AutomationWorld® TACTICAL BRIEF

Today's Basic Automation, Tomorrow's Solution

CONTENTS

Connecting PLCs for High-Speed Packaging Quality

Stone Technologies creates an effective automated defect rejection process requiring deterministic communication between controllers on separate parts of a high-speed packaging line.

David Greenfield, Director of Content/Editor-in-Chief

Packaging lines are well-known examples of multi-programmable-logic-controller (PLC) operations. There are PLCs on the conveyor lines, which may or may not be provided by the conveyor supplier, and there are packaging machine PLCs typically provided by the OEM.

This mix of controllers can produce some challenging issues if you're looking to connect controller communications in overlapping zones of control on a packaging line. And that's exactly what a Fortune 500 international producer and marketer of beer, wine, and spirits faced when it added a new multipacker to an existing can line used for new package types.

At the Siemens Automation Summit 2019, Fred Husman, senior project manager at system integration firm Stone Technologies, described how they handled this issue to facilitate an automated rejection of packages with defects. The multipacker in this application was added to an existing packaging line to handle a new type of sleek can, creating a system with five PLCs—one for the multipacker, two for the conveyors, one for the turner/diverter/rejector (TDR) table, and one for the tray packer. "In this line there were older Siemens S7 300 series PLCs, newer S7 1200 PLCs, and a Siemens Simotion controller," said Husman.

The multipacker performs quality checks with its PLC, but the actual rejection of defective packages takes place at the TDR table managed by a different controller. To handle this kind of high-speed processing taking place at fractions of a second at steps along the line just a few feet apart, Stone Technologies thought it would have to hardwire the PLCs, said Husman. "But how do you hardwire this when another PLC on the conveyor sits in between the two controllers in question?," he asked?

After considering network solutions to address the difficulty of hardwiring these separate controllers, the beverage producer and Stone Technologies chose Profinet because it is deterministic (i.e. It guarantees delivery of control

Continued
Connecting PLCs for High-Speed Packaging Quality

packets for the system to perform as required). “But it also had to be fast for this application,” said Husman. “We needed communications to be in the 100-millisecond range, and Profinet IO has cycles times in the 100-microsecond range, so it could handle our requirements.”

Because the line’s S7 300 series controllers do not have Profinet integrated, Husman said they added a CP 343 Profinet IO controller to the S7 300s. “This allows us to pass any info between those controllers on a fast, dedicated, deterministic network,” he said.

With Profinet IO added to the line to connect controller communications, cartons flagged for rejection were successfully rejected 100 percent of the time, according to Husman. “Using a dedicated Profinet IO level 1 network worked better than S7 communications over Ethernet level 2 because Profinet IO level 1 communications are deterministic. “Also, using Profinet, the conveyor and machine speeds can be synchronized across PLCs and additional signals can be added quickly without additional cost,” said Husman. “You don’t have to front-end engineer all interlocks or synchronizations between PLCs.”

Reliable Remote Monitoring Keeps Well Sites Productive

Roughneck Equipment, which provides chemical delivery equipment to oil and gas fracturing operations, uses Profinet to make it easier to keep utilization rates high.

Grant Gerke, Contributing Writer

Mostly brownfield operations, upstream oil and gas production sites require materials, equipment and delivery systems to work together to produce high rates of utilization. With hydraulic fracturing pumps, drilling equipment, blenders, and multiple types of storage tanks for sand, water, and chemicals, there are lots of moving parts to keep running smoothly.

Roughneck Equipment leases a wide variety of equipment and chemical delivery systems to oil and gas producers—from small to supermajors. Helping to ease integration challenges for its customers at well sites, the company has added remote monitoring to its machinery, which has proven its ability to improve operational performance.

Roughneck Equipment's parent company, PfP Industries, makes the stimulation chemicals—friction reducers, calcifiers, and foamers—for oil and gas fracturing applications. Roughneck itself manufactures the equipment to store, deliver, mix, and control those chemicals. Getting the right mix of chemicals and volume is essential for keeping upstream costs low.

"Most of our equipment on a frac pad integrates with what the oil and gas industry calls the data van," says Alex Yousefian, automation and controls manager at Roughneck Equipment. "The van receives all the data from the well site—pumps, chemicals, everything."

Monitoring is essential for all frac pad activities in well site operations, and that's where the data van comes in. The data van provides operators with the needed insight of their mobile factories—with their proppant, water, chemical storage, transport equipment, and frac blenders that mix powders, chemicals, gels, and liquids. This mixture is eventually pumped downhole by 25 to 50 tractor trailer-mounted frac pumps at extremely high pressures to fracture formations.

Fracturing production can last from four days to two months, depending on the number of wells. After drilling begins, the data van engineers begin to monitor these pumps that can produce up to 50,000 fracturing horsepower.

"Drillers frac in stages and the equipment can be running anywhere from an hour and a half to three hours," Yousefian says. "That's when pumps are producing a high-pressure mixture of water, sand, and chemicals into the fractures. They expand and hold the fractures open so hydrocarbons become accessible."

Roughneck designed its equipment to be turnkey operations for a wide variety of production companies. The chemical delivery systems

use industrial Ethernet networking standards and IP-based components. The chemical delivery systems include centrifugal pumps, progressive cavity pumps for pumping viscous liquids, and augers for metering in dry chemical. "All of our machinery is controlled by electric motors, most in the range of 5-20 hp," Yousefian adds.

The company relies on Profinet-enabled Siemens 1200 programmable logic controllers (PLCs) and Siemens ET 200 CPU controllers to keep track of its equipment operations and provide diagnostics to detect and correct any operational problems. Using Profinet communications reduces the complexity for Roughneck and its third-party equipment.

"Well site producers have different control systems," Yousefian notes. "Our challenge is to provide robust control to as many customers with a limited amount of programming and hardware."

Most oil and gas production companies still rely on analog I/O control; Roughneck uses PLC analog cards to provide operational data from its delivery systems to the data vans. "The ability to provide control and diagnostic capability all on one cable is desirable from a manufacturing and troubleshooting standpoint," Yousefian says. "Instead of having multiple wires, all control functionality is simplified.

The simplicity extends to the company's ability to use different types of drives for its electric motors due to Profinet's open standard. The variable-frequency drives (VFDs) used for the chemical delivery system come from Siemens, Danfoss, and Vacon. Roughneck is also considering leveraging Profidrive functionality on its equipment to provide easier programming and further expedite system integration at well sites. The VFD applications would use the standard application within Profidrive, setting the speed setpoint and control.

According to Roughneck, the company provides about 10 parameters to a well site's data van. "We're delivering chemicals and, as important as that is, they have all kinds of operating parameters, such as well pressure and pump flows," Yousefian says.

Profinet is more flexible, reliable, and fault-

Continued
Reliable Remote Monitoring Keeps Well Sites Productive

tolerant than other industrial Ethernet systems, Yousefian notes, making it easier to ensure that Roughneck's equipment stays productive. "As an Ethernet technology, Profinet allows us to remote access the unit and troubleshoot equipment," he says. "If additional data or functionality is needed, we don't need to add new wires and programming, which saves us thousands of dollars. The only work required is additional software, which makes it easy and cost-effective to modify our systems and enables us to easily read and write hundreds of parameters."

Hardened Wearables Bring Help into the Field

Voice-controlled, hands-free wearable devices are bringing virtual and augmented reality to field service, training and other uses.

Lauren Gibbons Paul, Contributing Writer

When you're 100 yards up in the air trying to fix a wind tower in a blowing gale, you don't want to take a chance that the piece of paper containing your work instructions snags on the pole and blows away. Such pitfalls might be a thing of the past thanks to a new class of industrial wearable devices that is enabling field service personnel to devote both hands to their tasks.

The equipment attaches to a hard hat or directly to the wearer's head, allowing navigation of critical repair data by voice, even when the wind sounds like a jet engine. Unlike wearable devices that might be used in gaming applications, these wearables are hardened to meet the rigors of industrial environments. They are still generally affordable—typically ranging from $2,000 to $5,000 per device before discounts—especially when you consider the potential ROI they can bring to industry.

"When the machine is down, the company is losing money," says Andy Lowery, CEO of RealWear, which makes ruggedized wearables. Being able to make quicker repairs is a huge benefit, he adds, and so is increased worker safety.

Chevron bought 100 HoloLens devices to use for remote assist in its refineries.

RealWear is one of the more well-known companies in this space, having recently announced its HMT-1 wearable Android-based tablet. Ruggedized to work in the most punishing environments, the HMT-1 provides voice access to connected systems so a worker can access instructions, manuals, knowledgebases, email, chat—any type of document. It works in noise conditions reaching 95-100 dB.

Virtual "expert on call" is another hot application for industrial wearables, giving field service personnel the chance to have a live call for troubleshooting with an expert located elsewhere. This can even include sharing camera images. In its most rudimentary form, the application resembles something like FaceTime. Other "expert on call" options can also extend to virtual reality versions of experts to help solve problems.

Shell has begun rolling out RealWear's HMT-1Z1 voice-controlled, head-mounted device for use at several of its operational facilities around the world. The hands-free platform is the first commercially available device that can be used by field workers in highly restricted ATEX Zone 1 C1/D1 zones where potentially explosive gases are present.

The oil major is using the HMT-1Z1 for remote assistance—enabling a maintenance worker, for example, to get real-time assistance via a video call. The expert on the other end of the call can essentially see through the eyes of the onsite worker and offer over-the-shoulder assistance.

Continued
Hardened Wearables Bring Help into the Field

In addition to saving time and money, field service applications like this are widely viewed as being an effective way to transfer knowledge from a generation on the cusp of leaving the workforce to those just coming up. "Folks are retiring in big numbers. These younger workers have to be supported," says Vincent Higgins, general manager of Connected Plant/Connected Worker for Honeywell, which is the global supplier of RealWear's HMT-1Z1.

Industrial wearables are able to provide workers in the field the information they need when they need it. "This allows the retiring experts to proactively capture information about the assets," says Todd Boyd, founder and CEO of Tacit, which provides software that can be used on a variety of hardware types. "That is very useful to someone who comes along two or three months later. Being able to access a digital envelope where you can access manuals and previous discussions is invaluable."

Shell has begun rolling out RealWear's HMT-1Z1 for remote assistance applications.

Various forms of reality

Industrial wearables getting the most attention at the moment employ virtual reality (VR), mixed reality (MR) or augmented reality (AR) to aid industrial applications. VR is a completely immersive digital experience (such as that offered by the Oculus Rift), providing a realistic simulation of a 3D environment experienced and controlled by body movement. It is used primarily in industrial design or training—because it doesn't allow for situational awareness, it is ill-suited for field applications. AR, on the other hand, layers digital, interactive objects on top of the physical environment, making it more appropriate for field work.

Somewhere in the middle, MR devices feature a world in which physical

objects interact with digital objects. MR encompasses the spectrum from AR to VR, blending the physical and digital worlds to produce new environments where physical and digital objects coexist and interact in real time.

Microsoft's HoloLens is an MR holographic computer that enables hands-free interaction with 3D digital objects. Announced early this year at MWC Barcelona (formerly Mobile World Congress), the Trimble XR10 with HoloLens 2 is a standout for training and field service use. One possible use would be for an oil company to create a 3D digital twin of an oil rig—a replica it can use for training and visualization without the safety risks, says Aviad Almagor, director of Trimble's MR program.

MR is also handy for design. "By placing design content on top of the physical environment, I can compare the digital asset with the physical construction to see if what was designed is being built correctly," Almagor says. "You can see information associated with this asset, you see it in context, and you see the information on top of it."

Chevron bought 100 HoloLens devices at roughly $5,000 apiece and is using Microsoft Dynamics 365 Remote Assist to digitally place experts from all over the world anywhere in the field, including locations that are difficult to reach. The investment has paid off in spades. Bisram Samlall, technology and innovation team lead at Chevron's El Segundo Refinery in California, says the HoloLens is "transformative" and provides "a tremendous reduction in operating expense." The remote expert application gives Chevron a competitive advantage, he adds. The refinery also uses HoloLens for remote inspection of its assets in real time.

Whereas the HoloLens mixes the physical world with the virtual, the RealWear HMT-1 and HMT-1Z1, in contrast, remain firmly rooted in the real world. The heads-up display system resembles the old displays that pilots used to wear, augmenting reality while maintaining situational awareness, a la the old Google Glass.

A RealWear device is not used for training applications, but rather in the field. "It's used when I need to fix something and I want to see the data. I need to do that in a very non-obtrusive, non-compromising way," Lowery says. "This can't be a system where we are taking our hands away to give information."

Through its software and hardware combination, the HMT-1 is considered to be "voice-robust," meaning that it is capable of operating in the highest noise levels and without Wi-Fi access. "Our system maintains voice access no matter what," Lowery says. "You can barely hear yourself speaking, but you can still control the device with your voice."

The HMT-1Z1 has received the Intrinsically Safe certification, which goes far beyond what a consumer device provides—safety from ignition, for example. And it is reliable, with a failure rate of less than 0.1 percent. Application-wise, RealWear is focused for now on four spaces: oil and gas, energy, transportation and general

manufacturing.

RealWear sold more than 10,000 systems in its first year and has also inked some high-profile partnerships. Honeywell has teamed up with RealWear for its robust, safety-certified system. “No iPhone can be brought into a plant. You have to have a certified device so it won’t spark,” Higgins says. “Typically, it has to be built from the inside out for that purpose.”

The Trimble XR10 with HoloLens 2, introduced early this year, can be used for training and visualization without the safety risks.

A software approach

Not all applications—especially training and service in non-dangerous environments—require hardware that has a safety certification or even a high degree of built-in safety. Tacit’s software allows users to leverage consumer-grade hardware they already have deployed, such as tablets, smartphones and other wearables.

“We’re focused on things that are simple and pragmatic for remote guidance—being able to see what the worker is seeing in the field and quickly get to a common understanding of the problem,” Boyd says. “These are simple things done around photo and video, but the user can bring in other elements as well. Everything is in the context of an asset.”

Tacit also offers quick startup: Customers download the Tacit app, select the device they want to use, then launch the app on their device. “We are focused on it being simple, but if we can save an expert one trip into the field, the software pays for itself,” Boyd says. All of the sessions are saved on the back end for reuse, which is a major plus in an industry that has many retiring personnel.

Honeywell is another vendor cre-ating software for wearables via its RealWear partnership mentioned above. “We are all about building software for the next-generation connected digital worker,” Higgins says. “We are enabling the field worker to be much more effective, safer and smarter in the way they do their work. We look for opportunities to co-brand and co-market with hardware companies.” Honeywell sees its role as providing a service and technology to customers that fits under the heading of digital transformation.

Toward that end, solutions benefiting workers in the trenches is an important piece, says Greg Sullivan, director of communications for Microsoft Commercial, the division that brought out the HoloLens.

“We believe first-line workers have not directly benefited from the digital revolution to anywhere near the degree information workers have,” he says. Devices like the HoloLens “enable first-line workers to be more efficient and productive, augmenting and enhancing the workforce, not replacing it.”

In addition to enhancing safety and efficiency, industrial wearables “help solve for the pending skills gap, enable effective processes to be mined and workplace wisdom to be passed on,” Sullivan adds.

Siemens' Plan for Thriving Amid Industry Disruption

Wherever you're at on the digital transformation spectrum, there's no question that industry is being disrupted by technological and economic forces. At Siemens' 2019 Automation Summit, the company presented its case for positioning both itself and its customers to successfully navigate these changes.

David Greenfield, Director of Content/Editor-in-Chief

"It's a time of disruption across industry," said Raj Batra, president of Siemens Digital Industries USA, during his presentation at the Siemens 2019 Automation Summit. The disruption he referenced relates not just to the rapid advances being made to industrial automation technologies and their impacts on industry, but also to the changing business dynamics surrounding customer demands for more customization and the shifting geopolitical realties of world-wide supply chain operations.

"Everyone [in industry] needs more flexibility to deal with mass customization," Batra said. As examples, he cited the chemical industry's need for flexibility to address local production strategies, the aerospace industry's need to better address time-to-market in light of their historically lengthy seven-year production backlogs, and the machine building industry's need to provide improved productivity by reducing commissioning time.

Batra explained that Siemens has been focused on addressing each of these issues—and others associated with industry's digital transformation—through its acquisition and R&D strategies for more than a decade. "You can't get there [providing the digital technologies and services industries need] in a bolt-on way through pure acquisition," he said, highlighting how Siemens has increased its $4 billion R&D spend in 2014 to a projected $5.7 billion spend in 2019. "That's a 40 percent increase in R&D spending in addition to the more than $10 billion we've spent in mergers and acquisitions since 2007."

The most recent effect of Siemens' acquisitions and "organic R&D" strategy was announced on April 1, 2019, with the launch of Siemens Digital Industries. This new organization of Siemens business units combines technologies associated with factory automation, motion control, processing, and software platforms and applications with Siemens customer services to deliver vertical solutions across the discrete, hybrid, and process industries, Batra said. He noted that Siemens Digital Industries has 75,000 employees located globally with, currently, 16.3 billion euros in orders and 15.6 billion euros in revenue.

"The foundation of Siemens Digital Industries is based on the integration of the virtual and real worlds of industry and it has driven our work in software development over the past decade toward delivering the digital twin," said Batra. He explained that Siemens vision of the digital twin encompasses product, performance, and production process across industry verticals.

This allows Air Products engineers to assess their customers' equipment data and provide the type of advanced notice of maintenance

Continued
Siemens' Plan for Thriving Amid Industry Disruption

and repair requirements that Air Products has previously only used internally.

Batra added that Siemens' own application of the digital twin has delivered a 30 percent reduction in design engineering time and 50 percent reduction in time to market for its products.

The key to achieving these levels of improvement with the digital twin is having a common digital repository for all your data, Batra said.

One example of the results Siemens is delivering for its customers through its digitalization technologies was highlighted in a presentation about Air Products and Chemicals' deployment of its ProcessMD application on the Siemens Mindsphere IoT platform. ProcessMD is a web-based predictive monitoring and fault diagnostics platform using advanced statistical models to adjust for variables like ambient temperature and production rate to determine when a key process variable is out of range. These models enable ProcessMD to provide advanced warnings to engineers and operators about pending issues related to fixed alarms that are often set at much higher levels before issuing alerts.

By connecting ProcessMD with Mindsphere, Air Products is extending its business services model to deploy ProcessMD at customer sites. This allows Air Products engineers to assess their customers' equipment data and provide the type of advanced notice of maintenance and repair requirements that Air Products has previously only used internally.

Digital Twin Makes Virtual Commissioning a Reality

Testing automation and industrial equipment in the virtual world is a more effective and less expensive way to commission and optimize the factory floor.

Beth Stackpole, Contributing Writer

Three-dimensional (3D) models and, more recently, digital twins are increasingly well-established as the epicenter for optimizing product designs, allowing engineers to hammer out problems and verify key concepts in the digital world without the expense of building costly prototypes.

The manufacturing sector is starting to head down a similar path, leveraging digital twins as a more effective and less expensive way to plan and commission automation processes and industrial equipment. Thanks to advances in system modeling and automation, as well as simulation software, some companies are going as far as spinning up entire plant floor operations and workflows in a virtual environment as the initial phase of commissioning. Gartner expects half of industrial companies to be using digital twins in some capacity by 2021, boosting their effectiveness by 10 percent.

Much like the engineering use case, the goal for the digital twin in commissioning is to run a factory virtually before ever building or laying out the exact physical environment. This allows automation and operations staff to detect and resolve problems early, while reducing the need for real-world adjustments during installation. The upside is that teams can keep cost overruns in check and streamline the time it takes to get a plant up and running. At the same time, the digital twin environment helps monitor ongoing plant and equipment performance, allowing for optimization and continuous improvement and enabling predictive maintenance—all critical steps to minimizing the risk of costly downtime.

"By having digital twins and overall visibility into manufacturing processes from a commissioning standpoint, you can identify potential bottlenecks and conflicts and minimize them to positively impact the quality of the products you produce," says John Renick who, as senior director of digital twins and content, oversees GE's digital twin strategy, which relies on the Predix platform as a core foundation. "Being able to simulate and run what-if scenarios [virtually] vs. doing them in the real world delivers far greater efficiency."

In the traditional scenario, automation engineers and machine builders work with various providers to program and customize equipment and processes, eventually coming together at the physical plant for a sort of Big Bang integration effort that can take weeks—even months—before all of the kinks are worked out and the production line goes live, notes Eric Harper, senior software architect with ABB. In contrast, ABB's RobotStudio, part of the ABB Ability digital portfolio, enables teams to virtually simulate factory operations, including automated motion of integrated automation assets over time, so they can resolve technical issues in advance.

ABB's Robot Studio enables training, programming and optimiza-

tion of robots via simulation without disturbing production.

"What we see now is—if we can bring the Big Bang together in a virtual environment—we don't have to be concerned about safety and other requirements," Harper explains. "We can customize work cells and determine possible interferences between the movement of robots and the work product, and do all of that work ahead of time."

Accelerating time to market

Though there are many benefits to integrating digital twins into automation processes, one of the most important is the ability to speed up the cycle, getting machines commissioned on the plant floor more quickly and accelerating time to production. Traditionally, machine building is a serial process, beginning with 3D mechanical concept design and then moving through the various stakeholders from electrical engineering to automation and programmable logic controller (PLC) configuration. The digital twin allows automation and design engineers to work in parallel, identifying errors early in the process when it's cheaper and faster to fix them, notes Colm Gavin, factory automation and digitalization specialist at Siemens.

"3D animations driven by a virtual PLC enable engineers to see how a machine will behave physically before a single piece of metal is cut to make the machine," he explains.

The virtual commissioning process—whether for machines and plant controllers or entire production lines—also allows a sequence of operations to be verified before actual manufacturing begins, saving time and allowing for advance optimization of PLC code. The process facilitates collision detection, ensuring there is no interference between machine parts and robots. Virtual human-machine interfaces (HMIs) can also be leveraged to train equipment operators well before an industrial asset is actually deployed into production, Gavin adds.

Though automation simulation capabilities have been available for some time, Siemens' Simatic S7 PLCSIM Advanced takes things to a different level, Gavin contends, injecting real-

SIMATIC S7-1200 controller for automatic conveying & handling system

Fori Automation Inc. is modernizing the assembly line of a large U.S. automobile plant with rail guided carts with Siemens. The use of the SIMATIC S7-1200 controller is part of a fail-safe, automatic conveying and handling system. Watch the video to learn how Fori Automation was able to reduce time and labor required by 25 percent.

time information into the virtual commissioning process. The platform allows for the comprehensive simulation of functions via virtual controllers during configuration and engineering with Step 7 (TIA Portal) without the need for physical hardware. Through an open API and OPC UA connectivity, S7 PLCSIM Advanced can be coupled with models created in Siemens NX Mechatronics Concept Designer, enabling a virtual machine model to be controlled and operated with real PLC code.

"We created a high-speed data communications link that allows us to input I/O signals from a running PLC and use those signals to trigger animation," Gavin says. "You're not looking at any movie here; you're looking at an animation based on real I/O signals turning on and off."

That extra element of realism takes virtual commissioning to the next level. So, if you're trying to determine exactly how parts come together or to view the correct sequencing of a gripper, you can do so without having to wait for the real machine to be built. "Typically, animation is only done within the context of the tool and not what's driving animation in real life. So, you're taking a guess about how well it will run," Gavin says. "With our system, you're tying animation to real code running in a PLC."

Maplesoft's MapleSim, a Modelica-based system-level modeling and simulation tool, is regularly used by machine builders to create high-fidelity digital twins of system dynamics to expand the functionality of CAD models for virtual commissioning. Unlike tools such as Emulate3D, which create digital twins that emulate an entire production line and automation sequence, MapleSim's focus is on creating digital twins at the machine level, aiming to improve integration of various components and offer a better prediction of what machine performance will look like, according to Paul Goossens, Maplesoft's vice president of engineering solutions.

Maplesoft's MapleSim-built model-driven digital twins lower the risks involved in machine-level system integration while promoting faster virtual commissioning.

The ability to perform machine-level integration testing with a digital twin delivers significant benefits, Maplesoft research found, including a 75 percent reduction in integration time and between 50 and 100 percent improvement in lowering project cost overruns.

"On paper, everything can look good. But when you are handling complex inertia and friction on a machine, there can be motors that run too fast or transient spikes in loading that aren't captured during the initial phases of design," Goossens explains. "A virtual prototype helps identify problems much earlier, giving engineers deeper insight into what loads look like or how to right-size components the first time around so when the machine is deployed, it's more effective."

Sight Machine, a manufacturing analytics platform that leverages artificial intelligence (AI), automates the process of collecting and contextualizing streaming production data to create digital twins of

every part, batch and process. As a result, it can play a key role in optimizing plant performance and the virtual commissioning use case, notes Nathan Oostendorp, Sight Machine founder and chief technology officer (CTO).

One of Sight Machine's key differentiators is that it builds digital twins based on real-world data rather than just modeling physical assets. It also connects digital twins of individual plant floor assets to create an end-to-end view—to map material flows, for example, or to gain visibility across the whole process or plant as opposed to a single, siloed model.

Sight Machine taps into real-world machine data and enterprise systems to create a plant-level digital model that offers real-time visibility and the opportunity for actionable insights.

"What often improves things in an isolated system can push problems down the line or create unexpected interactions," Oostendorp says. "Simulation frameworks can help predict those interactions."

More specifically, using real data to fuel digital twins is vitally important to both virtual commissioning and performance management use cases. Consider the example of a large footwear manufacturer that tapped Sight Machine to create digital twins to optimize plant performance and then used the resulting models as a basis for commissioning other plants. The digital twin helped reveal a number of challenges, including rooting out the cause of poor performance for a robot with an electrostatic end effector, which turned out to be tied to high humidity conditions in a particular plant.

"People think they know what performance numbers are. But if you're not tracking every second of uptime and downtime, you're relying on operators or looking at downstream metrics like output," Oostendorp says. "A digital twin for planning gives you a much more accurate picture. It really accelerates the curve when looking at deploying new automation. It enables you to make decisions much more quickly rather than doing a traditional Six Sigma-type process."

Caution: A long road ahead

While there's plenty of upside to leveraging digital twins for virtual commissioning and ongoing plant floor maintenance, there are also a number of hurdles that manufacturers must address before reaping the benefits. The biggest obstacles pertain to manufacturers' comfort level and their ability to harness data to create digital twins, especially since much of that data has been out of reach, tucked away in various siloed systems and historians. In the same vein, many manufacturers lack adequate expertise in data management practices, including mature data governance practices and an ability to create and foster data pipelines.

"A lot of customers have not worked with data extensively or they don't have the organizational expertise for managing data pipelines or building a data collection infrastructure," Oostendorp says. As a result, he adds, it's critical for manufacturers to consider data collec-

tion and data viability as key requirements when making decisions about automation platforms.

Standardization and the much-discussed IT/OT divide is another big impediment to digital twins and virtual commissioning. Most operations professionals have mechanical and automation expertise. They are less adept at 3D modeling and simulation, which tend to be the domains of mechanical engineering. Creating a culture and instituting new workflows that bridge that divide and foster collaboration between the two previously siloed domains is critical.

"No one has been thinking about whose responsibility it is to do this," ABB's Harper says. "The innovation with the digital twin has been looking us in the face. But with the longstanding IT/OT divide, it hasn't been seen as important to do that."

Though that sentiment has certainly shifted, the transformation won't happen overnight given the reality of where most manufacturers stand today. "Oftentimes, assets aren't digitized and they don't have all of the information at the ready to be able to develop or inform a digital twin," GE's Renick says. "Industry is way out ahead talking about digital twins and artificial intelligence, but customers in the manufacturing space are not quite there yet."