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Mars Partners with Microsoft for its Global Digital Transformation

The plan includes a “cloud-first” strategy, leveraging AI, IoT, and digital twins across its businesses, focusing on intelligent supply chains, and delivering hyper-relevant consumer experiences.

By Stephanie Neil

The latest news of digital transformation includes a partnership between food and petcare company Mars, Inc., and Microsoft Corp, as the two build upon a longstanding technology relationship that now will impact every touchpoint across the consumer experience, the companies said.

The partnership, announced in May, marks a significant move forward for Mars, which up until now was testing out innovation in corners of the company, such as a farm-to-fork tracking application that utilizes technology from Transparency-One, running on the Microsoft Azure platform, to help monitor rice production for its Ben’s Original brand, thereby giving customers insights into where and how rice was grown. The newest agreement expands the reach of intelligent manufacturing supply chains.

The companies are working to integrate data across a digital infrastructure that will provide Mars with business insights to accelerate growth and develop

trust with customers and consumers through transparent experiences, the company said. The use of artificial intelligence (AI), digital twins, and Internet of Things (IoT) technology across Mars' global portfolio of confectionery, petcare, pet services, and food businesses positions the company for more intelligent manufacturing and personalized customer engagement. Mars is also focusing on ways to improve digital skills training for its global workforce.

Working with Accenture as a partner to Microsoft, the companies are further expanding a unified cloud and data foundation across all Mars businesses on Microsoft Azure, helping Mars achieve its "cloud-first" strategy.

"It will change the relationship between our brands and consumers, deliver hyper-relevant consumer experiences that include content and media, and fulfill needs and expectations across every touchpoint in the consumer's journey," said Sandeep Dadlani, chief digital officer for Mars in a statement about the partnership. "After evaluating all the platforms on the market, we chose Microsoft as our primary Mars platform because of its rich portfolio of features, engineering partner ecosystem, talent availability, focus on data privacy, and security and similar cultural values and principles."

Mars has already made progress to enable this digitization, working with digital manufacturing and operations experts from Accenture's Industry X group to deploy the Azure Digital Twins IoT platform in its manufacturing facilities in order to optimize production, improve margins and reduce waste, and empower on-site associates to make real-time decisions. Based on this use case, Mars will be able to quickly scale to use similar IoT technologies for

optimizing manufacturing across its business segments, providing process control, consistency and uniformity across product lines, increasing speed and capacity, and reducing operational costs.

In the future, Mars plans to use digital technologies to introduce even more intelligence into the end-to-end supply-chain processes, including identifying the optimal way to create products through digital simulations that take into account climate and other situational considerations, as well as creating greater transparency and visibility into its supply chain from the point of origin all the way to the consumer.

Next steps

Mars plans to continue incorporating digital technologies to evolve and transform its workplaces, focusing on increasing the digital skills of its workforce. To accomplish this, Mars, Accenture and Microsoft will work together to establish an Innovation Lab to collaborate on the use of advanced technologies, expedite time to market for new use cases, direct-to-consumer initiatives, sustainability

Photo Credit: Mars

efforts, and digitized product innovation. Through the Innovation Lab, Mars is empowering its workforce with tools such as Microsoft Teams and Microsoft Viva, to drive tighter integration between its businesses and increase productivity and collaboration for its associates.

"By driving greater efficiency and effectiveness, we're giving our associates the gift of time to focus on what they do best. And we'll do so faster than ever — reducing time to market to weeks, rather than months or even years," said Dadlani in a blog post. "We'll also accelerate intelligent supply chain efforts, including scaling digital manufacturing and expanding the use of AI and data solutions to create smarter factories. This includes everything from a 1% savings on confectionery products to improved quality control. Finally, the relationship emphasizes sustainable growth by reducing our carbon impact in the transition to a cloud-first strategy. We'll also work to reduce waste during the manufacturing process by driving technological efficiencies."

Mars, Accenture, and Microsoft share similar ambitions around sustainability, which was a key decision-making factor for Mars choosing Azure, Dadlani said. As Mars continues to migrate key infrastructure and workloads to Azure, Microsoft's commitment to 100% renewable energy in its datacenters by 2025 will help Mars reach its own goal to reduce its total greenhouse gas emissions across its value chain by 67% by 2050. The relationship is also helping Mars make progress toward its other sustainability goals around environmental impact by implementing technology solutions for reducing the waste of energy, raw materials, and water across its production facilities around the world.

Moving the Data Center to the Factory Floor

Schneider Electric standardizes its EcoStruxure Micro Data Centers on Stratus Technologies' ftServer edge computing to bring data center operations into industrial operating environments.

By David Greenfield

At PACK EXPO Las Vegas 2021, Schneider Electric and Stratus Technologies showcased how they're addressing plant floor data latency and bandwidth issues by pairing Stratus Technologies' Stratus ftServer with Schneider Electric's EcoStruxure Micro Data Center to allow for data center computing power to be brought close to critical equipment.

Protected in a single enclosure, the companies say this combination of technologies is purpose-built for the operational environment.

According to Stratus, virtualization of the ftServer in EcoStruxure enables end users to concurrently run, monitor, and control on-premises historian, manufacturing execution systems, asset performance management, and automated material handling applications as well as advanced artificial intelligence applications.

The EcoStruxure Micro Data Center with Stratus ftServer is available in 6U,

12U or 42U rack sizes powered by Schneider Electric Secure Power systems. Each micro data center has integrated cooling and optional environmental monitoring (temperature, humidity, fluid, smoke) and security (door sensors and camera). The 42U enclosure features NEMA-12 with filters and ventilation fans for larger deployments where additional IT gear is required.

Each rack size enclosure offers three Stratus ftServer configurations:

Stratus ftServer 2900 supports up to 10,000 I/O points and two remote clients. The unit is powered by a 1.5kVA APC Smart-UPS (uninterrupted power supply) with on-line UPS and a network management card with additional capacity for lower power devices.

Stratus ftServer 4900 is designed for 25,000-50,000 I/O points and five remote clients. The unit is powered by a 2.2kVA APC Smart-UPS On-line UPS with network management card. This version has additional 6U of rack space for switches, KVM, and other IT gear.

Stratus ftServer 6900 supports up to 100,000 I/O points and 20 remote clients. The unit is powered by a 3kVA APC Smart-UPS On-line UPS with network management card.

Tim Black, global system integrator program manager at Aveva, noted that, before the combination of the ftServer with Ecostruxture Micro Data Center, “Integrators and end users had to source the compute platform and power components from separate vendors and distributors, align requirements

and costs, and then assemble, configure, and test. With the combined solution, teams have a pre-validated solution available from a single source with service and support from both Stratus and Schneider Electric. As a result, organizations are able to deploy an OT-ready micro data center with 40% less field engineering cost and 20% faster time-to-market."

Explaining the applications for which this new product is targeted, John Knorr, vice president of global IT alliances at Schneider Electric, said, "This new architecture is ideal for deployment in consumer packaged goods, water & wastewater, pharmaceutical manufacturing, oil & gas and other industries that want to harness real-time edge data for insight and competitive advantage."

Schneider Electric's R-Series data center.

Emerson Takes on Magnolia Power Plant Project in Mississippi

Manufacturers aren't the only adopters of Industry 4.0 technologies—the utility sector has long been active in the space as well, and the Tennessee Valley Authority has recently pledged $110 million to digitally transform its power generation fleet.

By David Miller

While Automation World often covers the many digital transformation initiatives occurring throughout the manufacturing industries, application of the same technologies in power plants and other critical electric infrastructure are taking place at a similar pace, sometimes exceeding those in manufacturing. The utilities industry has long been an adopter of Internet of Things (IoT) enabled devices and other cutting edge technologies to improve their operations, whether it's by using digital twin simulations to remotely analyze an asset's health, maintenance needs, and lifetime performance expectations, deploying smart meters and other edge devices throughout across the electrical grid, or even relying on artificial intelligence (AI) based analytics to improve

readiness for storms and other crises.

The first technology company BID worked with on its digital transformation was still in the process of building an IIoT platform, leaving ctivity to improve productivity and profitability for its customers.

Following from this trend, the United States' largest public power provider, the Tennessee Valley Authority (TVA), which supplies electricity to companies that serve 10 million people throughout its seven-state region, recently selected Emerson to assist in modernizing its operations. The project is a part of TVA's five year, $110 million investment to digitally transform its power generating fleet through advanced operations, enhanced cybersecurity, and digital twin-enabled training.

Emerson's focus will be on the 980-megawatt Magnolia Combined Cycle Power Plant in Mississippi, which uses steam generators to repurpose waste heat from burning natural gas, increasing electricity production by up to 50%. The upgrades will include replacing

existing systems with Emerson's Ovation Automation software that features a control system, simulation technology, and cybersecurity safeguards. In addition, digital twin simulations will be used to provide advanced training to operators. Finally, cybersecurity measures will be enhanced—a pressing concern in light of numerous hacking attacks on utilities and electric infrastructure in recent years.

Emerson and TVA also point out the issues with face-to-face interaction that have emerged in the wake of the COVID-19 crisis have made now the ideal time to move forward with the expansion of their virtual capabilities.

"TVA is committed to digitally transforming its fleet so it can provide more reliable and cleaner electricity to its customers," said Bob Yeager, president of Emerson's power and water business. "Our technologies have allowed us to keep this critical project on schedule and prioritize the safety of communities and operations."

Currently, the Magnolia project is scheduled to be completed by 2022.

The Machine-To-Machine Marketplace

The convergence of technologies—especially Internet of Things, artificial intelligence, and blockchain—is setting the stage for a new "machine economy" where self-sufficient systems autonomously execute transactions.

By Stephanie Neil

Imagine the day when the packaging machine on the plant floor automatically detects that it needs more materials and it alerts the supplier—ordering and paying for product and scheduling delivery, all without relying upon any human intervention. Or a factory floor where machines self-organize and self-optimize themselves to heighten productivity, reduce waste, and increase product quality.

This is the day that the Industry 4.0 movement is working toward. In this future state of manufacturing, data and services are shared beyond the factory walls in a global inter-company communication infrastructure and payment network.

Some of it exists now. "Communication amongst machines to route around failures is already happening," said Stephen Mellor, chief technology officer of the

Industrial Internet Consortium (IIC) and executive vice president of the Object Management Group (OMG). “In fact, it’s what the internet was invented to do in respect to network nodes. In a factory, say, data would be gathered by nodes in the edge and they would make decisions on how to re-route around the failed machine.”

So while we’ve not completely entered the age of the machine economy, defined as a network of smart, connected, and self-sufficient machines that are economically independent and can autonomously execute transactions within a market with little to no human intervention, we are getting close.

The building blocks to create the factory of the future are here, including the Internet of Things (IoT), artificial intelligence (AI), and blockchain. This trifecta of technology has the potential to disrupt the industrial space, but it needs to be connected with a few more things, such as digital twin technology, mobile robots, a standardized way for machines to communicate, and smart services, like sharing machine capacity in a distributed ecosystem.

More importantly, there needs to be a framework to enable this ubiquitous interconnectivity. While technology companies build the machine-to-machine applications, there are industry efforts underway focused on building the underlying architecture and ecosystem of partners.

A framework for machine autonomy

IIC (a program from the OMG) is a global not-for-profit partnership of industry, government, and academia that has been working on several

architectures including the Industrial Internet of Things Connectivity Framework (IICF), the Industrial Internet Reference Architecture (IIRA), the Business Strategy and Innovation Framework (BSIF), and the Industrial Internet Security Framework (IISF).

The IICF defines a reference architecture for opening up data otherwise locked in a plethora of domain-specific connectivity technologies used in IIoT systems, by using gateways to one of a few core connectivity standards that can provide syntactic interoperability without compromising the fidelity of the functional and non-functional aspects of the domain-specific technology.

The IIRA, a standards-based architectural template and methodology, enables Industrial Internet of Things (IIoT) system architects to design their own systems based on a common framework and concept. It addresses the need for a common architecture framework to develop interoperable IIoT systems for diverse applications across a broad spectrum of industrial verticals in the public and private sectors.

The BSIF provides a high-level identification and analysis of issues

that any enterprise will need to address to capitalize on the opportunities emerging from this current revolution that is the IIoT.

And, addressing the cybersecurity challenge is critical to the success of the IIoT, Industry 4.0, and the Industrial Internet revolution. To that end, IIC members have developed IISF, a common security framework and an approach to assess cybersecurity in IIoT systems. It is the most in-depth cross-industry-focused security framework comprising expert vision, experience, and security best practices, according to IIC.

These are just a few of the IIC research and development projects that will move the industry forward.

"At seven years old, we have published several seminal documents that establish the machine economy landscape," said Mellor. "We began several years ago with testbeds. As the name suggests, these were testing technologies and business models. We are now focused on deployments in industry that allow the target company to digitally transform their business."

For example, a testbed in Cork, Ireland, called the International Future Industrial Internet Testbed (INFINITE), is developing software-defined infrastructures using big data that makes it possible for multiple virtual domains to securely run via one physical network. In phase one of the testbed, three geographically dispersed data centers are interconnected into a reconfigured Dell network. In phase two, INFINITE is applied to a use case called "Bluelight," which allows ambulances to securely connect to a hospital's system and relay information while in route, so hospital staff are prepared to

take over the care of the patient once the ambulance arrives.

The ultimate outcome is to use smart data to improve the emergency services. According to the INFINITE testbed notes: “Consider the scenario where an emergency service vehicle is dispatched to an incident. The response time is critical. What if the real-time GPS data generated by the emergency service vehicle can be combined with other real-time data from diverse sources such as: current traffic levels for all routes to the incident, location of roadwork, diversions, and road closures. By combining and analyzing these diverse raw datasets in real-time in order to provide valuable and intelligent route planning and insights for the emergency service vehicle, response times will improve, leading to better life enhancing outcomes.”

This same concept could be applied to the plant floor. “Fleets of machines would gather data that is sent to a data center that can be compared and contrast and then change the operating parameters of non-optimal machines,” Mellor said.

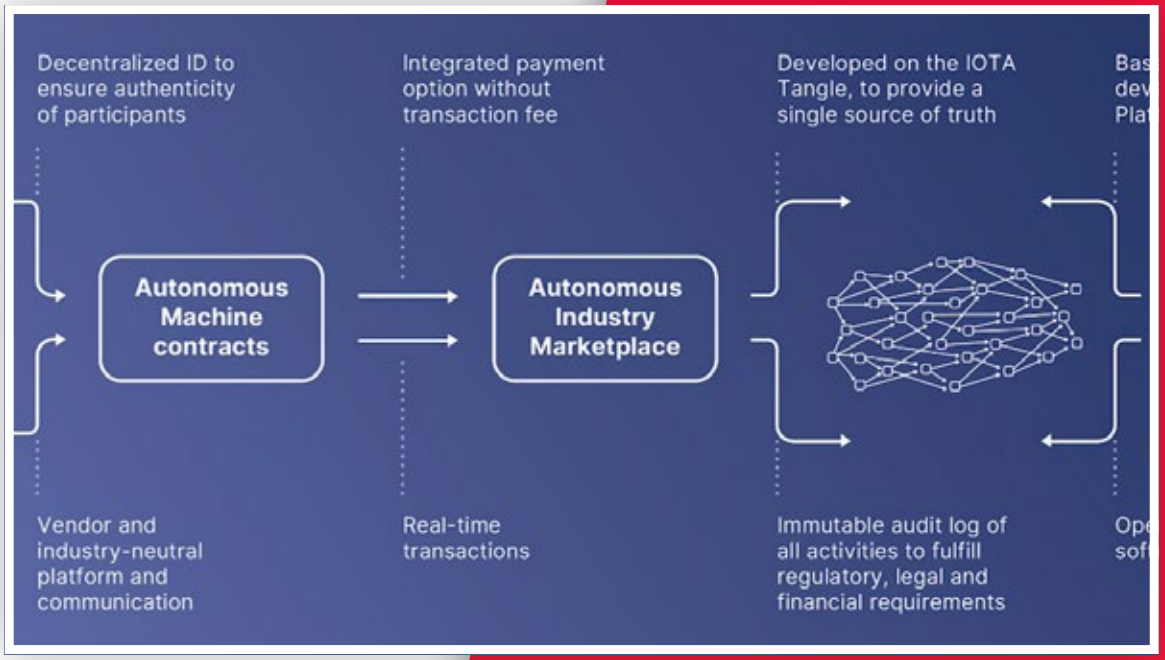
A machine marketplace

To perform financial transactions, machines will need to have their “wallets,” which is something that the IOTA Foundation has been working on since 2017, when the non-profit initiative was founded. This international consortium of European universities and technologists came together to create a protocol layer for IoT that defines how devices transact with each other using trusted data across the technology stack in a virtual industry market place.

Today, while the premise is the same, the execution is different. “The vision of IOTA is the same for the machine economy. To provide a public protocol or better public infrastructure of automation and machines is still important. But we’ve refocused IOTA more to infrastructure,” said Holger Köther, director of partner management at IOTA Foundation, noting the organization has spent the last year and half rewriting the IOTA technology stack (node, libraries, wallet) from scratch while keeping the IOTA vision and current market requirements in mind.

In March, IOTA announced the beta launch of its Firefly wallet, giving cryptocurrency wallets a new benchmark in security and usability. At the core of Firefly are two new, open-source libraries, one for wallet application development and the other for security. It is also lightweight and uses the Edwards-curve Digital Signature Algorithm (EdDSA), which is natively supported by most IoT devices, Köther said.

In addition, a reengineered distributed ledger technology (DLT), called Tangle, enables secure micropayments between machines.



Source: IOTA

It is open, feeless, and scalable, designed to support frictionless data transfer, and is not based on blockchain which has cost and scalability limitations, according to IOTA, which has a goal to build an entire ecosystem for machine communication that can apply to different industries.

"The overarching story is that IOTA is developer-friendly....and provides a DLT-based system that is resilient and scalable," Köther said. In addition, the IOTA is working with the Open Management Group to certify the IOTA protocol and standardize how it works.

As the architecture and standards get sorted out, others are developing areas that will be an important part of the equation, like the digital twin. "To have the ability to send requests which can be fulfilled basically means having a digital twin of that product that has been designed, validated, and the part program processed for a particular machine. That is an important part of the equation," said Alastair Orchard, vice president of Siemens Digital Enterprise.

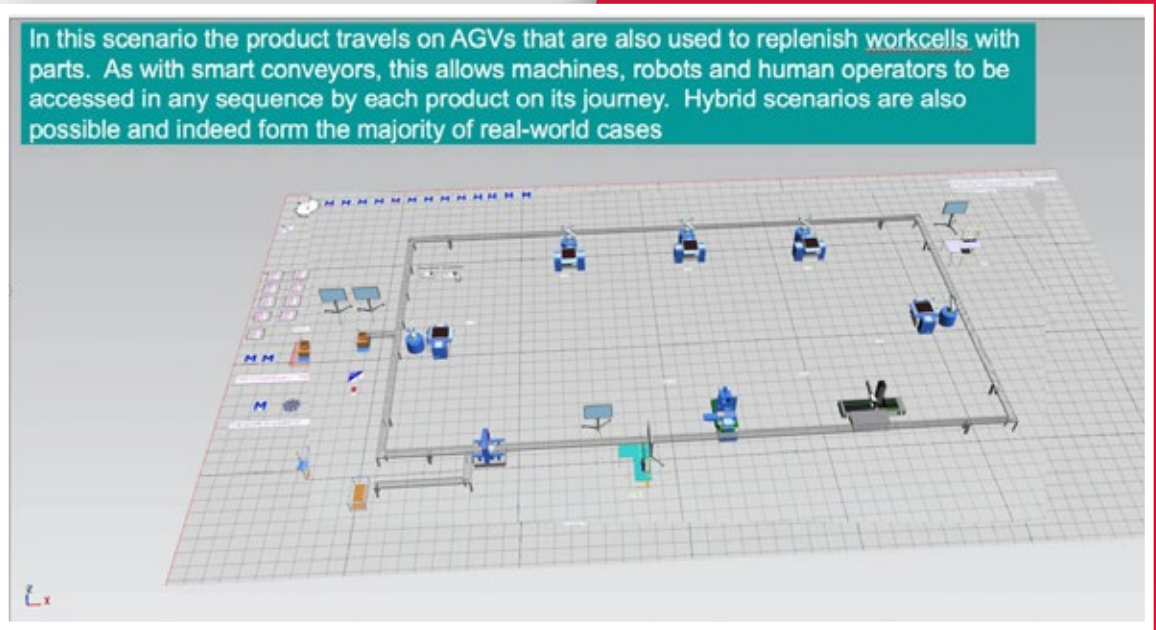
To achieve the Industry 4.0 dream where cyber-physical machines can understand their own capabilities, negotiate with other machines, and can design any product, full digitized manufacturing is required And, of course, not every machine is intelligent.

"We are working on and deploying a transitional technology where we take the manufacturing blueprint called the bill of process, which is like a recipe that contains all of the information needed to manufacturing something, including the materials, the tolerances, the set points, and part programs," Orchard said. "If [the machines] are not intelligent, we do have the possibility

with our edge technology to create an intelligent wrapper around them, and then use the manufacturing blueprint to broker conversations between machine wrappers."

A digital twin of the machine knows where all the product parts are to deploy a system where the bill of process is executed, distributed into edge boxes, and products are driven through the factory, communicating with brownfield machines through intelligent wrappers. "Key to this is logistics, either a smart conveyor or AGV to move product between machines. In this way we actually are able to kickstart fully autonomous and flexible manufacturing even though the machines themselves aren't this super cyber-physical intelligent entity that we've been dreaming of."

The ability to flexibly move things and capture that data across the supply chain is another area to tackle, according to IBM. "In today's supply chain everything is siloed," said Vijay Pandiarajan, director of operations at IBM Sterling, noting that there are so many steps in the process that it's hard to reconcile everything—especially if a shipment didn't



Source: Siemens

arrive. “We have business transaction intelligence that maps out all of the documents you are supposed to get and sequence it.”

Business transaction intelligence, part of IBM’s Supply Chain Business Network, enables companies to garner deeper insights into supply chain data to help them better manage, for example, order-to-cash and purchase-to-pay interactions. The technology does this, in part, using machine learning to identify volume, velocity, and value-pattern anomalies in supply chain documents and transactions.

“It’s a simple example of AI,” Pandiarajan said. “AI won’t [solve] everything, but it will make you more capable as a human.”

Culture and capacity

Indeed, ultimately what the machine economy is trying to accomplish is to create a better human experience. Yet, people are the biggest bottleneck to the autonomous marketplace.

“The biggest obstacle is culture,” said IIC’s Mellor. “The average age of the industrial plant is 19 years. These are huge investments that last for decades. The organizations that run these facilities are very cautious. Even a 0.5% chance of failure can cost millions of dollars.”

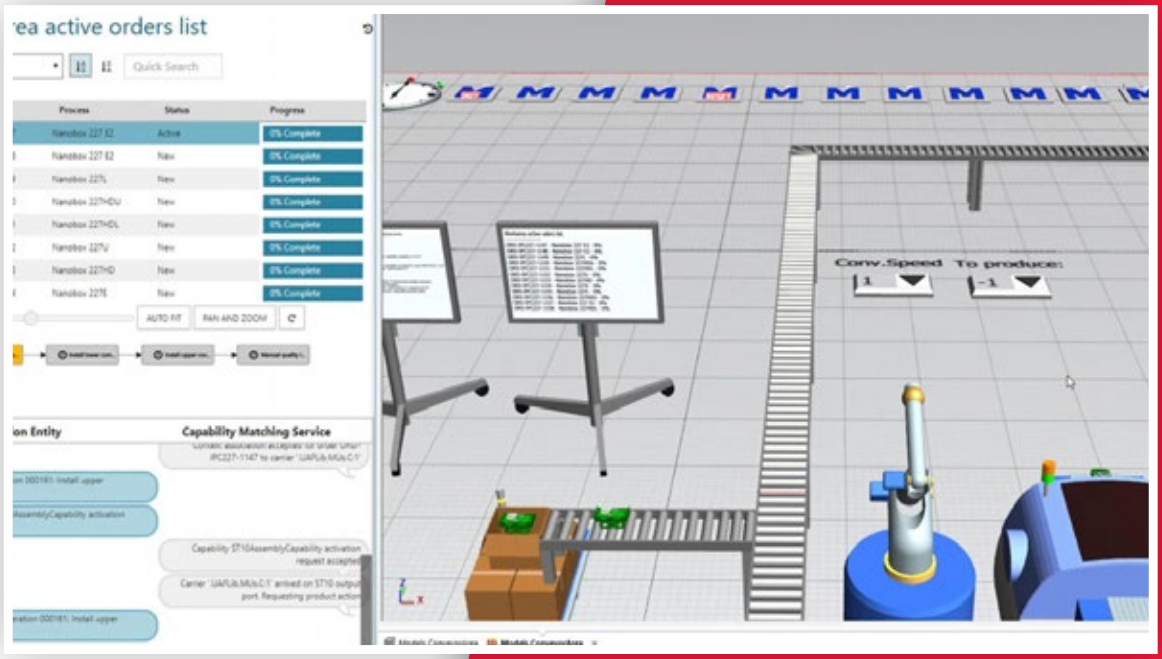
But we do have the technology, and the critical steps to move toward the machine economy are happening now.

You can see it at Siemens, where a proof-of-concept M2M marketplace is underway with the goal of machines selling their own capacity. “There are

so many areas of experimentation in our German machining factories, where each machine understands its own costs, its own schedule, its own maintenance, and communicates any windows of opportunity it has on a permission blockchain which others can subscribe to and request unused machine uptime capacity to machine their parts," Orchard said.

It is an early example of how machines, using IoT, AI, and blockchain, may completely disrupt the manufacturing business model in the factory of the future.

In discrete manufacturing, the bill of process may be published to an execution engine that matches equipment capabilities to each operation and guides the product on its unique journey through the factory. Source: Siemens



Automation World Exclusive Interview with Beckhoff

An interview with Hans Beckhoff, Beckhoff Automation managing director and founder, and Kevin Barker, president of Beckhoff USA, offers insights into where industry is heading with automation technology.

By David Greenfield

2020 was a year of change for everyone, and the industrial automation sector did not escape unscathed. After several years of growth and expansion, many industrial technology suppliers experienced significant downward impacts on sales and revenues. Even those suppliers that managed to have a year with positive earnings still felt the pinch compared to the levels of growth the industry had seen for years prior to the pandemic.

Automation World recently had the opportunity to speak with Hans Beckhoff, managing director and founder of Beckhoff Automation, and Kevin Barker, president of Beckhoff USA. The idea behind this interview was to get insights into Beckhoff's experience as a global supplier of industrial automation technologies during a year that so dramatically changed personal and business perspectives and to get insights into what may lie ahead for the automation industry.

What 2020 wrought

Our discussion began with a review of a Beckhoff's business in 2020. Hans Beckhoff noted that his company had been experiencing an average growth rate of 14% since 2000. However, in 2020, that rate of growth shrank to about 2%, buoyed by a strong performance from Beckhoff China, which grew by 20% in 2020, as well as a good performance in the U.S., where the business grew by 5%. For 2021, Beckhoff sees positive business development worldwide based on its current double-digit growth rate. The company reportedly generates more than $1 billion in revenue worldwide.

Barker noted that Beckhoff's "highly diversified" portfolio of products and industries it serves contributed to the company's good performance in 2020.

"We don't have more than 15% of our business in any one particular vertical," said Barker, "so when some of our existing customers did not invest in new theme parks or new oil and gas exploration, we still saw new projects with electric vehicles, semiconductor manufacturing, intralogistics, and packaging."

He added that Beckhoff's technology portfolio, including TwinCAT control software, industrial PCs, I/O, drives and motors, contribute to the company's ability to address a wide range of specific projects.

"In the U.S., it's pretty evenly distributed and that's because we are working with innovative companies looking to solve really important problems. And that starts at the control architecture and extends to the entire approach to automation. So, when we have these engagements, we see the revenue streams across all our different product families. We are leading the way with emerging

technologies—like mechatronics—which have been a growth engine for us. But we see strong growth across all of our different product families."

Hans Beckhoff added that the Beckhoff automation architecture is "quite unified across I/O, bus terminals, CPUs, motors and drives, and software, which can be used to do very small applications like controlling a conveyor or very complex and big applications like machine building or logistical transportation projects. Regardless of the application, it's always the same hardware with basically the same TwinCAT software."

One differentiator that Beckhoff pointed to is that his company's automation architecture is software-based and supported by modular hardware. "There are, of course, some differences in the software algorithms for different applications," Beckhoff explained, "but control can be realized with this unified hardware, which helps us with a lot of different customers in different segments."

Hans Beckhoff, managing director and founder of Beckhoff Automation (left), and Kevin Barker, president of Beckhoff USA.

At the IT/OT crossroads

As a supplier and proponent of PC-based control, Beckhoff has long positioned itself at the crossroads of

IT and OT (operations technology)—an area that has gained increasing attention as the drive toward Industry 4.0 and Industrial Internet of Things applications brings these two technology worlds closer together.

"We've been doing PC-based control for almost 40 years, so having IT and OT integrated has been a part of our technology for all these years," said Beckhoff. "Because we use a PC to control the machine, it's quite normal for us to collect and analyze data. And we are communication specialists; Beckhoff is the inventor of EtherCAT. We introduced the technology in 2003 and we knew that EtherCAT would be the perfect communication system for general automation, especially for demanding high-speed machine control applications with a lot of motion and measurement functions. Today EtherCAT is a global standard and has become the standard fieldbus for many automation architectures and device vendors. Nevertheless, Beckhoff supports an open control philosophy, which means that we support almost any communication interface in the industry, such as Profinet, OPC UA, EtherNet/IP, CANopen, and others—all of which is orchestrated through our TwinCAT software."

He contends that Beckhoff's focus on industrial PCs, I/O communication technology, and its TwinCAT software provide a strong base for delivering edge intelligence, an aspect of Beckhoff's business that has been growing rapidly as system integrators develop their own edge systems with Beckhoff hardware and "some big machine builders use our hardware to implement their own edge software concepts in different controllers on the machine."

Beckhoff pointed to a particular feature of the company's controllers as helping position the company well with integrators and OEMs when it comes to edge computing—the TwinCAT Analytics Logger inside the controller.

"This Analytics Logger works like a flight recorder, in that all signals from the machine are written in real time to a file or can be sent to the cloud. The complete operation of the machine is recorded," said Beckhoff. "This allows you to do analytics and optimize the machine because you can see how the machine is working from your desk at home. So, if a machine is going down every two weeks in the middle of the night, you can see exactly what is going on. We also have the Analytics Workbench, which incorporates analytics tools like min/max comparisons, fast Fourier transforms, and it even has an interface with MatLab/Simulink for high-end analytics, all of which can be done via standard IEC 61131-3 languages. This means a controls engineer who programs the machine is also able to program the analytics."

Beckhoff EtherCAT terminals.

Virtualization

With all the interest in the

virtualization of automation technology over the past few years, Beckhoff, as a supplier of PC-based control, is well-positioned to take advantage of this trend. Virtualization has been a mainstay of the IT world for years as a means of dividing physical servers into multiple, virtual servers to run separate operating systems. In the industrial realm, this technology can be used to create virtual machines for control operations.

Our discussion on this point revealed that a good bit of upside remains to be captured around virtualization in manufacturing considering that industry, as a whole, has not been quick to widely adopt virtualization yet.

"Virtualization means very different things to different companies and to different people within those companies in different groups," said Barker. "Conversations we're having with OT groups about this now tend to focus on what they're trying to accomplish with virtualization and what opportunities exist. This is especially true with companies that want to do something specific now, but also have an idea about where they want to go with that in the future. Our platform allows them an easy path to start with something they can get their arms around that has a clear return on investment and is both manageable and secure. Then, when they're ready, they can use this same platform and toolkit to expand."

Material handling

Beyond Beckhoff's focus on automation and control technologies, such as controllers, I/O, standard motion technology and software, the company also offers complete systems for material handling that can be used by OEMs and end users.

Two high-profile examples of this are the company's eXtended Transport System (XTS) and XPlanar. Both systems are relatively futuristic in their design and operation—for example, XPlanar uses levitating tiles to move materials in any direction.

Because of the advanced nature of these systems, we were curious to learn how receptive industry has been of these new material handling technologies.

"Manufacturers need time to digest these kinds of new systems and develop their plans around it," said Beckhoff. "We showed XPlanar for the first time in 2018 and it has generated a great deal of interest in very different application areas. We saw the same when we introduced the XTS system, our multi-mover inverse linear motion system, which also enables new thinking in terms of transportation concepts and the entire machine architecture. Our advanced customers understand these new possibilities quite well, as demonstrated by the new machine concepts they are developing. And this means that the XTS and XPlanar

Beckhoff's XPlanar system.

are not only fantastic new technologies, but they are also generating very good business for us. It´s really interesting to see where these technologies are being used."

Beckhoff noted that Plasmatreat was "one of the first XPlanar users in what was a smaller application of the technology. But we're getting orders for bigger applications too, in some cases due to its ability to hygienically handle materials. For example, a German schnitzel producer is using XPlanar to package their product because of its flexible packing applications. We're also seeing a lot of interest from biotech for applications like blood analysis, as well as interest in its use for general manufacturing assemblies."

Barker said some machine builders have had a difficult time envisioning how to use XTS within the type of applications they typically implement. XPlanar, however, "is so different that I think people look at it and can immediately see that it's a very different approach to manufacturing; but they can also easily envision how it can be used. If you think about it, there hasn't been a lot of significant changes to mass production since Henry Ford. I think XPlanar is potentially one of those fundamental shifts, as we move from a linear to a non-linear approach to material handling at a time when mass customization is everything."

In the U.S., XPlanar has been quickly adopted since its introduction here in late 2020, according to Barker. "We already have starter kits available that have all the hardware, software, cabling, and power supplies someone needs to set up the system. There's not a lot of items on the bill of material for XPlanar—it

basically comes in a box, you plug it in, and you can get applications up and running in a few hours."

This ease of setup has led Beckhoff to receive numerous new requests for the starter kits. "We're shipping a starter kit a week right now," Barker said, "and we also got two orders for new production systems where the users began with the starter kit just two months ago and they've already moved to a completed design and are moving to volume production with XPlanar."

Beckhoff's hygienic eXtended Transport System (XTS).

Users Unite as the Open Process Automation Journey Continues

From the evolving standard to test labs, movement to an interoperable framework is taking shape. But the OPAF group is asking for more help from manufacturers.

By Stephanie Neil

Despite the disruption to business that the pandemic has caused, the Open Process Automation Forum (OPAF) has not skipped a step in its effort to create a collaborative control architecture.

The first technology company BID worked with on its digital transformation was still in the process of building an IIoT platform, leaving ctivity to improve productivity and profitability for its customers.

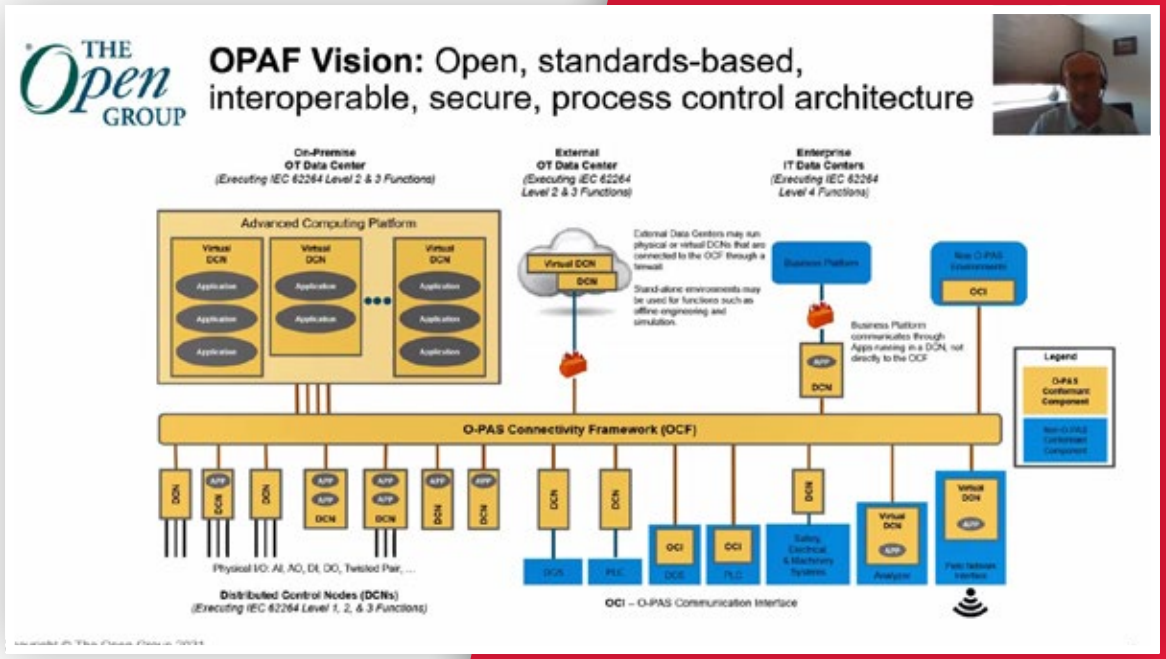
Since the formation of OPAF in 2017, the group—now comprised of around 135 members from suppliers, system integrators, academia, and end user organizations—has been on a mission to design and deliver a modular, scalable, and interoperable framework that can mix best-of-breed technologies and applications from a variety of industrial systems suppliers.

In the past two years the organization has rolled out the first developments of the Open Process Automation Standard (O-PAS)—which is described

as a “standard of standards,” as members emphasize that they don’t want to reinvent the wheel, but rather utilize what’s already in use for connectivity, security, systems management, and more. O-PAS version 1.0, released in 2019, specifically addressed the issue of interoperability. Version 2.0, announced last year, focused on configuration portability—the first step toward the ultimate goal of plug-and-play functionality for control equipment, OPAF officials said. In the next few weeks version 2.1 will be released as a preliminary standard.

O-PAS vs. 2.1, announced in February during the ARC Advisory Group Industry Forum, is a continuation of configuration portability and control functionality. This latest version has 12 parts, ranging from definitions of data types, function blocks, alarms, security, and it addresses the IEC 61131 programming language standard and the IEC 61499 standard for industrial automation application portability.

While the march toward a unified standard continues, the proof that OPAF is moving in the right direction comes from the user labs set up across the globe. During the ARC



forum, attendees were taken on a tour of three user labs around the world, from the U.S. to the Middle East to Australia. This was one of the perks of having a virtual conference, as attendees were able to get a tour of each of these facilities from the comfort of a home office—and it was interesting!

For example, energy and chemical giant Aramco, in collaboration with Schneider Electric, has built a test bed in the Saudi Schneider Electric Innovation and Research Center in Saudi Arabia. There, they test systems for multi-vendor interoperability, cybersecurity, artificial intelligence and advanced analytics in real-world applications. The University of Western Australia's Industry 4.0 Energy and Resources Digital Interoperability (ERDi) test lab is working with industry partners on proof of concepts, including how O-PAS will work in the mining industry. And ExxonMobil, together with Yokogawa Electric Corporation, has an open process automation test lab in Texas. It serves two purposes: first, to understand the open system technology with heterogenous parts and develop a design structure, and second, to get it to a field trial. "Even though we did a pilot, it was research, not a production unit," said David DeBari, a process control engineer at ExxonMobil. The original proof of concept project, which included many OPAF member suppliers like Schneider Electric, ABB, AspenTech, Inductive Automation, ANSYS, and Wind River, was built to demonstrate the feasibility of the architecture to deliver the targeted multi-vendor interoperability through standards without the use of gateways or translators, as well as prove interchangeability between different vendors' components without having to change the underlying logic.

ExxonMobil, having been the company that initiated this widespread industry movement, very much wants to move to an O-PAS based system. How fast, however, has always been the underlying question. The good news is that there is slow and steady movement in the direction of an open process automation architecture. The bad news is that there is still a long way to go on this journey of designing, testing, and updating the standard. For that, more industry participation is needed.

To that end, OPAF is asking for your feedback—even if you are not a member. They are asking for your stories related to what you are working on and what you need in O-PAS version 3.0. To submit your specific needs, go to: www.cognitoforms.com/opas1/userstories.

Liquid Metal 3D Printing Makes Its Debut

Xerox's new ElemX 3D liquid metal printer promises to solve challenges associated with traditional 3D printing methods, though deployment is still in its early stages.

By David Miller

Not unlike having a backup server or installing redundancy in critical systems, the on-demand nature of 3D printing—also known as additive manufacturing (AM)—can help end-users navigate increasingly common supply chain disruptions caused by trade shake-ups, unexpected supplier limitations, and global pandemics. In addition to allowing operators to rapidly produce spare parts that may no longer be available from the original manufacturers, AM continues to show promise in mass production, with some manufacturers using it to ramp up output of personal protective equipment (PPE) in the early days of the COVID-19 pandemic.

However, AM is not without its challenges. This is particularly true with powder bed fusion (PBF), a process commonly employed in commercial and industrial 3D printing applications where a laser or electron beam is used

to melt and fuse powdered materials together. For instance, objects printed with PBF may exhibit weak structural properties compared to other manufacturing processes and may require post-processing, adding labor and costs.

That said, recent innovations in a production methodology called liquid metal jet printing (LMJP) may help to surmount these issues.

Xerox's new ElemX 3D liquid metal printer is one of the first products on the market to employ the technology. Rather than powder inputs, The ElemX uses molten solid metal provided by standard commodity aluminum wire fed into the machine. According to Xerox, this new method can decrease total cost of ownership, increase cycle times, and improve safety, all while providing production-grade parts.

In an in-house use case, reported by Forbes, Xerox was able to deploy its own technology to great success. When a bracket for a digital press required replacement, the ElemX was able to reproduce the part within

four hours with an estimated 21% reduction in costs and 43% decrease in CO_2 emissions compared to traditional metal casting. In a second trial, in which it was benchmarked against a PBF AM system, the ElemX produced the same bracket at an estimated 38% cost savings and a 40% reduction in cycle time.

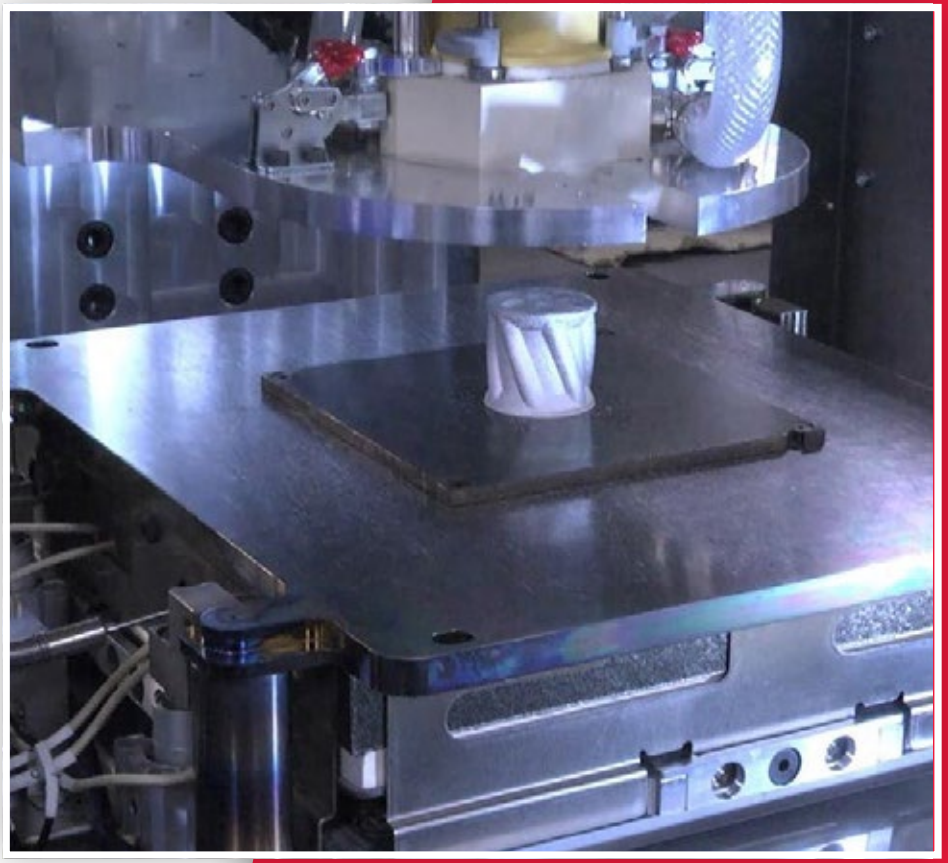
Moreover, independent research from the State University of New York and Concordia University asserts that LMJP may be up to 10 times faster and one-tenth the cost of prevailing AM methods. In addition, this research notes that LMJP may lead to denser metal parts with finer microstructures, resulting in a 30% or greater increase in overall tensile strength.

Xerox foresees the deployment of the ElemX beginning in defense, aerospace, heavy equipment, and oil and gas, due to these industries' complex supply chains and essential nature.

Currently, ElemX has seen its first deployment at the U.S. Naval Postgraduate School (NPS) in Monterrey, Calif., where it will be used in military research efforts.

"From the age of sail to the nuclear era, sailors have been fixing things at sea so they can

LMJP was first used by New York-based Start-up Vader Systems, prior to the company being acquired by Xerox in 2019.



complete the mission," said NPS President Ann Rondeau. "This partnership is about the strategic ability of the navy to have sailors on ships with the capability—through creativity and technology—to advance their operations at sea."

While NPS envisions ElemX being deployed in a back-up capacity for spare parts and batches of one, Xerox's long-term goal is for the ElemX to be used in mass production.

How COVID-19 Pushed ExxonMobil's Automation Technology Limits

From remote access and robotics to artificial intelligence-driven operator assistants, ExxonMobil is using industry's operational realties during the pandemic to drive the development and expansion of open automation technologies.

By David Greenfield

COVID-19 created the conditions that "pushed us to test our limits and we learned that we could do a lot more work remotely than we previously thought," said Dominic Clausi, vice president of engineering, ExxonMobil Research and Engineering, during a presentation at the 2021 virtual ARC Forum. "The time efficiency [gained] doing remote work or remote support allowed us to actually better leverage our technical resources to improve the coverage of those events we were supporting remotely."

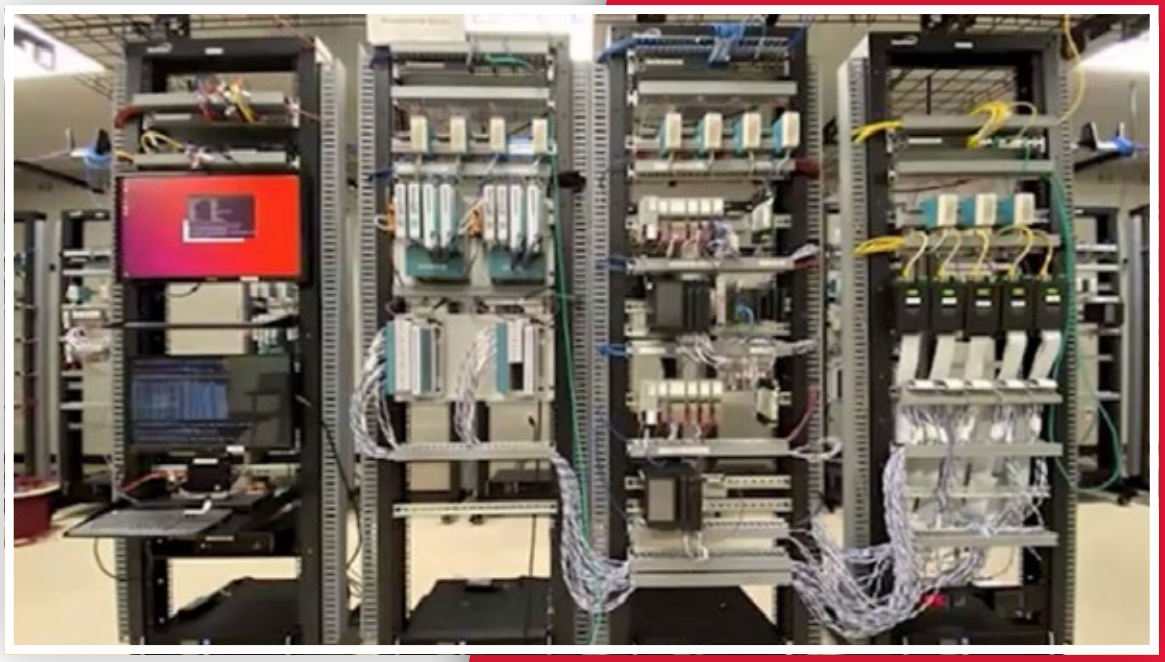
Prior to the onset of the pandemic, Clausi said it was generally perceived at ExxonMobil that the perceived risk associated with remote access and support would render it less effective than the in-person support the company had traditionally relied upon.

Speaking of industrial companies in general, Clausi said, "We often have the tendency to overestimate the risk and underestimate the value of digital technologies."

One example of a remote access and support advance made at ExxonMobil in 2020 involved the company's Baton Rouge, La., isopropyl alcohol facility. Isopropyl alcohol is a key ingredient in hand sanitizers and disinfectant sprays, so demand for this facility's product increased at a rapid pace in early 2020. Clausi said ExxonMobil was able to "leverage our remote connectivity tools with our advanced dynamic matrix control capability to rapidly and remotely update control applications. And we did that in sync with physical modifications we were making to the unit at the time. [Remote connectivity] allowed us to very rapidly expand the production capability of that unit and that helped us meet what was really a step change in demand growth and meet a key societal need."

Beyond pandemic-related benefits

An Open Process Automation testbed was launched in 2020 at ExxonMobil's The Woodlands, Texas, facility. Working with Yokogawa as the systems integrator, the testbed contains hardware and software products from a variety of suppliers and is currently confirming readiness for components and standards to support the system design for a field trial in 2021.



Clausi also mentioned the value ExxonMobil discovered in remote access technology when Hurricane Laura impacted its Beaumont, Texas, facility in 2020. "We had just set up a machinery monitoring group in one of our technical centers in Malaysia when our Beaumont facility was working through an orderly shutdown in preparation for the hurricane," he said. Because the staff in Beaumont had to perform the shutdown with a reduced number of engineers on site to manage the COVID-19 risk, remote monitoring capabilities allowed engineers in Malaysia to help guide the staff in Beaumont through the shutdown.

Engineers in Malaysia were able to observe "critical machines in detail as they were being brought down," Clausi said. "The remote connectivity and visibility of the data allowed us to do engineering support during an abnormal operation from across the globe. In addition, the team in Malaysia was able to uncover vulnerabilities that ultimately could have compromised an orderly restart and address those vulnerabilities before the units came back up."

Accelerated work with remote access and support technologies were not the only technology related advances experienced as a result of the pandemic, according to Clausi. ExxonMobil also pushed its use of robotic inspections further. "During the pandemic there was a premium on minimizing the number of people at our sites, as well as limiting the personal interactions in the field and this helped drive the deployment of various robotic inspection techniques that we had currently under development," he noted.

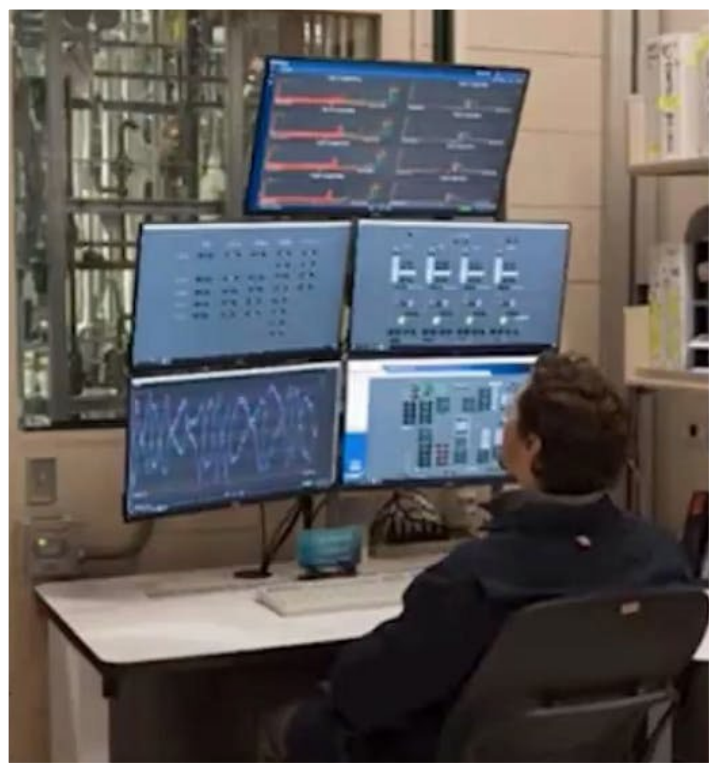
ExxonMobil's tech outlook

Beyond robotics and remote access, another area in which ExxonMobil sees significant opportunity is in autonomous operations and process control. Clausi noted that, in ExxonMobil's manufacturing facilities, operators are tasked with running complex processes safely and efficiently 24 hours a day, seven days a week and "they need to synthesize large quantities of data and manipulate potentially hundreds of variables to optimize an outcome. And that makes this a rich area to leverage digital technology."

In response, Clausi said ExxonMobil is pursuing the development of what they call an intelligent self-optimizing planner. "The goal here is to take advantage of cognitive learning and adaptive capabilities based on artificial intelligence and machine learning to reduce human error and make better decisions," he said.

Components of this system include a digital assistant for operators called SmartLane, which uses artificial intelligence to guide a console operator through an optimized transient event. Clausi explained that an example application of SmartLane could be "executing a grade switch on a reactor so that real time benchmarking and self-correcting guidance allows the operator to reduce off-spec material and avoid

In 2020, a pilot unit in ExxonMobil's Clinton, N.J., labs was converted from a proprietary system to an Open Process Automation-aligned distributed control system. According to Clausi, the prototype integrated components from 10 different suppliers and has successfully operated through both routine and non-routine operations.



costly shutdowns and trips."

Clausi noted that this SmartLane technology is already deployed on ExxonMobil's polymer plants and the company is in the process of adapting it for other platforms across its facilities.

ExxonMobil is also piloting the use of video images for process control for a program that uses mathematical models to interpret video images and then translate them into signals that can be used to "monitor and ultimately control an operation," said Clausi. "This becomes particularly useful in areas where traditional instrumentation falls short, like monitoring the control of a flare."

Another technology in the early stages of development at ExxonMobil is a virtual assistant for a console operator called Sofia. "Sofia means wisdom in Greek," explained Clausi, "and the way to think of Sofia is that it's like Amazon Alexa but designed for console operators. It will contextualize and mine data from various sources and then provide real-time answers to the challenging questions that an operator has in the day-to-day operation of the unit."

Edge Computing Gets a Platform Focus

Recent announcements from Siemens and Stratus Technologies/Rockwell Automation show how edge computing is evolving into a platform for broader industrial digitalization applications.

By David Greenfield

For years now, edge computing technologies have been gaining in popularity as a means of onsite equipment data aggregation and analytics—a key component of industrial digitalization. More recently, edge computing has also been gaining wider use for virtualization and providing secure remote access to equipment.

Siemens and Stratus Technologies have announced two new edge computing offerings that extend the use of edge computing beyond the specific applications mentioned above.

Siemens announced the release of its Industrial Edge v1.0 platform which encompasses an edge management system, edge apps, and edge devices. The company describes this platform as a “scalable infrastructure for managing connected edge devices and apps” which can be used to “remotely monitor

the status of every connected device and remotely install edge apps and software functions on distributed edge devices."

Essentially, Siemens Industrial Edge platform enables IT or plant floor personnel to manage distributed edge devices and centrally monitor their operating states. The company says this ability is key to securely rolling out new software applications company-wide on all connected edge devices. It also minimizes the maintenance and updating of distributed software.

Stratus Technologies' announced its "Solution in a Box" process control architecture running Rockwell Automation's PlantPAx 5.0 (distributed control system) software on the Stratus ztC Edge device. PlantPAx uses a common automation platform to integrate process and discrete control with plant-wide information.

The "Solution in a Box" architecture includes: Rockwell Automation's Process Automation System Server with FactoryTalk View (HMI software), FactoryTalk AssetCentre (centralized asset management), FactoryTalk Historian, FactoryTalk VantagePoint (enterprise manufacturing intelligence); Rockwell Automation

Siemens Industrial Edge v1.0 platform encompasses an edge management system, edge apps, and edge devices. Source: Siemens

Application Server-OWS, a ThinManager remote desktop server for remote, mobile, and tablet access; and Stratus ztC Edge 110i.

Stratus says the "Solution in a Box" supports up to 2,000 I/O points, five redundant Logix controllers, 10 clients, and 5,000 historian tags.

"With ztC Edge's industrial-grade design, teams can now install redundant, virtualized edge computing on the DIN rail in the same cabinet as the PlantPAx DCS controllers, even in harsh environments," said Frank Hill, director of Rockwell Partnership at Stratus. "In addition, ztC Edge's built-in virtualization allows users to integrate multiple solutions—PlantPAx applications and Rockwell's ThinManager that previously required multiple computers—into a single platform which delivers enormous savings for engineering, operations, and maintenance."

Stratus Technologies' ztC Edge is part of the company's "Solution in a Box" process control architecture, which runs Rockwell Automation's PlantPAx 5.0 (distributed control system) software on the Stratus device. Source: Stratus Technologies

Colgate-Palmolive Focuses on Machine Health to Improve Supply Chain Operations

The COVID-19 pandemic highlighted the connection between production operations and the supply chain. In response, Colgate-Palmolive is connecting asset health and the supply chain to free up capital for strategic growth.

By David Greenfield

From toilet paper shortages and soaring lumber rates affecting home prices to long-delayed shipments of household appliances and furniture, numerous supply chain concepts once reserved to procurement and logistics professionals have become almost common knowledge to people outside industry. Likewise, a focus on the close connection between production operations and their affect on supply chains is gaining more adherents.

As noted in the recent Automation World article, “Supply Chain Optimization and the Future of Industry”: The growing need for end-to-end

visibility is particularly relevant for plant-level operators and systems integrators because it often requires more integration between supply chain software and manufacturing execution systems (MES) to extract granular data such as equipment health and material availability that can help to more accurately gauge a facility's true capacity. Collecting and communicating this data to supply chain partners in real time can assist them in more effectively coordinating their own procurement and inventory activities.

A good example of this trend in connecting manufacturing operations to the supply chain can be seen at Colgate-Palmolive where, according to Warren Pruitt, vice president, global engineering services, the company has been bolstering its supply chain reliability by moving toward predictive maintenance of our machinery. The predictive maintenance model employed by the company "preserves machine health through 24/7

An Augury Machine Health sensor on industrial equipment. Note: this photo is supplied by Augury and is not from a Colgate-Palmolive plant.

monitoring via wireless sensors combined with analytics powered by artificial intelligence [AI]," said Pruitt.

Colgate-Palmolive is feeding this wireless sensor data into Augury's machine health software platform. Pruitt pointed out that this enables Colgate-Palmolive's machine data to be compared with machine data from more than 80,000 other machines connected to the Augury platform around the world.

"That massive analytical scale brings us insights on how to optimize the performance of equipment and make ever-smarter choices on how and where we deploy it," Pruitt said. "What's possible only gets more compelling as this AI solution harnesses more data to create better health outcomes for our machines and our business."

Sensor data

Approaching the development of this machine health monitoring system at Colgate-Palmolive required investigation into the best sensor type for this job. According to Pruitt, "Bluetooth sensors require a person with a smart phone to collect the data, and wired sensors come with a high price tag. But the wireless sensor solution we're now using automates that data collection and analysis—monitoring vibration, magnetic flux (energy use) and surface temperature. When issues arise, reliability professionals remotely alert and collaborate with our plant teams as needed."

The sensors used in the Augury Machine Health system were retrofitted onto Colgate-Palmolive's existing equipment to capture vibration, temperature,

and magnetic data and transmit it to the Augury platform.

Pruitt explained that Colgate-Palmolive uses Augury's sensors on a variety of rotating equipment, such as homogenizers, mixers, pumps, case packers, fillers, cartoners, conveyors, and agitators.

Sensor data is transmitted via Wi-Fi to the Augury Machine Health platform in the cloud. With the data in the system, Augury's AI algorithms can diagnose machine malfunctions to create what Augury calls the "baseline."

Improving yield, reducing risks

According to Augury, its Machine Health system doesn't just "automatically diagnose machine malfunctions, it tells users how and when to fix them." The company claims its software goes beyond the capabilities of the average predictive maintenance system by providing a real-time snapshot of a machine's health and immediately alerting users of machine faults, their severity, and what actions to take to prevent a failure. This also allows for specific machines at highest risk of failure to be prioritized and helps users better understand the risks of downtime.

"Although early diagnosis of problems is a key advantage here, there are additional savings from extending use of equipment past what would be typical preventative maintenance schedules," said Pruitt. "Instead of stopping production as a matter of course, say, every six months, we monitor the near real-time health and performance of our machines and if all is well, we can safely keep them running nine months or longer. This has increased our

available manufacturing capacity by allowing higher production volumes, which has been invaluable during the COVID-19 crisis."

Pruitt also noted that supply chain interruptions and capacity requirements were reducing the available capital for strategic growth at Colgate-Palmolive, driving the company to explore new systems, like Augury's Machine Health, to improve yield, lower operating costs, and mitigate manufacturing risks. "The goals of the Machine Health program were to help improve output, reduce downtime, and reduce MRO (maintenance, repair, and operations) spending by moving from preventive to predictive maintenance," he said.

Notable improvements

Providing a specific example of how Augury's Machine Health system has helped Colgate-Palmolive, Pruitt noted that the system's AI detected rising temperatures in the drive of a tube maker and alerted the plant team. "Upon inspection, they discovered a problem with the motor's water cooling system," he said. "By getting it quickly resolved, we prevented the drive from failing due to overheating, which would've stopped the tube production line and incurred replacement costs. We figure the savings at 192 hours of downtime and an output of 2.8 million tubes of toothpaste, plus $12,000 for a new motor and $27,000 in variable conversion costs."

In another example, Pruitt said Machine Health's AI provided an early warning that a gearbox in a liquids machine was experiencing structural and operational issues, putting it at high risk of failure that could shut down

the line. “The team was able to order a replacement gearbox and plan the maintenance to swap it in, bringing the machine to acceptable condition with minimal interruption,” he said. “The benefits of having real-time access to machine health analytics have been so powerful, we’re going to roll out this technology across our global supply chain.”

Accoring to Pruitt, mutiple Colgate-Palmolive plants currently use Machine Health. “For example, six Hill’s Pet Nutrition plants have deployed the technology. Within four months of deployment, the cost savings from Machine Health had paid for the annual Machine Health program in all six plants,” he said.

Based on its experience thus far with the system, Hill’s is starting to combine machine insights with quality insights to predict which pet food formula will run best on which extruder, a process which will influence future product development, Pruitt said.

How Automation Enables Viable Reshoring

COVID-19-related supply chain disruptions have prompted manufacturers to consider bringing operations back to the U.S. But successful reshoring depends on disruptive technology.

By Stephanie Neil

In January, President Joe Biden ordered government agencies to take action and require the wearing of masks in airports, on commercial aircraft, ferries, and all public transportation, while encouraging "masking across America." And, if we are going to be buying more face masks, why not purchase other products that are also "made in America?"

When the pandemic reached the U.S. early last year, about half of the world's disposable masks were produced overseas in China. And as COVID-19 became a global healthcare crisis, face masks became essential and countries imposed restrictions on exports, which increased the worldwide shortages of masks and raw materials, according to the U.S. National Institute of Health's National Library of Medicine.

"All it took was stopping the supply of disposable masks produced overseas

from coming to the U.S. for us to be critically impacted," said Raphael Kryszek, founder and CEO of Intrepid Protect, a manufacturing start-up focused on producing face coverings made at a new state-of-the-art facility in Los Angeles, Calif. It was the PPE shortage, a dependence on foreign sourcing of goods, and a lack of quality-control standards that prompted Kryszek to make manufacturing in America a viable option. It is also his way to create jobs and help bolster the U.S. economy.

And Kryszek is not alone when it comes to setting up shop stateside. According to a recent Thomas Industrial Survey assessing the ongoing impacts of COVID-19 on North American manufacturing, there is heightened interest in reshoring and hiring—mainly as a result of rethinking supply chains.

Of the 746 manufacturing companies surveyed in May and June of 2020, 69% are looking to bring production back to North America, 38% are actively hiring, and 55% said they are likely to invest in automation, specifically as it pertains to production performance, process control, and product testing and quality. "With the growing appetite for reshoring and onshoring, respondents shared the top products they are looking to source domestically: metals (15%), machining tools and parts (13%), fabricated materials (13%), and PPE (12%)," the Thomas report states.

"Clearly, the pandemic has been an accelerant to reshoring, as well as nearshoring," noted Paul Wellener, a vice chairman at Deloitte LLP, and the leader of the company's U.S. industrial products and construction practice. "Nearshoring is getting into your time zone, like utilizing manufacturing

in central or south America if you are in the U.S., and reshoring is bringing production back into your country. But as things come back to the U.S., it is not coming back in the same way as it's being done in another part of the world. There is technology being added to help continue to drive the cost targets, quality targets, and safety targets that manufacturers have."

According to Wellener, automation and robotics play a significant role as a way to offset labor costs, but machine learning, artificial intelligence (AI), cloud computing, 3D printing, and supply chain management (SCM) are also aiding in the effort to reshore manufacturing.

Intrepid Protect, for example, uses servo motors and absolute and relative encoders on the assembly line and relies heavily on AI and machine learning to ensure quality control and predictive maintenance to optimize operations and accelerate the delivery of mask inventory at the lowest cost. "There are a lot of moving parts on the assembly line, and they fail due to wear and tear. But we've seen huge improvements due to AI and predictive maintenance cycles, which has increased productivity, efficiency, and reduces pricing due to our ability to minimize waste and minimize faulty products," said Kryszek. "We didn't reinvent the production of three-ply masks, what we did was streamline and automate it by adding technology to improve different parts of the assembly line."

The high price of production

In recent history, the U.S. has had an $800 billion/year trade deficit. The U.S. has been dependent on imports primarily because the cost to manufacture

here is just too high. According to Harry Moser, founder and president of the Reshoring Initiative, his data shows that U.S. manufacturing costs are often 20% higher than European manufacturing and 40% higher than China and other low labor cost countries, which makes offshore manufacturing more appealing from a cost-competitive standpoint. And the price is too high mainly because the dollar is too high, he said.

In addition, in the U.S. there aren't enough engineers and the country lacks the quantity and quality of skilled manufacturing trades people relative to the opportunities, hindering productivity growth that could overcome the impact of the U.S. dollar, Moser said. Plus, the U.S. has too many regulations, high corporate tax rates—which until 2017 were 35% when most of the world was around 22%—and there are no value-added taxes (VAT) here, whereas other countries apply it. "These are important things that we concentrate on, and reversing those over 10-to-20 years would balance the trade deficit and get us out of the problem we're in," Moser said. "We call it leveling the playing field, and if you do that then it

is a lot easier to get companies to decide to bring work back."

With that said, Moser agrees that the latest interest in reshoring is driven significantly by COVID-19. "From March 2020 through the end of the year, about 60% of reshoring cases mentioned COVID-19 as one of the factors causing them to reshore. Some of those cases involved COVID-related products, like masks, gowns, and ventilators, and others were related to the company recognizing that whatever it makes, it is too dependent on China or offshore sources, and COVID-19 has educated it to not be so dependent."

In addition, from a longer term perspective, growth and productivity is the only way to raise living standards. The average U.S. manufacturing growth rate for the last ten years is 0.4%, Moser said. So the lack of applying automation due to concerns that robots will take jobs, for example, has not helped U.S. productivity. In contrast, China's productivity is growing at 6% per year.

"If we don't invest in automation, we don't increase our competitiveness," Moser said. "Some people are afraid of automation because they'll lose their jobs. But, throw away that statement, because the U.S. will lose more jobs to Chinese automation if we don't automate than we will to U.S. automation if we do. Since we are competing, you have to automate the best you can just to stay even."

But automation, too, must change to help manufacturers compete. Moser points to Bright Machines, a San Francisco-based manufacturing technology startup that is transforming this space with its modular system for electromechanical product assembly.

The future is bright

The Bright Machines' Microfactory for assembly, testing, and inspection, is designed to get products to market faster by leveraging intelligent software and adaptive hardware, using computer vision, machine learning, cloud computing, and robotics.

The platform is focused on hardware standardization and common interfaces that map to a common data model. On top of that, there is a set of algorithms and microservices combined via an API gateway for a common set of apps that take the manufacturer through all stages of automation, such as line planning, configuration of robotic cells, deployment, and service and support. Key to this is an AI-powered software layer that configures, monitors, and manages machines and operations.

"We are automating automation," said Bright Machines' chief product officer Abhishek Pani. To that end, Bright Machines will work across a variety of controllers and different components through an abstraction layer that makes it PLC agnostic.

Bright Machines' Microfactory uses computer vision, machine learning, cloud computing, and robotics to get products to market faster.

"There are a bunch of things happening through different vendors, but it is how we bring it together in one common interface and one common workflow and a common software tool."

To understand how the Bright Machine Microfactory works, and the speed at which this all comes together, look at Argonaut Manufacturing Services, a U.S.-based contract manufacturer for the biopharmaceutical, diagnostics, and life sciences industries. With a focus on molecular diagnostics and parenteral drug products, the company currently has many active programs in the COVID-19 area, partnering with companies on the manufacturing and supply chain side.

For example, the company produces kits for COVID-19 testing and collecting of the swabs and the liquid that preserves the sample to be tested. The company does both filling and packaging of materials, which can involve different chemicals in different tubes that make up a kit. "We work with Bright Machines as an enabler to significantly automate the process to increase our scalability in the areas of filling and finalizing these kits," said Eric Blair, chief commercial officer at Argonaut. The benefit is the modularization that fits well into the operational budget. "It enables us to take what tends to be a capital-intensive process and turns it into taking the key parts and building it out for specific needs in shorter periods of time."

This is important for reshoring because there's a need for innovative diagnostic testing and drug discovery here in the U.S., and to do it quickly and at scale while mitigating supply chain risk. To do that, many companies will look to contract manufacturers, like Argonaut.

Inventory made easy

Another technology that can speed up supply chain operations and on the assembly line is additive manufacturing, otherwise known as 3D printing, which is a way to fabricate an object by sequentially layering material, such as plastics and metals, in successive cross-sections. It has been used by manufacturers to make parts while eliminating tooling costs and shortening lead times.

Part of the evolution of additive manufacturing is introducing new materials, like carbon composites, a strong lightweight material. Arris Composites, founded in 2017, is a pioneer of next-gen composites for mass market applications, including aerospace, automotive, and consumer products. The company developed continuous carbon fiber composites that can be combined with other materials in a high-speed process that brings 3D printing together with the traditional high-volume manufacturing method of injection molding.

The Arris Additive Molding technology is capable of manufacturing complex geometries using continuous fiber and it can integrate hardware with advanced electronics. So, for example, a smartphone enclosure could have the electronics embedded within the structure. In addition, combining additive manufacturing and injection molding creates repeatability for production volume at lower production costs—producing parts that are stronger than titanium at about one-third of the weight.

Skydio, a U.S. drone manufacturer, worked with Arris to redefine airframe designs using the Arris Additive Molding carbon fiber manufacturing technology. It resulted in taking 17 parts in an assembly and consolidating them

into one single, multifunctional structure with a 25% weight reduction, better strength and durability, and an improved appearance.

"Industrial design teams at consumer products companies are excited about the cosmetic latitudes we give them to make beautiful products," said Ethan Escowitz, CEO and founder of Arris. But the beauty of it all goes beyond aesthetics. "The ability to collaborate with customers and take the functional requirements for a single part or an assembly of parts and design something better is the key."

Skydio is a success story in that the drone company figured out how to innovate from the ground up and manufacture on U.S. soil. A lesson other companies looking to reshore can learn from. "One of the most important things about reshoring is that it requires rethinking how something is made," Escowitz said. Sometimes companies just look at a bill of materials to figure out what is made overseas that could be made here. "I think there are more disruptive reshoring opportunities that are more interesting...like taking advantage of new manufacturing technology...looking at the architecture to make a more desirable product, and picking the right location based on the customer supply chain."

Making it in America

Deloitte's Wellener notes that what is coming back to the U.S. shores are high-value products—like the Skydio drone, highly engineered items, and components that go into larger subsystems. So there is a balancing act for

companies considering what to reshore and how to make investments at the right time.

To that end, the Reshoring Initiative offers a free online tool, the TCO Estimator, that helps companies quantify all offshoring costs and risks. The tool helps account for all relevant factors—overhead, balance sheet, risks, corporate strategy, and other external and internal business considerations—to determine the true total cost of ownership. Using this information, companies can better evaluate sourcing, identify alternatives, and even make a case when selling against offshore competitors.
In addition, the Reshoring Initiative created the Import Substitution Program (ISP) to convince and facilitate importing companies to produce or source more domestically. Customized versions of ISP are available for U.S. manufacturing companies, technology suppliers, trade associations, economic development organizations, and manufacturing extension partnerships. Moser estimates that consistent use of the program would increase domestic manufacturing by about 10%.

For companies like the Intrepid Protect, the labor costs, capital equipment costs, material costs, and technology costs all factored into the equation when deciding where to build a facility. “It was a challenge,” Kryszek said. But making masks in America was always the goal. “The founding principle of the project was to help the American supply chain and the American labor force.”

Is Combining SCADA and MES a Good Idea?

System consolidation offers a number of cost and complexity reduction benefits. But when it comes to mission critical systems, do the benefits outweigh the risks? A system integrator who's worked with manufacturers who have done this offer his insights.

By David Greenfield

Technology convergence is well-known in nearly every sector. We've all seen it happen in the consumer tech sector, most notably as our cell phones transformed into smartphones that allow us to make and receive phone calls, visit websites, provide GPS travel directions, conduct video meetings, take high quality photos, and much more.

This kind of convergence happens in the industrial sector too.

A couple of high-profile examples include the programmable automation controller, which extends the capabilities of a programmable logic controller with broader industrial computer capabilities and, more recently, the growing combination of robot and vision technologies to expand and enhance industrial robotic picking and placing.

This combination of existing technologies, particularly in industry, serves two purposes—to extend the capabilities of each technology beyond what each could do on its own and reduce the amount of systems operators or managers need to rely on for information. With respect to the latter purpose, it's as much a technology consolidation as a combination.

One early example of this can be seen in the evolution of MRP (materials requirement planning) into ERP (enterprise resource planning), as more front office and plant applications were combined with, what was originally, a production planning and scheduling tool.

Now, we're beginning to hear about the potential of combining MES (manufacturing execution systems) and SCADA (supervisory control and data acquisition) technologies. To learn more, we connected with Sam Russem of Grantek (a system integration firm) for a recent episode of the "Automation World Gets Your Questions Answered" podcast series. We spoke with Russem about this because, not only is he aware of this technology consolidation, he's worked with manufacturers who have done it.

Differences and overlaps

We began our discussion by focusing on the differences and similarities between MES and SCADA to better understand where these systems are distinctly different and where possibilities for convergence make the most sense.

"Both of these systems are software tools designed to perform a lot of different functions. MES is going to do things like manage your production orders and

data relevant to them, analyze some of your raw production data, and turn that into more useful management information like track-and-trace information or summarize raw data into performance KPIs (key performance indicators)," said Russem. "It also needs to communicate in real time to your SCADA systems and work transactionally with business and ERP systems. On the SCADA side, that's really defined by the ability to connect to plant floor equipment, particularly PLCs, sensors, and other shop floor devices; raw data records [from these devices] are often kept in that SCADA layer. Most importantly, SCADA is where you have the supervisory controls that let your human operators see what's happening with the plant floor equipment and help to control it."

Since both systems are focused on device data acquisition and visualization, it helps to view them with respect to the ISA 95 or Purdue Model.

"When you're talking about Level Zero of the Purdue Model, these are physical production processes that happen in real time," Russem explained. "But up at the Level Four business systems, those are usually operating in terms of weeks

Inductive Automation's Ignition SCADA screenshot (right) and a Sepasoft MES screenshot.

and quarters. Therefore, a SCADA system at Level Two needs to be able to communicate a lot faster with PLCs. That's why it can communicate at sub-second rates. MES works on a slightly longer time scale; it is not usually going to be getting into sub-second level control data, it's more focused on hours, or shifts, or sometimes days or weeks. This difference in speeds affects the protocols that each of those systems use. SCADA needs to be interfacing with industrial protocols like OPC, EtherNet/IP, or Modbus, whereas MES has an even wider range of communication protocols it needs to support because it talks to SCADA systems—usually through OPC or database connections—but also to the business systems through a firewall using web services and other protocols."

Given these differences in communication speeds, it would be easy to dismiss the possibility of combining MES and SCADA, but Russem noted that the concept of "flattening the stack" helps explain the push toward combining the two systems due to the human interfacing nature of both.

"If you can present your control layer and your management layer in a similar platform in a similar way, where it's kind of seamless between those two functions, there's definitely an opportunity to streamline that human interface," said Russem. "They're also, of course, both managing your production assets. They're just usually concerned about doing that at different scales. For example, think about the temperature of a batch tank. A SCADA wants to know the temperature of the batch tank tag and it wants to monitor that every second because if it starts to drift in a bad direction,

the SCADA system is going to be where you'll issue your correction and try to bring that temperature back into control. The MES is going to care about the temperature of the tank too, but it likely only cares if it actually went out of spec and it needs to know an exception for future quality review. So, while they're focused on different aspects, they are both connecting to the same type of data."

What's the benefit?

Russem contends that the main driver behind the idea of combining MES and SCADA is, ultimately, about reducing things like license costs and hardware overhead.

Another benefit he noted involves reducing the number of screens and process complexity that operators must deal with daily. "You walk up to these machines and there can be five different screens just to run a single piece of equipment. So, anytime you have an opportunity to streamline operations or bring things to a single control point to make sure that people don't need to be monitoring multiple screens to get the information they need to do their job, there are huge benefits."

Despite such benefits, Russem does advise caution if you're thinking of combining MES and SCADA. "A combined MES and SCADA system can require a lot of compute power, as both are heavyweight systems on their own. By putting them all together, you're making a super system and you need to make sure that you have the physical compute power to monitor and

maintain them. This is especially important for SCADA because it's working in real time and is absolutely mission critical. You don't want slow network speeds to affect your ability to actually control your process."

Real-world application

Referencing a manufacturer who has combined its MES functions into an existing SCADA system, Russem said, "In this plant, they had comprehensive SCADA layer connecting to all their PLCs and it was the main terminal their line operators would use to run material through their process every day. Then they had an MES initiative, and they built that MES using the same SCADA platform. This SCADA system had a set of MES modules that could be added into the platform."

The system this manufacturer is using is Inductive Automation's Ignition SCADA with Sepasoft's MES modules. Sepasoft is a strategic partner of Inductive Automation.

To have all of this within one system was very beneficial to the manufacturer, Russem said, as they developed this system with an agile approach of starting with SCADA and iterating on that over time to add production scheduling, OEE (overall equipment effectiveness), and SPC (statistical process control) to manage their risk at each of those stages.

Sam Russem of Grantek.

"The only downside we really saw was that the system got a bit bulkier, and there is a little bit of a risk to the business (as a result)," he said. "As they continue to add more features and more lines [to the system], there might be a place down the road where they're going to need to split that [combined system] into multiple servers to run it; at which point it might actually make sense to kind of split out their MES and the SCADA functions again. I'm not quite sure if we're going to get to that point. But we are looking at a horizon where it could make sense to split those again, and we'll see how it all works out."

Automation Expectations: Discrete Manufacturing

To help illuminate expected trends in the industrial automation market in 2021, Automation World conducted a survey of technology suppliers to better understand how they see end-user plans developing.

By David Greenfield

Few would argue that 2020 was a year in which our collective and individual visions of the present and future were not profoundly impacted. In light of this, several studies were conducted over the course of the year to obtain end user input on the effects of COVID-19 on industrial manufacturing and processing operations.

To provide a broader view, Automation World conducted a study in late 2020 of automation technology suppliers. We asked those suppliers an array of questions to better understand how they saw their customers—end users across the industrial spectrum—reacting to the economic and societal changes of 2020.

The results of this survey will appear in four feature article installments in 2021. The first of which is this article, exploring how the marketplace realities of 2020 are—or are not—influencing the direction of automation use in the discrete

manufacturing sectors. Following articles will look at trends in batch manufacturing and continuous processing, with the final article comparing trends across all three verticals.

Spending forecasts

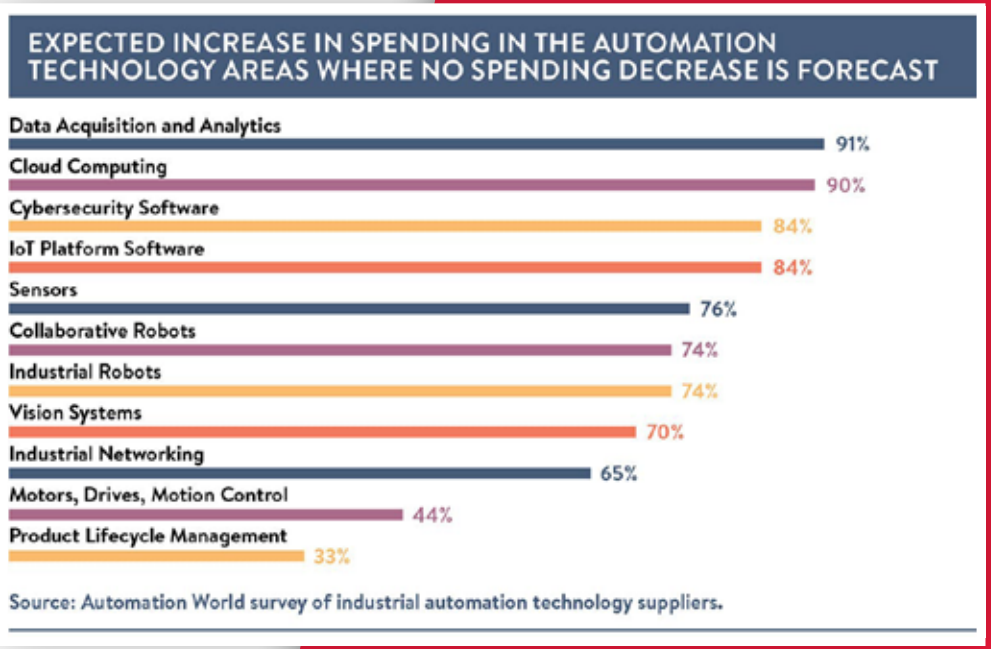
The survey asked technology suppliers for feedback on how they gauged planned spending (based on activity with their end user customers) across more than 20 key industrial automation technology areas. Eleven of these technologies showed no signs of slowing (i.e., 0% of respondents expect to see a decrease in spending) into 2021. Those technologies, along with the percentage of respondents' projecting increases in spending in 2021 are:

cloud computing (90%)
collaborative robots (74%)
cybersecurity software (84%)
data acquisition and analytics (91%)
industrial networking (65%)
industrial robots (74%)
IoT platform software (84%)
motors, drives, motion control (44%)
product lifecycle management (33%)
sensors (76%)
vision systems (70%)

The technologies around which respondents expect to see decreased spending in 2021 are: augmented reality, controllers, edge computing, ERP (enterprise resources planning), HMI/SCADA (human machine interface/supervisory control and data acquisition), I/O (input/output), MES/MOM (manufacturing execution systems/manufacturing operations management), remote access/monitoring, and simulation/digital twin. However, expected spending decreases for these technologies are not significant. Six percent of respondents forecast a decrease in ERP spending, with all the rest indicating only 3% of respondents expect a decrease in spending.

Given these results, planned spending on automation looks to remain stable into the next year, with significant spikes expected for data acquisition and analytics, cloud computing, cybersecurity software, IoT platform software, and sensors.

Expected increase in spending in the automation technology areas where no spending decrease is forecast. Source: Automation World survey of industrial automation technology suppliers.



Digital transformation: delayed or sped up?

"The number one concern I hear from mid-market manufacturers today, aside from sales, is labor, including cost, skills, and availability," observed Steve Bieszczat, chief marketing

officer for Dassault Systèmes' DelmiaWorks. "I would single that out as today's digital transformation bottleneck."

These labor factors are so impactful to small and mid-sized manufacturers because these manufacturers "don't fit the mold of the highly automated manufacturing processes we envision when we think of a modern factory—with teams of synchronized robots welding a car frame together in one continuously orchestrated movement," explained Bieszczat. "Instead mid-market manufacturers are built to be flexible. Produce 10,000 hub caps, and then stop and make 1,000 swimming pool ladders, and so on. That agility and flexibility are their core values, but this defeats total automation. If you're going to change your job mix every day, you need people, and you need to be good at doing changeovers. Human labor is notoriously flexible. So, rather than complete automation, we're seeing digital transformation take the form of having a connected, directed worker at each work center."

Bieszcczat's observation that the digital transformation is more about connecting and directing workers than it is about delivering widespread lights-out factories was echoed by Josh Eastburn, director of technical marketing at Opto 22. "Increased productivity and reduced costs remain strong financial motivators for these [digital transformation] investments. In the short term, customers are seeking ways to maintain pace in spite of current economic pressures," he said. "However, they are doing it with a long-term vision of developing data-centric infrastructure that generates insights into potential process improvements, increases in operating equipment

effectiveness (OEE), and better maintenance of machines."

This perspective on the digital transformation—that it's more about gathering and analyzing data to optimize industrial work than it is about constructing a highly futuristic factory—is a key realization in terms of how industrial digitization should be properly viewed. Recognizing that the ideas behind Industry 4.0 and the Internet of Things are aimed at realistic, achievable improvements enabled by new levels of connectivity and insights helps smaller manufacturers understand that digital transformation is not something solely reserved for the largest players in industry. Instead, it is the means through which manufacturers can get a better handle on the labor and operational issues that drive their day-to-day activities and decision making. This realization can be even more impactful for small and mid-sized manufacturers given that making the digital transformation does not require a big bang type of rollout. In fact, most technology suppliers advise manufacturers, regardless of their size, to approach the digital transformation in bite-sized chunks to better assess and adapt their approach based on achieved results as well as real and projected returns on investment.

Bieszczat said, "Today, in most parts of the country, the pool of available hourly manufacturing workers is stagnating. Immigration has slowed, many workers are choosing service and distribution jobs over manufacturing jobs, and some people are just removing themselves from the work force. Higher pay would draw people back into manufacturing, but the business model the mid-market is fighting to maintain is built around $16-per-hour workers. Manufacturers fight to maintain that business model because higher wages tend to push

business offshore."

He said this business model "brings us back to digital transformation and the concept of orchestration, which started with MRP (materials requirements planning)—to orchestrate materials, and progressed on to ERP—orchestrating end-to-end manufacturing operations, and to MES —orchestration at the work center." Bieszczat explained that's why the concept of the connected and directed worker is becoming so popular. "The idea is to create digital work center consoles that guide, record, and inform the worker so they can quickly step into a work center, know what to do and how to do it, and take whatever manual actions might be necessary to complete a particular production run. With the rapid turnover in job mix and in the hourly labor performing these jobs, the ability to quickly and digitally direct a worker to take the exact steps related to a particular job creates faster changeovers, requires less training, and significantly increases labor flexibility."

Eastburn noted that, generally, labor reduction and retasking aren't "a direct part of our customers' project goals, but we expect it to be an outcome of the resulting process improvements. Likewise, we expect these kinds of technology investments to increase the appeal of the manufacturing industry for incoming generations of automation professionals."

COVID-19 effects

Responses to the survey indicated that the biggest boost COVID-19 delivered for automation technologies was for remote access.

Bill Dehner, automation specialist at AutomationDirect, said "Health risk to employees and unpredictable lockdowns are factors that weigh heavily on

a production facility during a pandemic. The remote visibility provided by IoT (Internet of Things), cloud computing, and associated technologies allows facilities to operate with a skeleton crew if needed to ensure minimal risk to employees and continue production during lockdown conditions."

Opto 22's Eastburn added, "With the shift to remote work, there is a renewed emphasis on remote connectivity to equipment with a keen focus on cybersecurity, without which some equipment is no longer securely accessible. Applications indirectly sustaining manufacturing during the pandemic, like contact tracing and workplace hygiene, are also triggering some new investment [in automation technologies].

"The challenges brought by COVID-19 have created a newfound appreciation for the role of ERP in business continuity," noted DelmiaWorks' Bieszczat. "Many of our customers have been adding modules or seats to manage remote workers and spikes in demand, particularly in medical products, consumer goods, and packaging."

According to Bieszczat, some of this is "certainly related to COVID-19 social distancing, but the longer-term trend is the attractiveness of jobs in the service sector over those in manufacturing. Manufacturers' only real choice for attracting and retaining the workforce they need is to pay more and offer

Planned spending for automation technologies in the discrete manufacturing sectors (e.g., automotive, aerospace, electronics). Source: Automation World survey of industrial automation technology suppliers.

Planned spending for automation technologies in the discrete manufacturing sectors (e.g., automotive, aerospace, electronics). Source: Automation World survey of industrial automation technology suppliers.

more compelling work environments. Digital transformation has two immediate impacts: It automates previously manual tasks and it eliminates some of the more mundane work on the shop floor. The result is lower labor costs and a more interesting or challenging working environment."

Bieszczat also noted that "we're seeing manufacturers use a combination of ERP and MES to minimize their onsite shop floor staff by precisely scheduling work; dispositioning materials; and monitoring equipment for output, quality, and maintenance issues in real time. In other words, manufacturers are managing the shop floor by exception rather than rote supervision. Those employees who can work remotely have been accessing their ERP systems from their mobile phones or tablets to, for instance, track which jobs are running, determine the inventory stock on hand, or check on order status and completion progress within seconds."

He also noted that DelmiaWorks has seen the term "rapid" take on new meaning in the wake of COVID-19. "Whether responding to rapid changes in market demand or shifts in the supply chain, manufacturers have relied on real-time data to quickly make informed decisions," said Bieszczat. "Real-time process and production monitoring have been instrumental in giving manufacturers insights into capacity that have allowed them to take on additional business, as well as identify potential issues before they affect product quality or delivery times. Manufacturers are also using real-time production monitoring in combination with MES and quality management software to run lights-out manufacturing shifts."

Obsolescence

Several respondents to our survey indicated that the approaching obsolescence of installed technologies is driving the discrete manufacturing industry's interest in advanced, IoT-related technologies. Based on the responses we received, we wondered if those making significant automation investments are doing so not just to replace existing technologies, but to leapfrog ahead of their competition.

John Gaddum, U.S. service sales manager at Bosch Rexroth, said the trend in today's environment of uncertainty is to look at applying IoT technologies wherever applicable to provide more transparency to existing, aging equipment to meet the operational efficiencies or goals set by production. "For example, many of our customers are holding back on large capital expenditures, such as new equipment, and looking at maximizing profits, with as little investment as possible, in order to collect data from existing equipment. The equipment may have been installed 20 to 30 years ago and was not designed with the current IoT technologies available today. The additions of a single gateway often can meet most of the needs, yet the customer can do this with as little as a couple thousand dollars versus upwards of a million or more."

He explained that these connectivity technologies are often focused on data analysis for production purposes, such as improvements surrounding OEE practices or providing predictive maintenance capabilities with the goal of improving the operational efficiency of aging equipment. "The benefits, which

were non-existent on the equipment approaching obsolescence, can make a big impact on operational efficiencies and, in turn, the company's profitability."

Opto 22's Eastburn added: "The goal is to aggregate operations technology (OT) data, combine it with data from other sources, and transport it into supporting systems, regardless of the age of the technology. Existing technologies are mature and functional, so often it isn't worth the risk or expense to modify code or upgrade hardware directly. It's easier to layer on newer, connected devices that can harvest the data from old and new systems alike."

DelmiaWorks' Bieszczat explained that, over the last few years, he's seen an uptick in manufacturers investing in upgrading their existing machinery with IoT sensors or buying new smart, connected machines. "More recently, there's been a bigger push to buy new, smart equipment. The driver for this can be as simple as monitoring the number of cycles on a machine and predicting maintenance needs rather than having maintenance staff walk the floor looking for machine issues," he said. "Or, it can be part of a more complex digital transformation, like measuring critical dimensions with digital scanning devices and alerting for issues through statistic process control-type process monitoring intelligence."

2021 Leadership in Automation: First Team Honorees

Automation World's Leadership in Automation program reflects reader input on the companies they recognize as being outstanding suppliers of industrial automation technologies.

By Automation World Staff

End users' selection of automation technologies—including hardware devices and software platforms—is contingent on many factors. These factors include established business relationships, familiarity with the technology, ease of integration, availability of support, and, of course, price. The importance of relationships, familiarity, and support play a prominent role in automation technology decisions because users rely on these technologies to not only keep them competitive, but keep them in business. This often translates into users being rather consistent in their technology supplier preferences.

However, we are seeing more and more companies—outside the scope of the most recognized players—receiving recognition from Automation World readers. Recommendation by our readers is the driving force behind our Leadership in Automation program. The honorees listed on the following pages were noted by readers in an open-ended survey that Automation World maintains nearly

year-round on the AutomationWorld.com site. We do this to ensure that reader responses are not influenced by a pre-determined list on a survey. Instead, respondents weigh in with their honest preferences.

This year's Leadership in Automation honorees list, created from the recommendations of your peers across industry, is designed to help highlight the technology suppliers most worthy of your consideration as you make product buying decisions in the coming year. Please return the favor by letting us know who your preferred suppliers are as well. Visit awgo.to/lia to access the voting survey for our 2022 Leadership in Automation program. Your input is greatly appreciated.

Actuators & Valves

Festo
Rollon
SMC

Alarm Management

Aveva
Emerson
Honeywell Process Solutions

Augmented Reality/ Virtual Reality

PTC

Cables

Binder USA
Murrelektronik
Phoenix Contact
Wago
Weidmüller

Cloud Computing

Aveva
Cisco
Emerson
Oracle

Data Acquisition Hardware including I/O

National Instruments

Opto 22

Red Lion Controls

Siemens Industry

Drives

ABB

Bosch Rexroth

Lenze

Rockwell Automation/Allen-Bradley

Schneider Electric

Siemens Industry

Yaskawa

Edge Computing

Advantech

Emerson

Moxa

Opto 22

Stratus

Enclosures

Hammond Manufacturing

Hoffman

Rittal

Energy Management

ABB

Aveva

Schneider Electric/Square D

Siemens Industry

Historian/Data Acquisition Software

Aveva

GE Digital

Inductive Automation

OSISoft (now owned by Aveva)

HMI Hardware

Advantech

AutomationDirect

Beckhoff Automation

IDEC

Kinco
Omron Industrial Automation
Pro-face, a Schneider Electric Co.
Red Lion Controls
Rockwell Automation/Allen-Bradley
Siemens Industry

HMI Software

AutomationDirect
Aveva
Inductive Automation
Red Lion Controls
Schneider Electric
Siemens Industry

Hydraulics/Pneumatics

Bimba Manufacturing
Festo
Parker Hannifin
SMC

Industrial PCs

Advantech
B&R Industrial Automation
Beckhoff Automation
Moxa
Siemens Industry

IoT Platforms

Aveva
AWS
Google
IBM
Inductive Automation
Microsoft Azure
Opto 22
Schneider Electric

Maintenance/Reliability

Aveva
Emerson
MES/MOM Software
Aegis
Aveva
Epicor Software
Inductive Automation

Oracle NetSuite
Rockwell Automation
Siemens Industry

Mobile HMI/SCADA

Aveva
Emerson
Inductive Automation
Opto 22
Siemens Industry

Motors

ABB/Baldor
Lenze
Nidec
Oriental Motor
Siemens Industry
Toshiba
Yaskawa

Networking-Wired

Cisco
Hirschmann, a Belden brand
Moxa
Phoenix Contact
Red Lion Controls
Siemens Industry
Weidmüller

Networking-Wireless

Cisco
Hirschmann, a Belden brand
HMS Industrial Networks
Moxa
Phoenix Contact
Red Lion Controls
Siemens Industry
Sierra Wireless

PLCs/PACs

AutomationDirect
B&R Industrial Automation
Beckhoff Automation
Emerson
IDEC
Mitsubishi Electric Automation

Omron Industrial Automation
Opto 22
Phoenix Contact
Rockwell Automation/Allen-Bradley
Schneider Electric
Siemens Industry

Power Supplies

Emerson/SolaHD
IDEC
Mean Well
Phoenix Contact
Siemens Industry
Weidmüller

Process Control Software

Aveva
Emerson/Delta V
Honeywell Process Solutions
Rockwell Automation
Schneider Electric
Siemens Industry
Yokogawa

Robotics

ABB Robotics
Epson Robots
Fanuc
Kuka
Mitsubishi Electric Automation
Omron Industrial Automation
Stäubli
Universal Robots
Yaskawa

Safety-Machine

Banner Engineering
IDEC
Omron Industrial Automation
Pilz Automation Safety
Rockwell Automation
Schmersal
Schneider Electric
Sick
Siemens Industry

Safety-Process

Emerson/Delta V
Honeywell Process Solutions
Omron Industrial Automation
Sick
Siemens Industry

SCADA

Aveva
Emerson
GE Digital
Inductive Automation
Siemens Industry

Sensors-Discrete

Balluff
Banner Engineering
IFM Efector
Omron Industrial Automation
Pepperl+Fuchs
Sick
Telemecanique
Turck

Sensors-Process

Balluff
Emerson
Endress+Hauser
IFM Efector
Sick
Siemens Industry
Wika
Yokogawa

Simulation/Modeling

Siemens Digital Industries Software

Vision Systems

Balluff
Banner Engineering
Cognex
Keyence
Omron Industrial Automation
Teledyne Dalsa

Saint-Gobain Sekurit Deploys Edge Platform

As a key part of its Industry 4.0 strategy, Saint-Gobain Sekurit implements Litmus Edge technology to connect its plant floor and IT assets.

By David Greenfield

Well known for supplying materials and services to the residential and commercial construction industries, Saint-Gobain also supplies the automotive and transportation, aerospace, health and biomedical, industrial equipment, security, and household appliance industries. At Saint-Gobain Sekurit, a division of Saint Gobain and leader in automotive glazing for more than 80 years, the company set out to achieve a centralized Industry 4.0 strategy.

The company's Industry 4.0 strategy is to "transform its shop floors into a digital workplace and generalize a data-driven approach," said Sebastien Thuillier, digital transformation program manager at Saint-Gobain Sekurit. "The end goal is to be able to provide the right data to the right person for the right purpose."

Driving this strategy was the company's realization that it lacked a connectivity standard allowing to collect the massive amounts of production data trapped in machines, historians, and quality systems efficiently and easily. Also, like most manufacturing operations, Saint-Gobain Sekurit uses machines from "a wide

variety of vendors, including brownfield assets, which can add up to 20 different machines on each production line," said Thuillier.

Now consider the scope of Saint-Gobain Sekurit's Industry 4.0 initiative in light of the fact that this division has more than 30 plants and around 16,000 employees worldwide. (View an illustration of Saint Gobain Sekurit's automotive glazing manufacturing process).

Edge integration

A key aspect of the transformation identified by Saint-Gobain Sekurit is the use of Litmus Edge—an industrial edge computing platform that can reportedly collect data from any plant floor asset, includes key performance indicator (KPI) and analytics applications, and can integrate with any cloud or enterprise system.

"Saint-Gobain Sekurit chose to install Litmus Edge on the shop floor for its ability to connect to the full breadth of OT (operations technology) and IT assets with out-of-the-box support for any driver, protocol or connection," said Marc Dekker, senior technical account manager at Litmus. "They started small and then added data points and use cases as the solution showed a return on investment."

Dekker explained that Litmus Edge uses proprietary driver technology to connect to existing assets—of which more than 250 have been created—to "help customers quickly deploy Litmus and unlock the data they need to improve operations at scale. Litmus has developed the most drivers [for such connections] in the industry."

To date, Saint-Gobain Sekurit has implemented Litmus Edge in 20 of its plants in the first year of the project (2018-2019), with four more plants added in 2020. Thuillier expects another four plants will be equipped with Litmus Edge in 2021.

Implementation results

In each of the Saint-Gobain Sekurit plants where the Litmus Edge platform has been implemented, it has been installed on HPE GL20 gateways with the Litmus Edge Manager hosted on-premises to manage devices at each location, said Dekker. The HPE gateways then send data to the company's MES and historian systems.

Results of the implementation reported by Saint-Gobain Sekurit include:

Collecting a multitude of production data points that can be accessed by anyone in the plant;

Consolidating views of all data across all cells;

Enabling live analytics with dashboards, alerts, and process improvement directions; and

Performing offline machine learning on historical data by collecting, storing, analyzing, and building an analytics model.

Thuillier offered an example of how Saint-Gobain Sekurit uses online machine learning through auto regulation. He said, “by collecting machine, process, and quality data on a product, we can define links or laws to build a model that can predict the quality of a product based on parameters and measured inputs. The collected data helps us to build these models and test them for improved product quality.”

Data insights provided by Litmus Edge have improved Saint-Gobain Sekurit’s operations and production through the delivery of immediate alerts from equipment whenever there is a deviation in KPIs. This has resulted in “better reactivity, quicker decisions, and fewer losses,” Thuillier said. “And for our daily meetings, we can more easily reference previous data to make sharper analyses.”