance and obtain data for standardization and quality control. The position requires a BS in engineering, preferably electrical engineering, and at least seven years of relevant experience. A strong knowledge of endoscopic visualization systems, including optics, mechanical systems, electronic design, analog circuit design, electro-mechanical design, and high-speed digital circuits is also desired . . . see more at Jobs.isa.org.

Industry noise, hype, buzzwords, and automation professionals

By Bill Lydon

ABOUT THE AUTHOR

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

There is an overwhelming amount of information, buzzwords, and predictions about how manufacturers need to adopt new technologies or go out of business. There certainly is change in manufacturing and production driven by world competitors all trying to apply a wave of new technologies to become winners in their industries.

Technology advances are created by exponential levels of increasing computing power, software advances, artificial intelligence, and communications. New technologies have been adopted in high-volume applications, including smartphones, gaming, virtual reality, online shopping, search engines, speech recognition, and a range of consumer products, driving the cost of the technology down dramatically. At the same time, manufacturing changes are being driven by a number of factors:

- There is a worldwide recognition that low-labor cost is not a winning strategy.
- Manufacturing technology is *not* advancing at the rate of consumer and business systems.
- Technology advances are creating opportunities for dramatic manufacturing improvements.
- Real-time synchronization of enterprise and industrial processes is recognized as means to be more competitive.
- Real-time analytics deliver greater productivity and profits.

To put this into focus, consider smart watches that are selling for under $150 U.S. These devices are like a mini-SCADA system with an embedded processor, 12-bit analog/digital converter, local human-machine interface/display, wireless communications, three-axis accelerometer, vibration motor, complex sensors, embedded software, embedded time series data logging, and a free cloud application for data logging and alerting. Further, these are relatively rugged devices. Smartphones are another example, and I'm always amazed how they survive being carried in the back pockets of blue jeans.

The stage has been set for dramatic changes in manufacturing with automation as a key element for success. In particular, manufacturers and production organizations in developing economies are not encumbered by legacy automation and can easily adopt newer technologies to compete.

Automation should be viewed as a core business function that is critical for success for a manufacturing organization to prosper. *The measure of intelligence is the ability to change. —Albert Einstein*

Technology investments

In this environment of change, automation professionals who can sort out fact from fiction and hype from reality are important. Reactive investments adopting new technology for the sake of doing something new generally have a low probability of success and can be catastrophic. These investments also have an opportunity cost, since there is a limited amount of money available to be invested. Alternatively, sitting on the sidelines and making no investments in new technology can cause the manufacturer to be less competitive and lose market share, profits, and jobs. *If you want something new, you have to stop doing something old. —Peter Drucker*

Automation professional's responsibility

Manufacturing and production companies need knowledgeable automation people to be successful. This also means that automation professionals need to remain knowledgeable by keeping up to date on technology and methods. The focus should be on increasing productivity through automation and leveraging data to achieve the goals of modern manufacturing, including synchronized manufacturing, advanced optimization, overall equipment effectiveness, real-time maintenance monitoring, predictive maintenance, and tracking and tracing.

ISA offers a wide range of opportunities for automation professionals to stay up to date and also participate in the development of industry initiatives and standards. ISA also provides opportunities to share ideas by networking with other members, which can be invaluable in helping sort out hype and reality.

Earn management value

Automation professionals should be a key part of the management team, and this must be earned. Management will listen if automation professionals share reasoned information that links technology investments with business performance to make the company more competitive and profitable.

There have been times in history when there were radical changes in technologies and methods that transformed industries, creating winners and losers. Describing Industry 4.0, many discuss past advances in technology including mechanization, mass production assembly line, and automated controls. At each stage, those that adopted appropriate new technologies and methods became winners, and the others were losers. ■


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10
ALARM SUMMARY
TOTAL ALARMS 3
TOTAL DURATION 02:16:01
TOTAL UNACKNOWLEDGED 3
AVG TIME TO ACK 00:00:00
AVG TIME TO CLEAR 01:09:30
MOST FREQUENT Day Tank - 2 (66.7%)
LONGEST DURATION Tank 1 - 7621 (93.4%)
ALARMS BY HOUR
# of Alarms
Duration (sec)
Tour Feature 1/5